Technology in Nursing

Pulse oximetry is one of the most common methods of measuring the percentage of oxygen saturation in blood (Narayen et al., 2016). Pulse oximeters play a crucial role in critical care settings by detecting low levels of oxygen saturation. Pulse oximeters are also adopted by anesthesiologists in recovery, emergency, and pediatric wards; operation theatres; and neonatal units (Hendaus, et al., 2015). This annotated bibliography provides insight into how pulse oximeters are used, their limitations and accuracy, and patient outcomes.

Annotated Bibliography

Hendaus, M. A., Jomha, F. A., & Alhammadi, A. H. (2015). Pulse oximetry in bronchiolitis: Is it needed? *Therapeutics and Clinical Risk Management, 11,* 1573–1578. https://doi.org/10.2147%2FTCRM.S93176

This article discusses the use of pulse oximetry in pediatric wards. The authors state that hospitals in the United States admit a significant number of children every year with bronchiolitis and other respiratory problems. These problems are usually monitored with the help of a *pulse oximeter*, an instrument used to measure the saturation of oxygen in the blood. Oxygen saturation levels are used by health care providers to evaluate a patient's respiratory status and are one of the deciding factors for a patient's discharge. Pulse oximetry is frequently used in pediatrics (in pediatric intensive care units and pediatric wards) and in emergency departments. Pulse oximeters are used to monitor oxygen saturation during resuscitations, while estimating perfusion, while detecting pulsus paradoxus, and while screening infants for congenital heart disease. Though the source does not fully explain why the limitations occur, it identifies several cases in which pulse oximeters are likely to be inaccurate. Pulse oximeters have certain

Commented [A1]: Comprehensive information regarding the types of pulse oximetry devices, selection criteria, decision makers, and associated costs is not available in the selected papers. The two types of pulse oximeters and their advantages over the others is provided; however, information on the various types of pulse oximeters is not available and the associated costs are not provided. This paper does mention that this technique is cost-effective which can fulfill the required criteria.

limitations due to inadequate signals. Inadequate signals occur in cases of anemia, bright external light, dark skin, nail polish, low perfusion, and intravenous dye. Pulse oximeters show low readings in cases of venous pulsations such as severe right heart failure, tricuspid regurgitation, and blood pressure cuffs or tourniquets above the site of the pulse oximeter. Pulse oximeters might not detect hypoxemia in patients with elevated arterial oxygen tension levels because of the sigmoidal shape of the oxyhemoglobin dissociation curve. Also, pulse oximeters provide unreliable readings in cases of methemoglobinemia. The source highlights several limitations, which will help readers exercise caution when using pulse oximeters. However, despite these limitations, the use of pulse oximeters in pediatrics is recommended because they are handy and allow for noninvasive measuring of arterial oxygen saturation.

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Jubran, A. (2015). Pulse oximetry. *Critical Care, 19*(1), 272. https://doi.org/10.1186%2Fs13054-015-0984-8

This article provides insight into the principles, accuracy, functioning, and outcome of pulse oximeters. It discusses the potential advantages of multiwavelength pulse oximeters over conventional pulse oximeters. Multiwavelength pulse oximeters are capable of estimating the blood levels of carboxyhemoglobin and methemoglobin, whereas conventional pulse oximeters assume that dyshemoglobins such as carboxyhemoglobin and methemoglobin are absent because they can only distinguish between hemoglobin and oxyhemoglobin. Hence, physicians prefer to use multiwavelength pulse oximeters for more accurate results. In hospital settings, the transfer rate from a postsurgical care floor to the intensive care unit (ICU) is an important factor that influences the use of pulse oximeters. The resource reviews a study by Ochroch et al. in which patients were

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monitored by pulse oximeters either continuously (oximeter group) or intermittently based on clinical needs as judged by a physician or a nurse (control group). The rate of ICU transfers for pulmonary complications was lower in the oximeter group than in the control group. Additionally, for patients who did require ICU transfers, the estimated cost of treatment from enrollment to the completion of the study was lower for the oximeter group ($15,481) than for the control group ($18,713) despite the patients in the oximeter group being older and having higher comorbidity. The reduction in pulmonary transfers to the ICU in the oximeter group was speculated to be the result of early recognition and treatment of postoperative pulmonary complications. As cited in Jubran, another study by Moller et al. indicates that anesthesiologists considered pulse oximetry to be of immense value as it guides clinical management. Anesthesiologists recommend the use of pulse oximeters because they believe that maintaining oxygenation within limits might help prevent irreversible injury. Pulse oximetry is, therefore, a key part of the standard protocol for monitoring critically ill patients.

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Narayen, I. C., Blom, N. A., Ewer, A. K., Vento, M., Manzoni, P., & te Pas A. B. (2016). Aspects of pulse oximetry screening for critical congenital heart defects: When, how and why? *Archives of Disease in Childhood – Fetal and Neonatal Edition, 101*(2), F162–F167. http://doi.org/10.1136/archdischild-2015-309205

This article describes how pulse oximetry is being implemented worldwide for the screening of critical congenital heart defects (CCHD). The use of pulse oximetry to screen for CCHD is highly recommended because it is effective, quick, simple, and cost-effective. The authors state that training parents and caregivers and using tools that are computer based can improve pulse oximetry screening. Pulse oximetry helps detect significant pathology and is reliable for keeping track of CCHD, which requires constant

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And also fulfills: **Describes organizational factors influencing the selection of a technology in the health care setting.**

diagnosis and immediate medical intervention. In almost every infant with CCHD, clinically undetectable hypoxemia is identified by pulse oximeters. Early studies of neonatal pulse oximetry screening for CCHD showed accurate details. As a result, the U.S. Secretary of Health and Human Services advised adding CCHD screening to the recommended uniform screening panel. According to a meta-analysis of 13 screening studies, pulse oximetry screening reported a specificity of 99.9 percent, a sensitivity of 76.5 percent, and a false positive rate of 0.14 percent. Therefore, the authors concluded that the universal screening criteria were met by pulse oximetry screening. Pulse oximetry screening shows no difference in accuracy when pre-ductal and post-ductal pulse oximetry measurements are performed. The authors also observed that pulse oximetry screening done 24 hours after birth increases the risk of late detection of CCHD in infants but decreases the false positive rate. Therefore, the use of pulse oximeters can be crucial for the early detection of CCHD and helps reduce mortality and improve postoperative outcomes.

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Nitzan, M., Romem, A., & Koppel, R. (2014). Pulse oximetry: Fundamentals and technology update. *Medical Devices: Evidence and Research, 7,* 231–239. https://doi.org/10.2147/MDER.S47319

This article offers comprehensive insight into how pulse oximetry works; particularly, it looks at the techniques involved in measurement, the limitations of using the techniques, and the accuracy that can be expected while determining oxygen saturation. Oxygen saturation (SaO_2) is the measurement of the percentage of oxygen in hemoglobin. Pulse oximeters detect the significant decline of oxygen in the respiratory function of patients. Measurements of oxygen saturation in pulse oximeters (SpO_2) are often inaccurate when

critically ill patients receive supplemental oxygen. The difference between SpO_2 and SaO_2 determines the accuracy of a pulse oximeter. Though the outcome of pulse oximetry in measuring SaO_2 in sick patients is 3–4 percent inaccurate, pulse oximeters quickly detect the abrupt drop of SpO_2 in anesthetized patients and in patients in intensive care units. Despite the limitations of pulse oximetry, SpO_2 values obtained from the pulse oximeter are considered reliable for the detection of deterioration in respiratory function. Further, pulse oximetry has the advantage of being a noninvasive technique to measure oxygen saturation. Studies suggest that pulse oximetry should not be the only method to monitor SaO_2 in the neonatal intensive care unit because of infants' vulnerability to retinopathy of prematurity, which is induced by the high partial pressure of oxygen in arterial blood. The authors conclude that technological advancements in pulse oximeters over the years have enabled them to diagnose and monitor patients better.

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Conclusion

Despite their limitations, pulse oximeters are recommended for monitoring oxygen saturation levels in patients with respiratory problems. The use of pulse oximeters helps reduce the rate of pulmonary transfers of patients from a postsurgical floor to the ICU. They play a crucial role in screening infants for CCHD, and therefore, the use of pulse oximeters in pediatric wards is highly recommended. Pulse oximetry helps in the early detection of certain diseases, thereby preventing irreversible damage to organs and reducing the rate of mortality. Pulse oximeters are a cost-effective resource in hospitals. They can easily detect a significant decline of oxygen in the respiratory function of patients. The rate of transfers to the intensive care unit due to pulmonary complications was significantly lower in patients who were continuously monitored using pulse oximeters than in patients who were intermittently monitored using pulse

oximeters. The readings obtained from pulse oximeters are reliable and help make immediate adjustments to a patient's oxygen supply, which can help prevent irreversible damage or death. The limitations of conventional pulse oximeters are overcome by multiwavelength pulse oximeters, which can estimate the levels of carboxyhemoglobin and methemoglobin in blood. Medical practitioners in interdisciplinary teams, such as pediatricians, pulmonologists, and anesthesiologists, can collectively use the readings obtained from pulse oximetry to assess the condition of a patient before administering treatment. Hence, pulse oximetry is valuable in hospital settings, helping medical practitioners decide the correct course of treatment and provide immediate and effective care to patients.

References

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