Racial Discrepancies in Pulse Oximetry Reading and Their Effects on Self-monitoring Devices Usage and Clinical Decision-Making

Sewo, L.[1]; Dove, A.[2]; Latimer, L.[3]; Dove, J.[4]; Gould, D.[5]; Norwood, D.[6]; Walker, R. PhD[7]

INTRODUCTION

As technology use rises and the use of pulse oximetry data increases, the demand for accurate oxygen saturation (SpO2) readings is paramount to ensure health equity among all populations.

Pulse oximetry is a non-invasive tool used to monitor SpO2. Self-monitoring devices, such as SMART devices, allow for portable and cost-effective utilization; therefore, self-monitoring device usage and pulse oximetry data are quickly becoming more available to patients and their providers.[1,2,3\] Pulse oximetry is a critical component for evaluating the severity of arterial deoxygenation.

Providers often use data from pulse oximetry to determine treatment options. Recent studies have found discrepancies in pulse oximeter reading among Black patients, posing a problem for both patients and their providers.[4,5] We hypothesize that self-monitoring devices can affect mortality rates among Black patients if these disparities are not addressed.

OBJECTIVES

The aim of this study is to investigate how racial discrepancies in pulse oximetry reading among self-monitoring devices can affect mortality rates among Black patients in the United States in addition to providing possible solutions for pulse oximetry discrepancies.

MATERIAL AND METHODS

- The design of this study is a systematic review and data extraction of relevant articles that discuss the use of self-monitoring devices to determine oxygen saturation and relevant racial disparities associated with health outcomes.

MATERIAL AND METHODS CONTD.

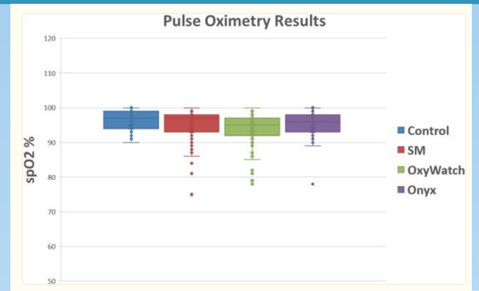

Figure 1: Illustrates the findings of a study that examined pulse oximetry readings by the following devices Santa, Medical SM-165 (SM), Walgreens' OxyWatch C20 (OxyWatch), and Nonin Onyx II 9550 (Onxy). Each data point represents the oxygen reading for one patient. 50.5% of the patient population was African American in this study. The oxygen percentage data shown includes outliers and mean lines.[2]

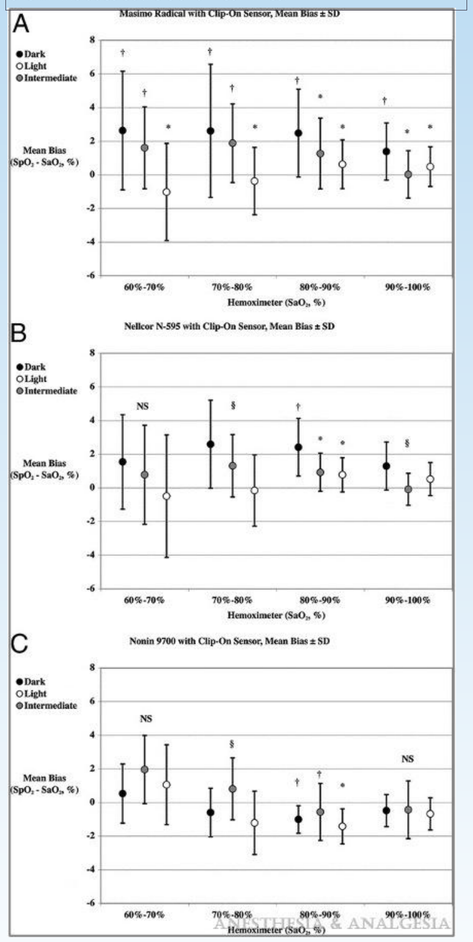

Figure 2: Displays data from a study examining bias in pulse oximetry device readings at different ranges of oxyhemoglobin saturation on varying skin pigments. Results show that bias increases as oxyhemoglobin saturation decreases. Open circles indicate light-skinned subjects. Closed circles for dark-skinned subjects and intermediate skin pigments with gray circles.[4]

Oximeters are: A. Masimo Radical, B. Nellcor N-595, and C. Nonin 9700.

RESULTS AND DISCUSSION

Characteristic	Black patients, mean (SE)		
	Hidden hypoxemia	No hypoxemia	*P* value
No. (%)	1789 (6.9)	24 243 (93.1)	NA
Age, y	58.26 (0.51)	57.76 (0.15)	<.001
Sex, No. (%)			
Female	862 (48.2)	11 243 (46.4)	.11
Male	927 (51.8)	13 000 (53.6)	
Serum creatinine levels, mg/dL			
Before ABG	2.37 (0.09)	2.27 (0.03)	<.001
After ABG	2.2 (0.08)	2.07 (0.02)	<.001
Difference	−0.21 (0.06)	−0.2 (0.02)	.08
Serum lactate levels, mg/dL			
Before ABG	3.4 (0.13)	2.85 (0.03)	<.001
After ABG	3.27 (0.22)	2.5 (0.04)	<.001
Difference,	−0.34 (0.25)	−0.82 (0.05)	<.001
Long-term clinical outcomes			
Hospital LOS, d[a]	13.51 (0.58)	16.48 (0.18)	.00
In-hospital death, No. (%)	369 (20.6)	3557 (14.7)	<.001
SOFA score[c]			
At the time of ABG			
CVSOFA	0.98 (0.07)	0.85 (0.02)	<.001
RSOFA	1.87 (0.12)	1.4 (0.03)	<.001
SOFA	4.98 (0.25)	5.26 (0.06)	<.001
24 h After ABG			
CVSOFA	7.02 (0.29)	6.33 (0.07)	<.001
RSOFA	1.87 (0.1)	1.4 (0.03)	<.001
SOFA	8.17 (0.27)	7.26 (0.08)	<.001

Figure 4: Shows Descriptive Statistics comparing Patients With Hidden Hypoxemia to Patients Without Hypoxemia. ABG, arterial blood gas; CVSOFA, cardiovascular Sequential Organ Failure Assessment; LOS, length of stay; NA, not applicable; RSOFA, respiratory Sequential Organ Failure Assessment; SOFA, Sequential Organ Failure Assessment. The data shows that Black patients with hidden hypoxemia experienced increased mortality and organ dysfunction lab values.[1]

Data shows that self-monitoring or portable pulse oximetry devices are less accurate than devices used in the hospital. Furthermore, these devices' accuracy decreases as oxygen saturation decreases.[2] Researchers suggest a number of ways to improve accuracy, such as breathing quietly without talking for several minutes, only measuring while indoors, and removing nail polish before usage of these types of devices; however, this does not address the racial disparities.[6] Data also shows that Black patients with hidden hypoxemia experienced increased mortality and organ dysfunction lab values.

CONCLUSION

The standard of care for patients in medicine involves obtaining pulse oximetry values as part of vital signs. Pulse oximetry measurements must be accurate to ensure the best patient outcomes in healthcare. Unfortunately biases in medical equipment can lead to worse outcomes for patients. Our results do not definitively state that self-monitoring device, cause mortality rates among Black patients; however, we did find that pulse oximetry technology, as a collective, does not provide values that accurately represent hypoxic levels in black patients.These inaccurate readings could contribute to higher mortality rates amongst black patients. We believe this phenomenon warrants further research studies.

Our research found that a standard pulse oximetry device using only two-wavelength finger pulse on darker skin tones leads to decreased accuracy.. An updated pulse oximetry standard should be implemented using a multi-wavelength oximeter in order to take account for those with darker pigmented skin,

The cost of implementing multi-wavelength finger pulse oximeters as a standard is a challenge.. Lowering this costs will be necessary to make the transition possible, and improve health oucomes for darker skin-toned patients.[5]

Educating medical officials about potential equipment biases, having readily available date on pulse oximeter calibration are necessary to provide patients with the best outcomes.

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