The EquiOx Study

Prospective Clinical Study of Pulse Oximeter Errors in Hospitalized Patients: Update after enrolling 479 patients

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The authors have no conflicts

CERSI UCSF-Stanford

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UCSF Center for Health Equity in Surgery & Anesthesia chesa.ucsf.edu

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The EquiOx Study

Primary aim is to measure the bias in pulse oximeter SpO_2 measurements across a range of skin pigmentations among critically ill hypoxemic patients.

PI: Dr. Carolyn M. Hendrickson

EquiOx Secondary Aims

-Compare subjective skin pigment scales to objective spectrophotometer data to inform pulse oximeter performance studies.

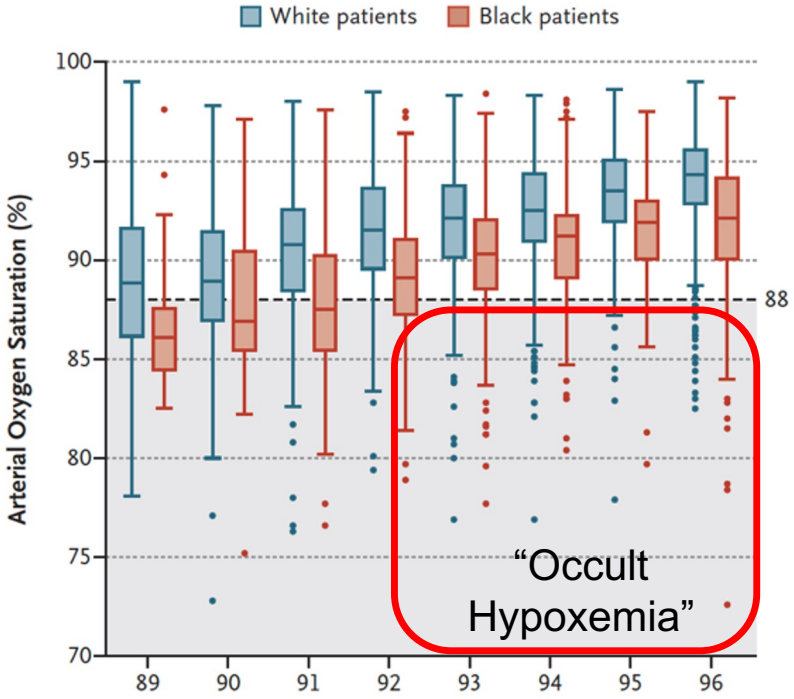
-Relate skin pigmentation and race among patients hospitalized in San Francisco

-Test if previously described differences in bias between race categories is explained by skin pigment differences

-Determine if pulse oximeters performance in clinical use is similar to performance measured in controlled laboratory studies

-Test low perfusion as a mediator explaining differences in oximeter performance

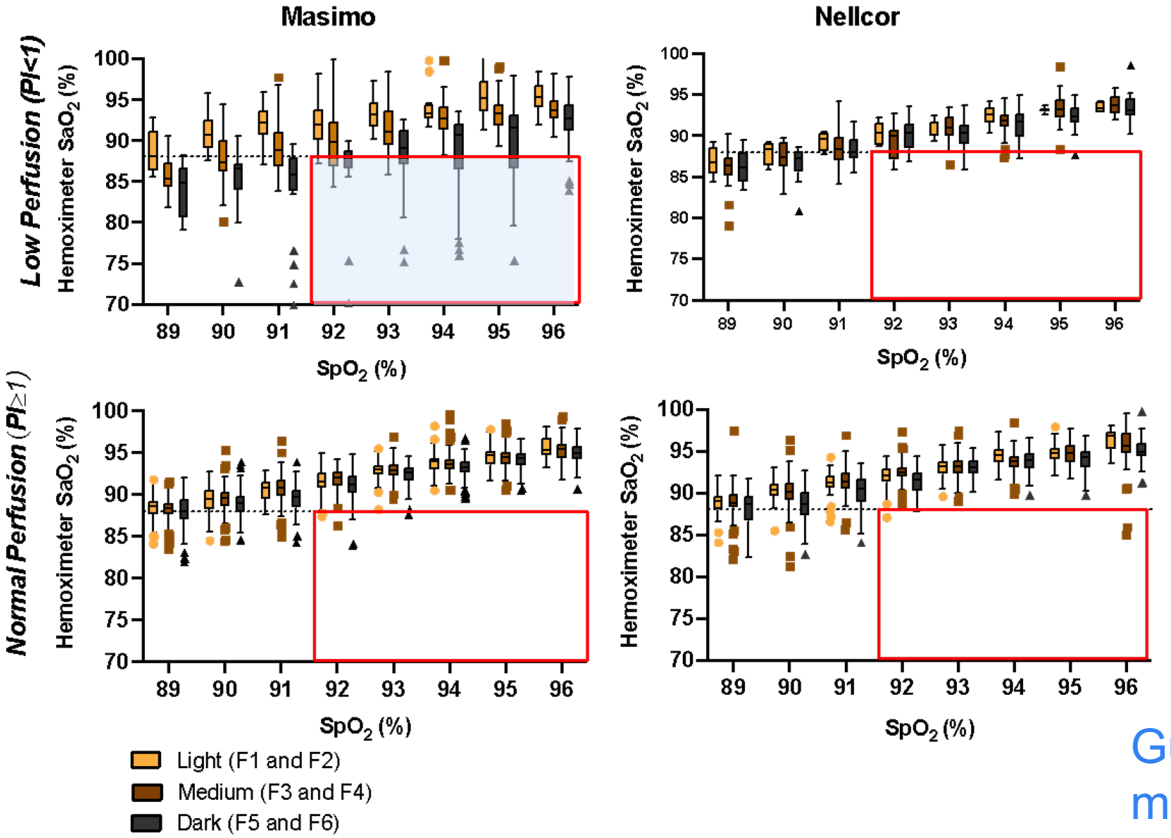
Why the EquiOx study?



-Imprecise pairing of SpO_2 and SaO_2
-Hemoximeter set to fractional not functional saturation
-Self reported race, no skin pigment data
-Interfering pigments
-Anemia
-Low perfusion
-Motion

Sjoding *et al.*, NEJM, 2020

Missed hypoxemia



Missed hypoxemia rate 30% (Masimo), 8% (Nellcor) among darkly pigmented subjects with low perfusion

Gudelunas *et al.*, medRxiv 2022, A&A 2024

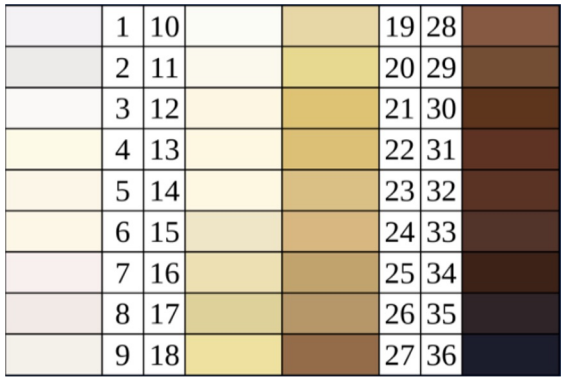
The EquiOx Study

Study strategies and advantages over retrospective studies

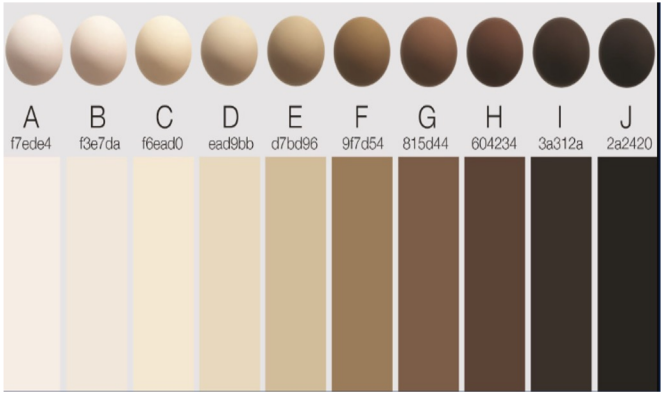
- -Synchronous paired samples
- -Functional saturation measured
- -Skin pigment quantified (Monk, VL, FP, Konica-Minolta)
- -Perfusion quantified
- -Optical signals measured
- -Inclusive Network of Collaborators/ Stakeholders, Statisticians
- -Population with broad skin pigment range

Subjective Measurement Scales

- Categorical variable
- Von Luschan, Fitzpatrick, and Monk scales
- Measured at forehead, ear, nare, inner arm, fingers



Von Luschan (VL) Scale



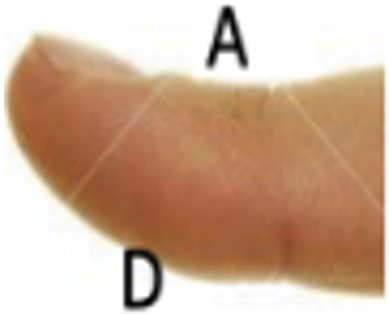
Monk Scale

Fitzpatrick (FP) Scale

Objective Measurement Tool

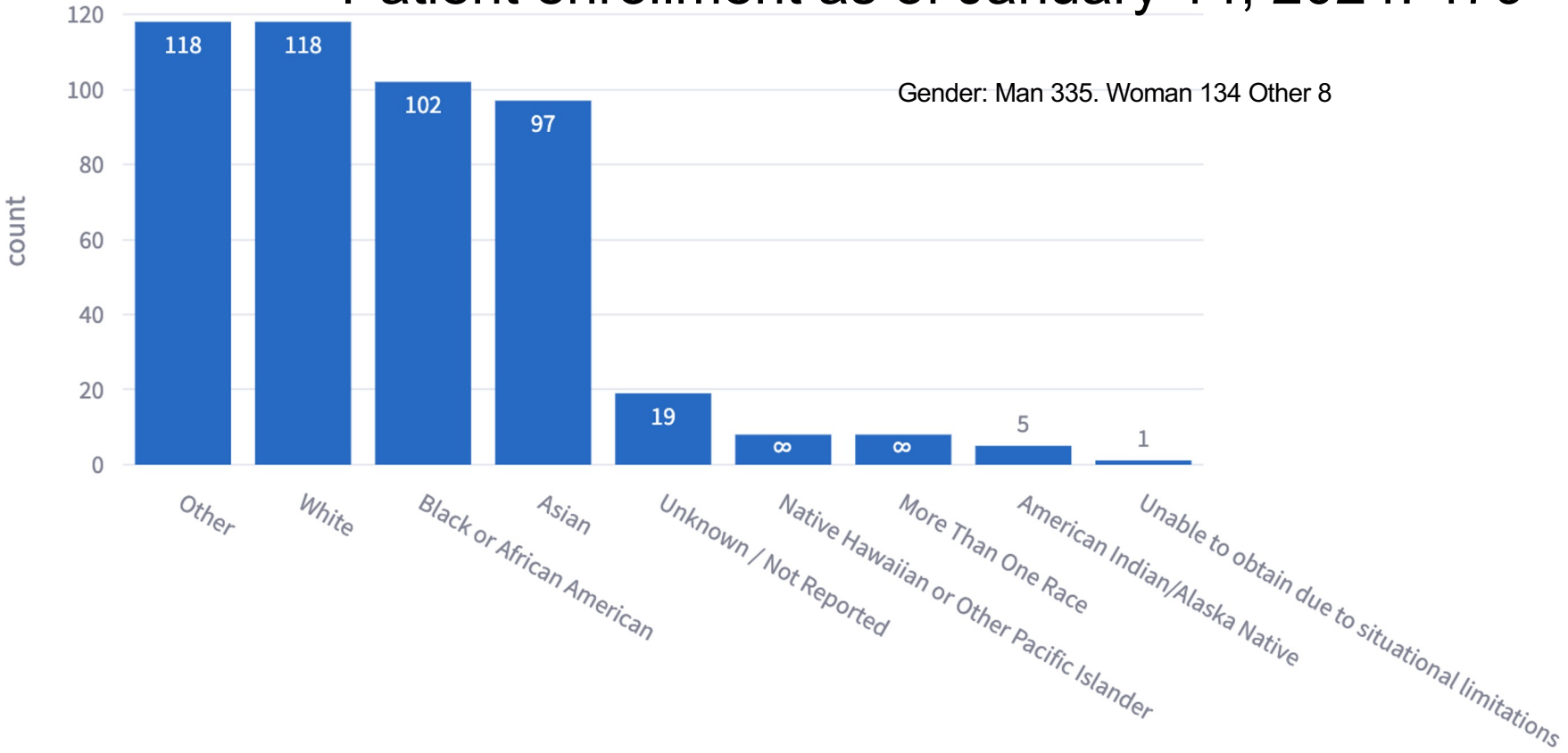
Konica Minolta (KM) CM700d Spectrophotometer

- Calibrated with manufacturer guidance

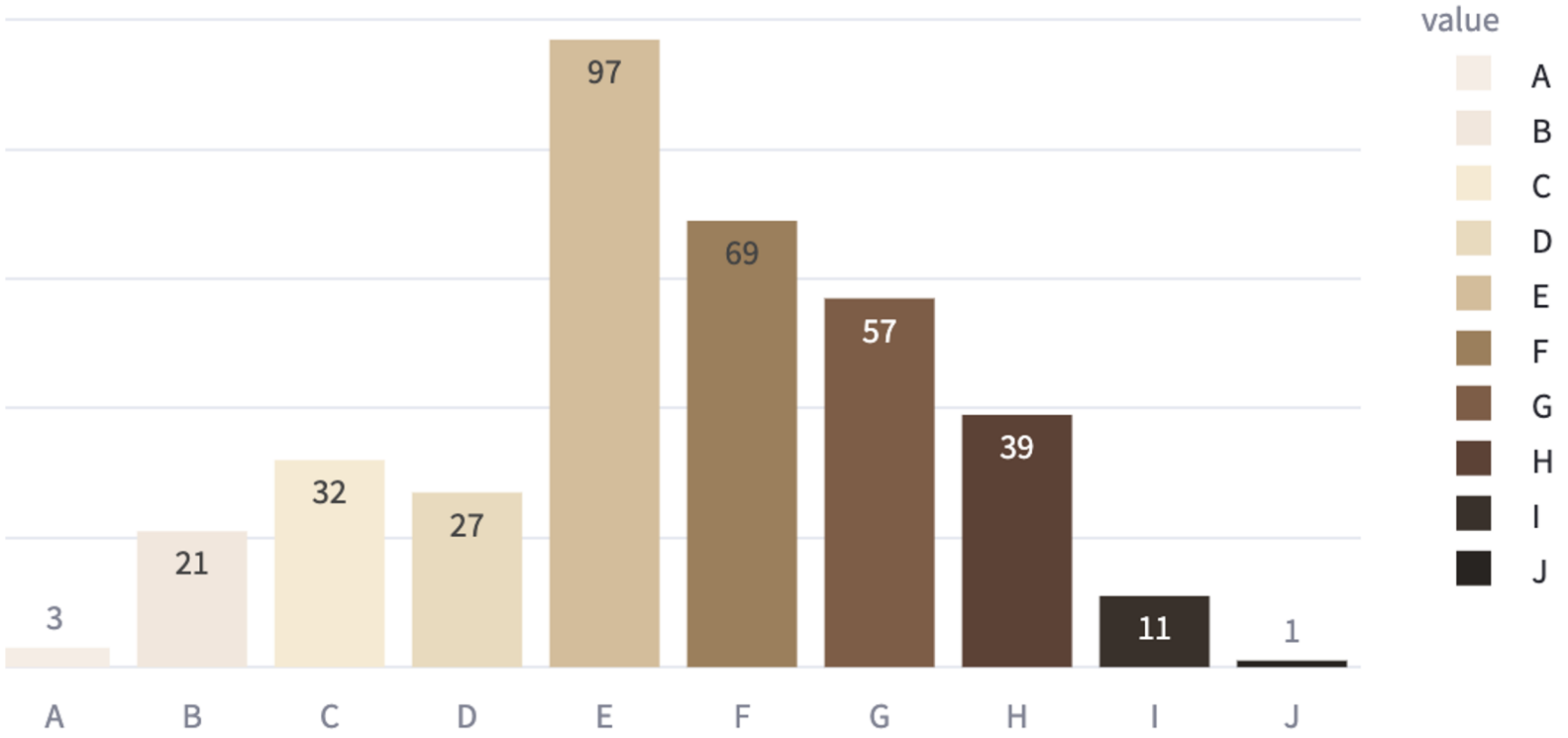


ITA: brightness, yellow/blue, red green

Patient enrollment as of January 14, 2024: 479

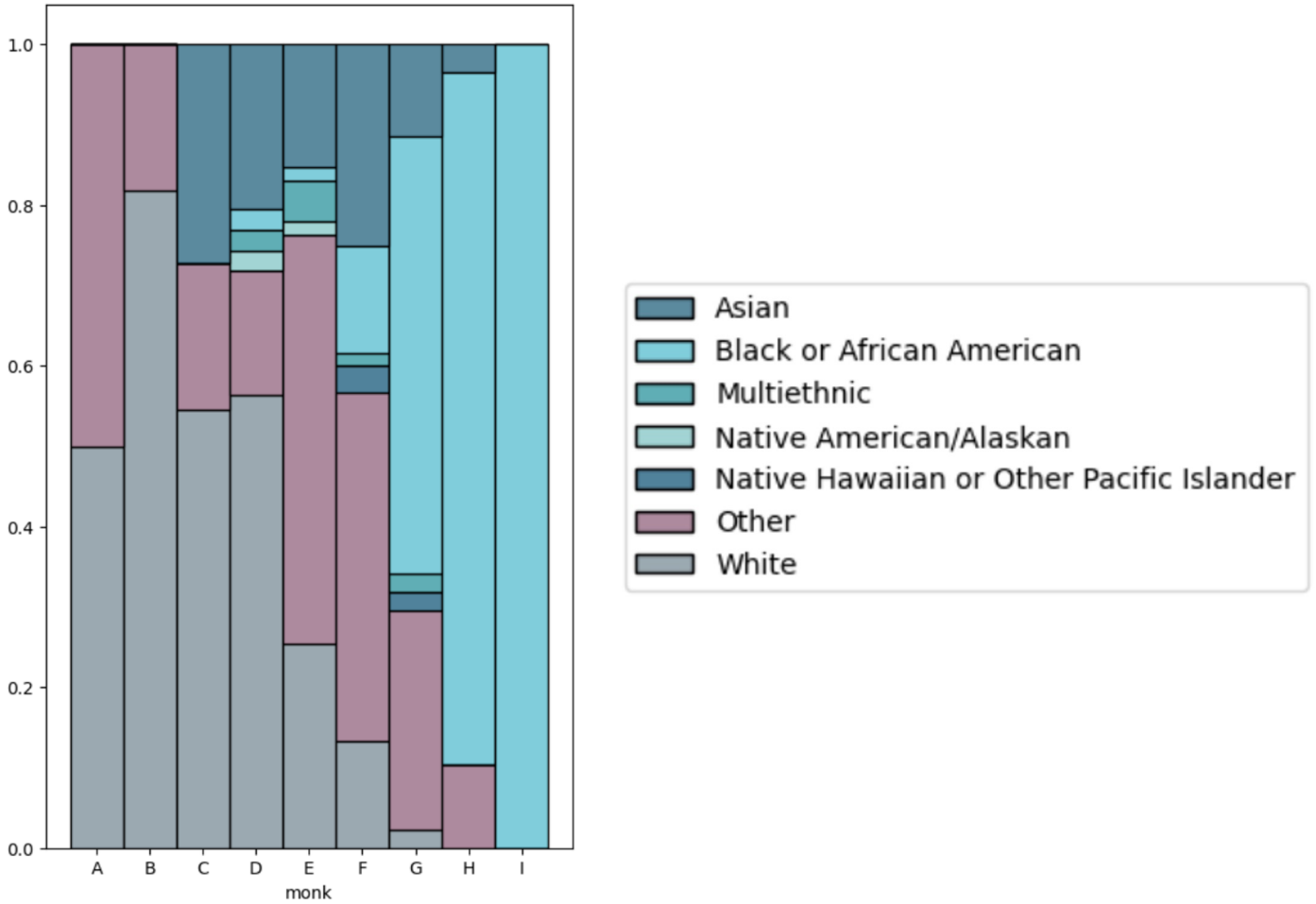


Gender: Man 335. Woman 134 Other 8

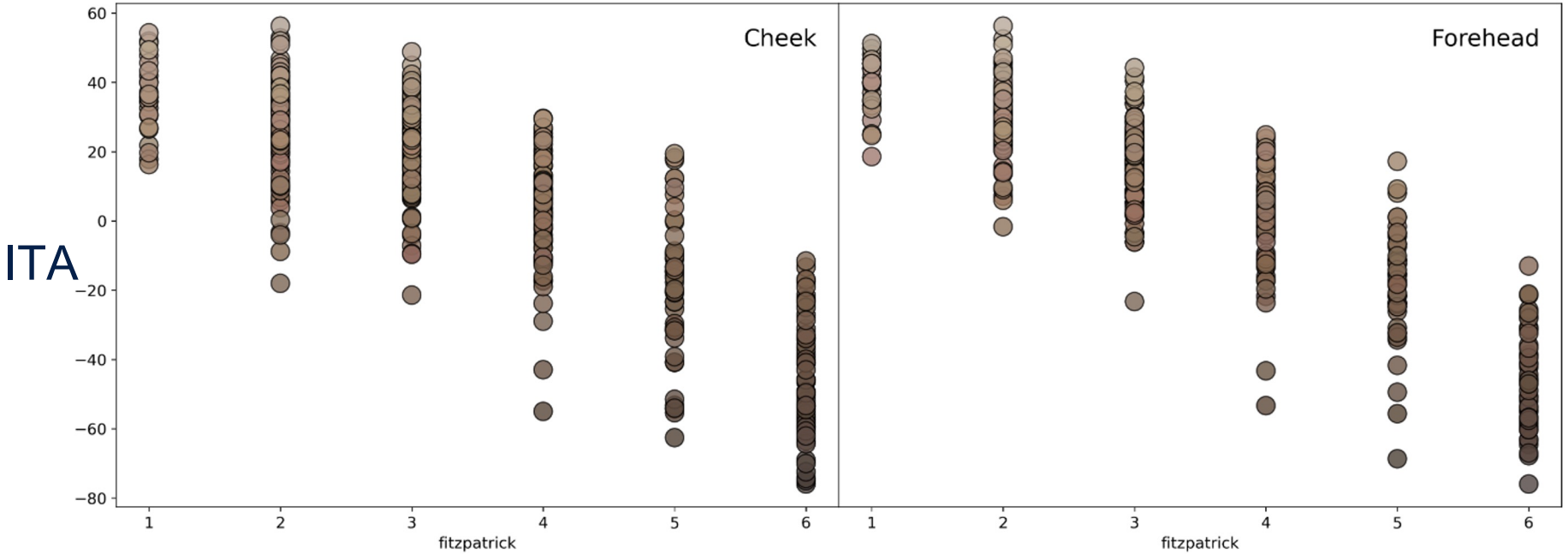

value
A
B
C
D
E
F
G
H
I
J
3
21
32
27
97
69
57
39
11
1
A
B
C
D
E
F
G
H
I
J

Skin tone varies within self-reported race categories

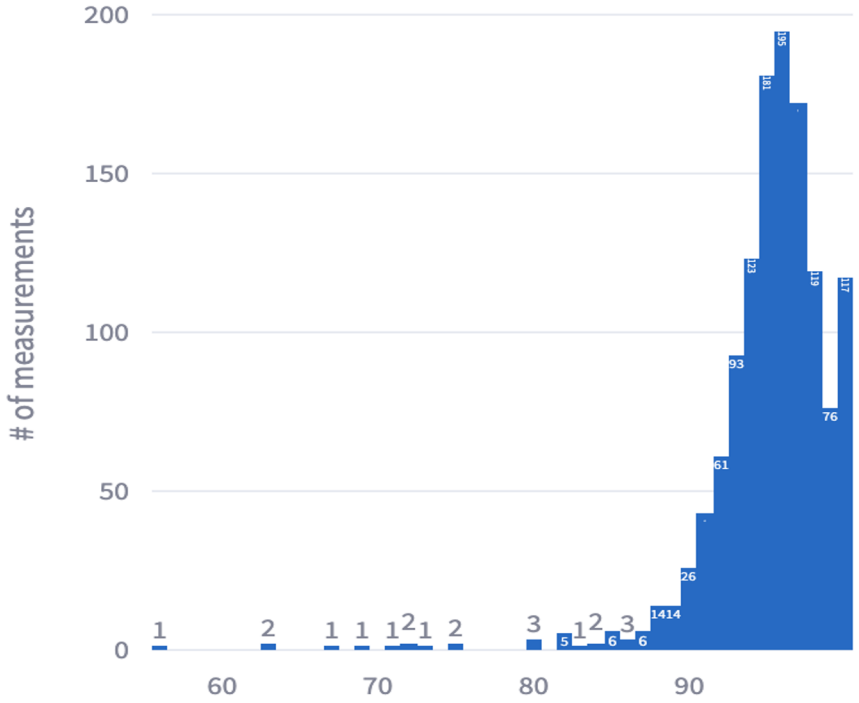
Proportion in each MST category



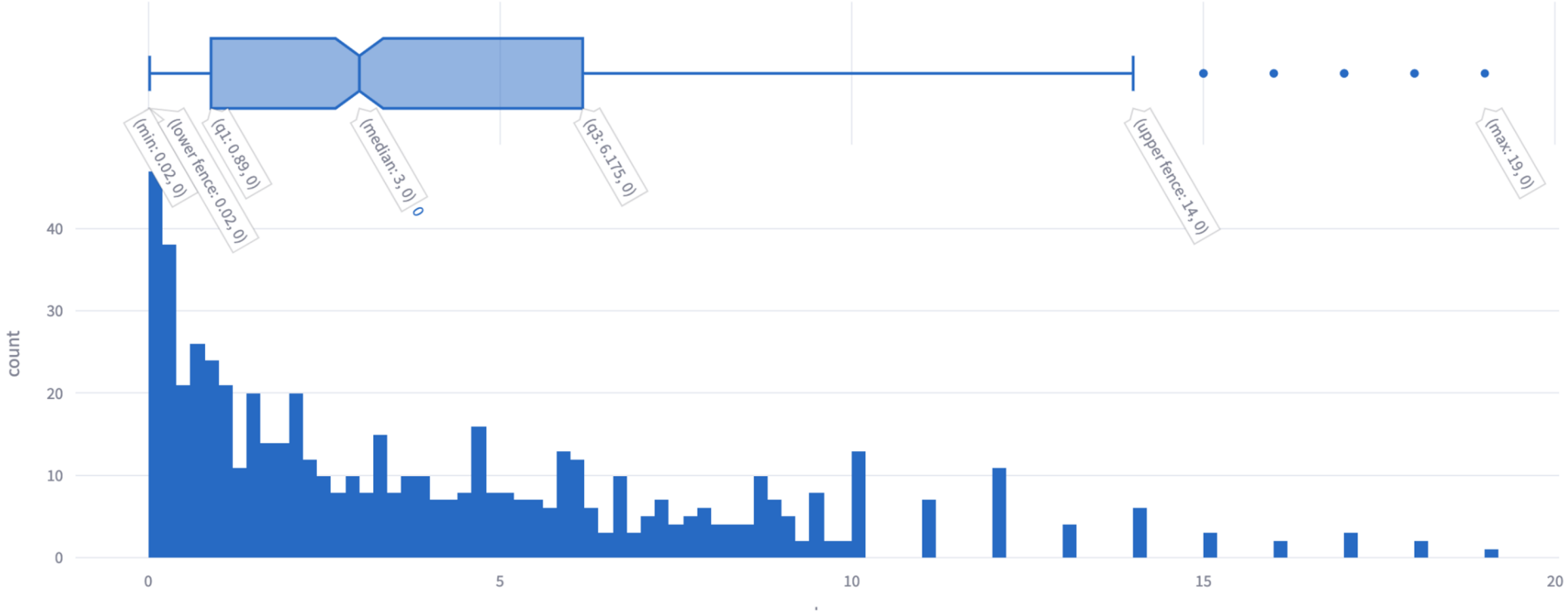
Objective assessment of skin pigment (ITA) versus subjective (Fitzpatrick)

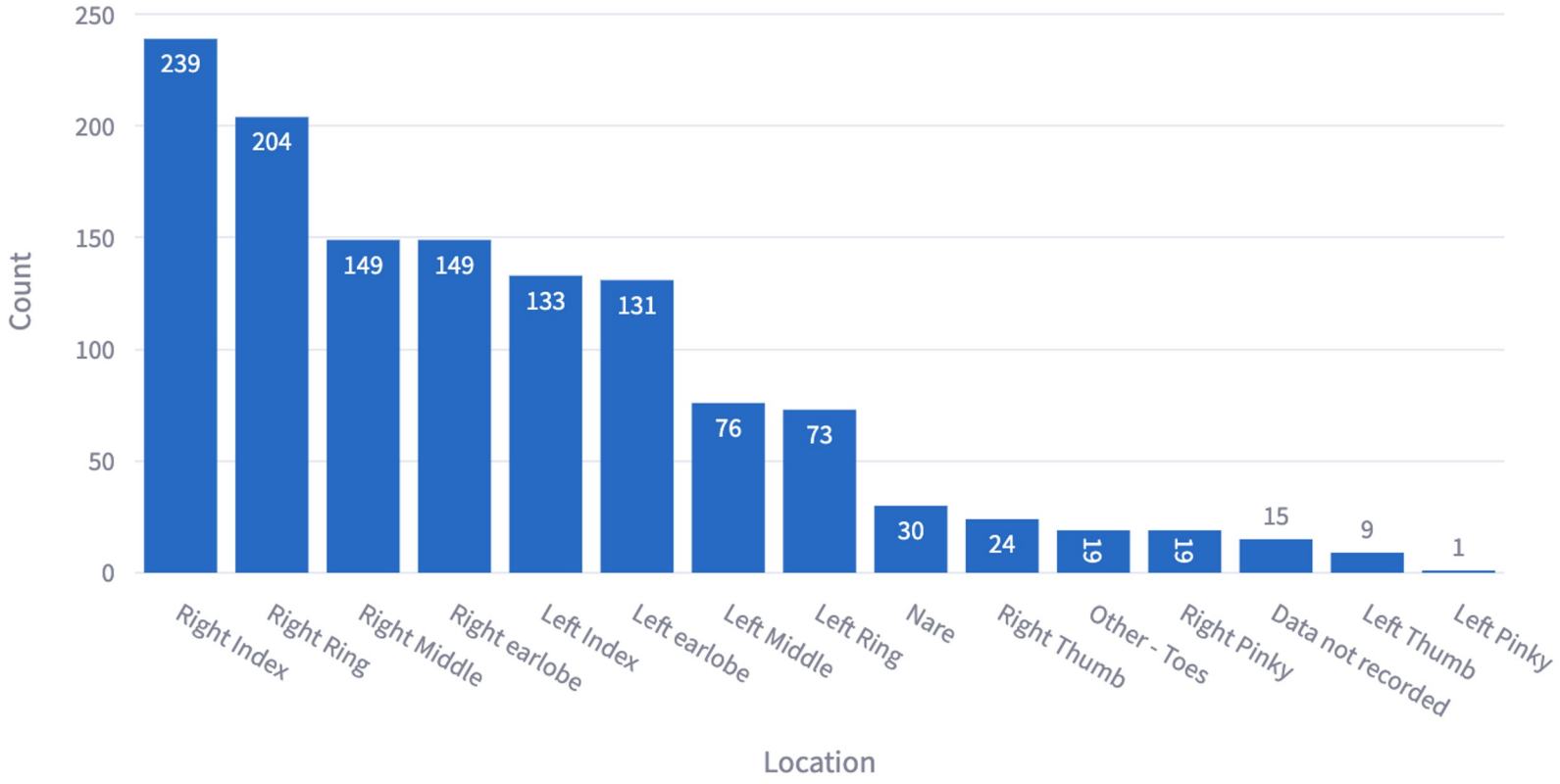


Fitzpatrick skin tone group


200
150
100
50
0
# of measurements
60
70
80
90
1
2
1
1
1
2
1
2
3
5
1
2
6
3
6
14
14
26
61
93
123
181
195
119
76
117

Distribution of perfusion index values (Masimo)




250
200
150
100
50
0
Count
239
204
149
149
133
131
76
73
30
24
19
19
15
9
1
Right Index
Right Ring
Right Middle
Right earlobe
Left Index
Left earlobe
Left Middle
Left Ring
Nare
Right Thumb
Other - Toes
Right Pinky
Data not recorded
Left Thumb
Left Pinky
Location

Summary

- EquiOx is a real-world prospective study of pulse oximeter accuracy with detailed data collection
- Self identified race, subjective and objective skin pigment measurements, perfusion index, comorbidities, stability of SpO_2 data
- Most blood samples are at SaO_2>90%
- Perfusion index is low in most observations
- Probe location varies in a real-world setting

The Open Oximetry Project

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