



# Hypoxemia and postoperative monitoring after anesthesia: a prospective observational study using portable pulse oximetry in a resource-limited setting in Guatemala.

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## Background

- Monitoring of tissue oxygen saturation through pulse oximetry is essential to assess a patient's clinical status and ensure adequate oxygenation in the perioperative period.
- Pulse oximetry remains underutilized in low- and middle-income countries (LMICs) due to barriers such as device scarcity, insufficient funding and lack of training.<sup>(1, 2)</sup>
- In Guatemala, limitations in funding, equipment, and workforce can impact care delivery in the public hospitals.
- A needs assessment at Hospital Nacional de Coatepeque (HNC) in Coatepeque, Guatemala revealed a lack of perioperative monitoring and a designated post-anesthesia care unit.
- Through the Safe Surgery Initiative of the non-profit AmeriCares organization, two portable pulse oximeters were provided as donations to the hospital for monitoring of post-surgical patients.

**Objective:** To describe the incidence of previously undetectable hypoxic events and management of patients in the immediate post-surgical setting at HNC. Additionally, we explore the perceptions of perioperative staff at the HNC regarding concerns and needs for improved postoperative patient monitoring.

## Methods

- Prospective single-center observational study, approved by COMIRB and local ethics committee.
- Data was collected regarding the early postoperative course and oxygen saturation after surgery.
- Convenience sample of post-surgical patients during four weeks from May-August 2024.
- Exclusion criteria: inability to consent, refusal, or age <1 year.
- Informed consent was obtained, and information was stored in a secure online database.
- Multiple logistic regression for association of risk factors with hypoxemia, with Bonferroni correction.

### Measures recorded included:

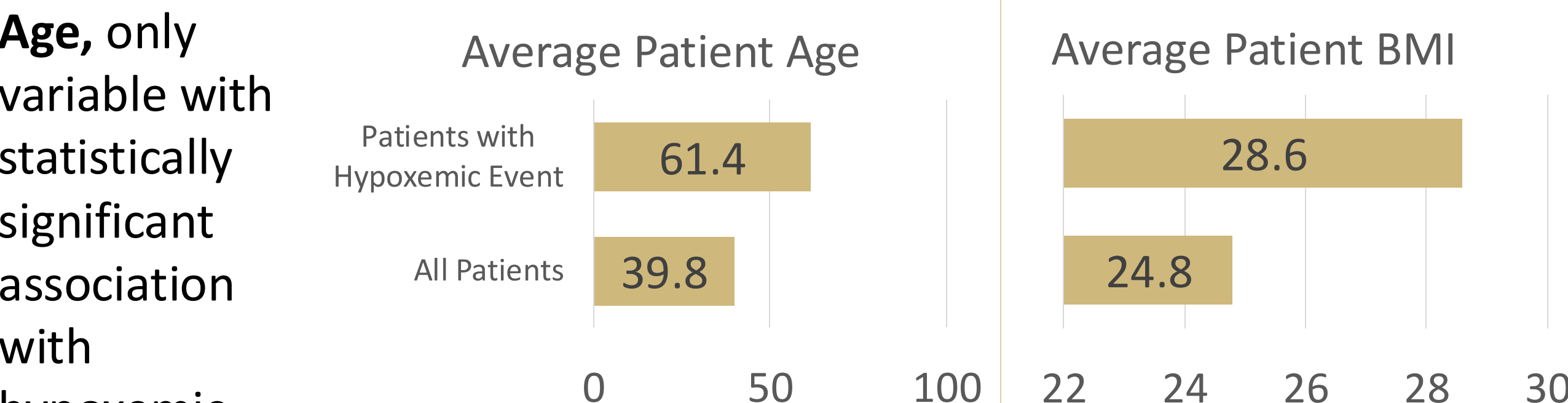
- hypoxic episodes: occurrence, duration, lowest SpO<sub>2</sub>
- clinical reason for any desaturation, interventions
- patient disposition following surgery
- duration in recovery area
- anesthesia type and surgical procedure
- patient information (age, gender, past medical history, body mass index [BMI], American Society of Anesthesiologists [ASA] score).
- Semi-structured interviews were performed with perioperative HNC staff regarding patient safety concerns and needs.

## Results

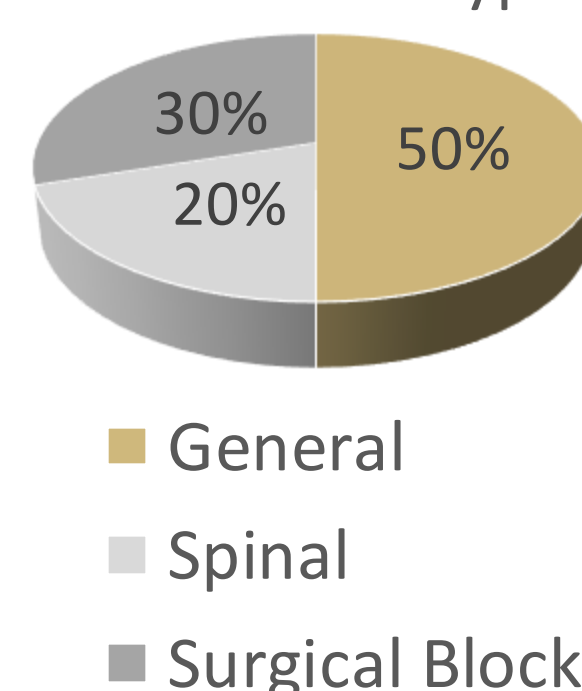


- 100 patients, 41% female
- 10% had at least one episode of hypoxemia
  - Lowest recorded oxygen saturation was 86%
- Key informant interviews revealed widespread concern for inadequate postoperative monitoring.

**Age**, only variable with statistically significant association with hypoxemic events,  $p = .004$

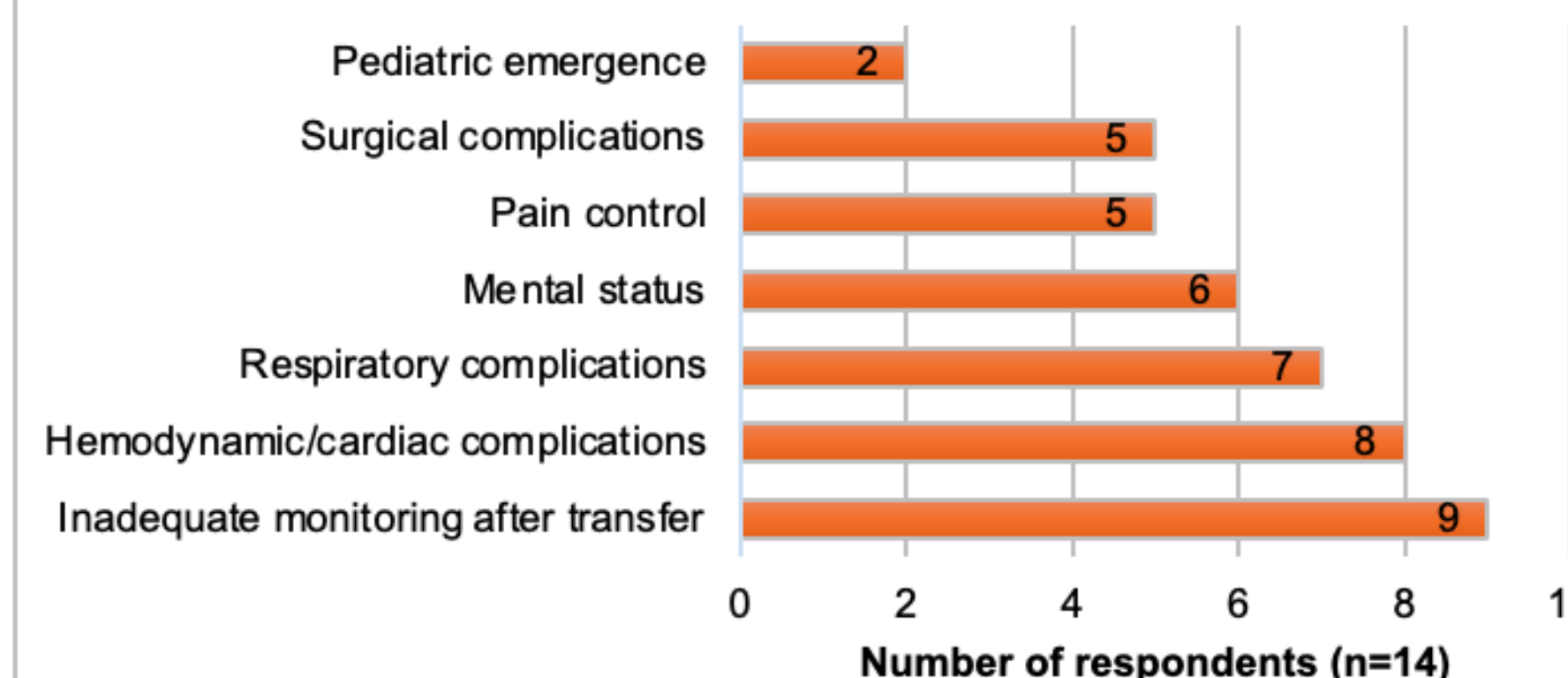


Hypoxic Events by Anesthesia Type

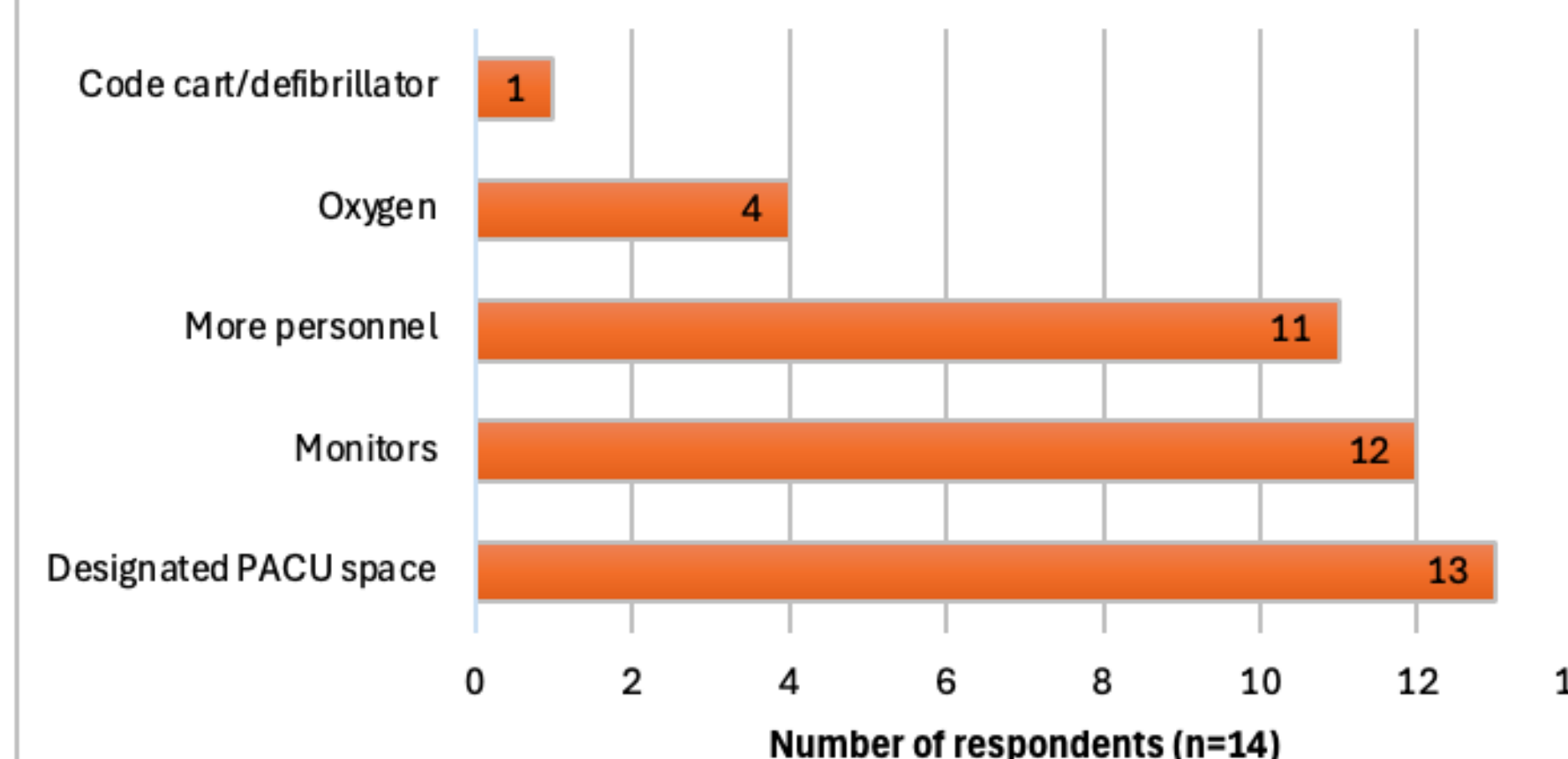


**14 minutes** was the average duration in immediate postoperative area.

### Patient safety concerns of HNC medical staff



### Critical needs per HNC medical staff



## Discussion

- Desaturation events were identified, although the number of incidences was lower than anticipated.
  - Prior studies in LMICs have reported an incidence of early post-op hypoxemia ranging from 4-24%.<sup>(3, 4, 5)</sup>
  - When considering only patients who received general anesthesia the incidence is nearly double.
- Age was a significant risk factor associated with hypoxemia.
  - Patients who received general anesthesia were found to have an eight times greater chance of developing hypoxemia than those who received regional anesthesia.
  - Prior studies have observed associations with general type of anesthesia, type of surgery, age, severe pain, history of obstructive sleep apnea and duration of anesthesia.<sup>(4, 5)</sup>
- Short duration in recovery without a designated PACU could result in missing many hypoxemic events.
- Objective findings correlate with concerns expressed by HNC staff regarding lack of adequate monitoring.
  - Significant needs include a dedicated PACU with staff, monitors, and equipment.

## Conclusion

- The study underscores the need for increased availability of pulse oximeters, additional staffing, education and a dedicated PACU.
- Establishing a system to triage patients most at risk for desaturation could improve detection and management of postoperative hypoxia.
- Portable pulse oximetry is an effective tool for detecting previously unrecognized hypoxemia in postoperative patients in resource-limited settings.

## Sources / Disclosures

- Peterson ME, Mattingly AS, Merrell SB, Asnake BM, Ahmed I, Weiser TG. Pulse oximeter provision and training of non-physician anesthetists in Zambia: a qualitative study exploring perioperative care after training. BMC Health Serv Res. 2022 Nov 23;22(1):1395. doi: 10.1186/s12913-022-08698-5. PMID: 36419106; PMCID: PMC9682720.
  - Enright A, Merry A, Walker I, Wilson I. Lifebox: A Global Patient Safety Initiative. A A Case Rep. 2016 Jun 15;6(12):366-9. doi: 10.1213/XAA.0000000000000335. PMID: 27301049.
  - Sama HD, Maman AF, Walker IA. Incidence of hypoxia and related events detected by pulse oximeters provided by the Lifebox Foundation in the maternity unit at Sylvanus Olympio University Teaching Hospital, Togo. J Anesth. 2015 Dec;29(6):971-3. doi: 10.1007/s00540-015-2048-2. Epub 2015 Jul 22. PMID: 26198600.
  - Quintero-Cifuentes, Iván Fernando; Pérez-López, Danielab; Victoria-Cuellar, Diego Ferneyb; Satizábal-Padrín, Nataliaa,c; Billefals-Vallejo, Einar Stena,b; Castaño-Ramírez, Darío Albertoc; Beltrán-Osorio, Luis Davidd. Incidence of early postanesthetic hypoxemia in the postanesthetic care unit and related factors. Colombian Journal of Anesthesiology 46(4):p 309-316, October-December 2018. | DOI: 10.1097/CJ9.0000000000000082
  - Andualem AA, Yesuf KA. Incidence and associated factors of postoperative hypoxemia among adult elective surgical patients at Dessie Comprehensive Specialized Hospital: An observational study. Ann Med Surg (Lond). 2022 May 19;78:103747. doi: 10.1016/j.amsu.2022.103747. PMID: 35734654; PMCID: PMC9207005
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