Early detection of COPD Exacerbations Using Remote Monitoring and a Machine Learning Risk Score: A Validation Study

BIOSENCY
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Introduction

- Acute exacerbations of COPD (AECOPD) drive disease progression, hospitalizations, and mortality[1].
- Early detection is critical to enable timely interventions, but remains a major challenge[2].
- Remote monitoring and artificial intelligence (AI) open new perspectives for proactive COPD care[3].
- The BVS^3 risk score, a transparent machine learning–based score, integrates daily variations of oxygen saturation (SpO_2), breathing rate (BR), and heart rate (HR).

Objectives

- Validate the predictive performance of the BVS^3 risk score for early detection of AECOPD.
- Assess patient adherence to long-term continuous monitoring.
- Evaluate lead time, accuracy, sensitivity, and specificity compared to physician-confirmed exacerbations.

Methods

- Study design: retrospective analysis on data collected in the eMEUSE-SANTÉ (NCT04963192), monocentric prospective observational trial France (2021–2024).
- Population: 220 COPD patients monitored for 6 months.
- Device: Bora band® CE-certified wristband (Class IIa) measuring SpO_2, BR, HR continuously.

[1]Safiri S et al. BMJ; 2022, PMID:35896191
[2]MacLeod M et al Respirol Carlton Vic 2021 532–551. PMID:33893708
[3]Wu C-T et al JMIR MHealth UHealth 2021 PMID:33955840

- BVS^3 score: computed from Z-scores of vital signs.
- Outcomes: Performance of BVS^3 vs. physician-validated exacerbations.
- Analysis: AUC-ROC, accuracy, sensitivity, specificity, anticipation time.

eMEUSE-SANTÉ 6-month follow-up

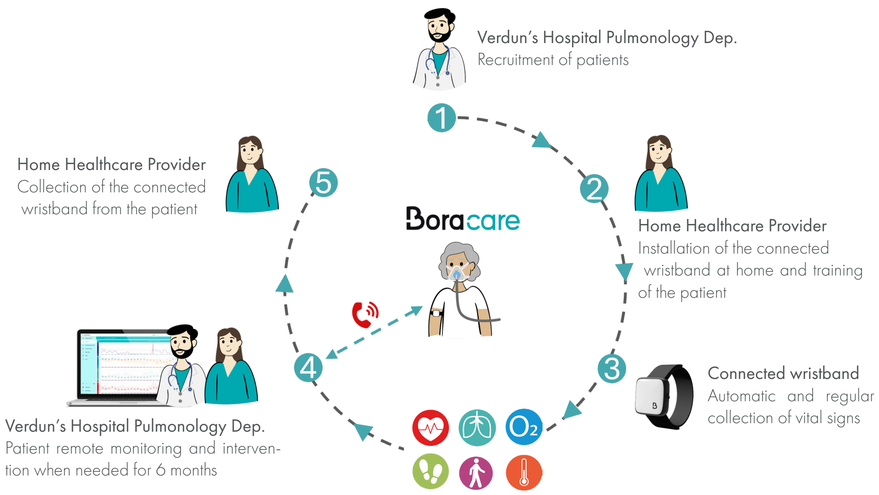


Fig1 Description of the eMEUSE-SANTÉ study flow

Results

Population & Data

N = 220 COPD patients (63 ± 8 yrs, 55% male, GOLD II–III predominant).
36,375 monitoring days analyzed.
Median adherence: 86%.
42 AECOPD (7 severe, 35 moderate) in 39 patients.

Prediction performance (fig 2)

AUC = 0.94 (severe), 0.88 (all events).
Sensitivity 86%, 94% specificity (severe events).
Accuracy 84.8%, sensitivity 74%, specificity 85% (all events).
Anticipation: Mean 4.4 ± 3.1 days before clinical confirmation.

Comparison with Single vital signs (fig3)

HR (AUC 0.83), BR (0.82), SpO_2 (0.71).
Composite BVS^3 consistently outperformed individual metrics

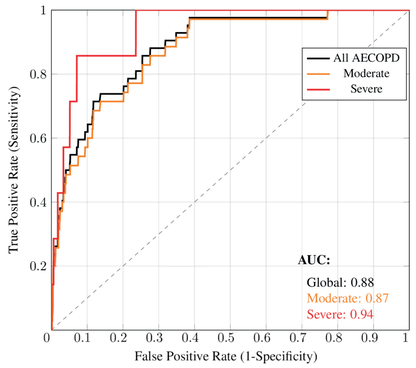
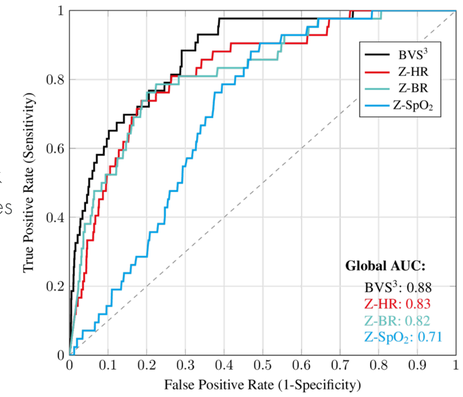


Fig2 ROC curves and AUC for alerts based on the BVS^3 risk score (red: severe AECOPD events, orange: moderate AECOPD events, black: all events).

Fig3: ROC curves and AUC for alerts based on individual vital sign Z-scores versus the BVS^3 risk score, over all AECOPD severities



Conclusion

- BVS^3 enables early, accurate, and interpretable detection of COPD exacerbations.
- High acceptability and adherence to continuous remote monitoring.
- Anticipation of ~4 days provides a valuable window for proactive intervention.
- This scalable, digital approach may transform COPD management and improve outcomes.