

# Impact of the environment on health status of intensive care unit patients: functional data analysis using wearable monitoring systems

*Juan A. Arias-Lopez<sup>1,2</sup>, Carmen Cadarso-Suarez<sup>1,2</sup>, Manuel Oviedo de la Fuente<sup>3</sup>, Pablo Jesus Lopez-Soto<sup>4,5,6</sup>*

<sup>1</sup>juanantonio.arias.lopez@usc.es, Biomedical Data Science Unit, Department of Statistics, Mathematical Analysis, and Operational Research, Universidade de Santiago de Compostela

<sup>2</sup>CITMaga, 15782 Santiago de Compostela

<sup>3</sup> CITIC, Research Group MODES, Department of Mathematics, Universidade da Coruña±a

<sup>4</sup>Comprehensive Nursing Care. Multidisciplinary Perspective. Instituto Maimonides de Investigación Biomedica de Cordoba (IMIBIC)

<sup>5</sup>Department of Nursing, Hospital Universitario Reina Sofia de Cordoba

<sup>6</sup>Department of Nursing, Pharmacology and Physiotherapy, Universidad de Cordoba

The aim of this study was to identify the environmental variables in a critical care unit (ICU) that have the most significant impact on patient health and to determine whether functional data analysis (FDA) is a useful method for analyzing continuous data obtained from wearable devices. Physiological and environmental data were collected from 77 patients using wearable devices through an IoT platform.

FDA is a field in modern statistical science that allows to analyse complex data objects (e.g. vectors, curves, images ...) that provide more information than traditional multivariate analysis. We used FDA tools to identify the environmental variables that were most strongly correlated with physiological variables, and tested linear and non-linear regression models to predict patient health outcomes.

Our analysis revealed that the average noise intensity in the ICU was the most important variable, together with the previous 15-minute interval functional curve for a given health outcome. These results show that ICU noise levels have strong impacts on cardiac frequency, systolic blood pressure, and diastolic blood pressure. Our results also suggest that FDA is a useful method for analysing continuous data from wearable devices and that interventions to reduce noise levels in the ICU may have significant positive effects on patient health outcomes.

**Keywords:** Functional Data Analysis, critical care, wearable technology