

## Chapter 7

# Data Quality and Critical Events in Ventilation: An Intensive Care Study

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### ABSTRACT

*The data quality assessment is a critical task in Intensive Care Units (ICUs). In the ICUs the patients are continuously monitored and the values are collected in real-time through data streaming processes. In the case of ventilation, the ventilator is monitoring the patient respiratory system and then a gateway receives the monitored values. This process can collect any values, noise values or values that can have clinical significance, for example, when a patient is having a critical event associated with the respiratory system. In this paper, the critical events concept was applied to the ventilation system, and a quality assessment of the collected data was performed when a new value arrived. Some interesting results were achieved: 56.59% of the events were critical, and 5% of the data collected were noise values. In this field, Average Ventilation Pressure and Peak flow are respectively the variables with the most influence.*

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## **INTRODUCTION**

Mechanical Ventilation is an artificial process of helping a patient to breathe. In an Intensive Care Unit (ICU), the patients are in a weak condition, and they need to be continuously monitored through bedside monitors (vital signs and ventilation). The ventilators are an essential support for these patients as they suffer from organ failure. When the ventilator is connected to the hospital network, it is possible to obtain several patient results (e.g. Support Pressure, Compliance Dynamic (CDYN), Plateau Pressure, Positive End Expiratory Pressure (PEEP), Respiratory Rate and others). Transcription errors normally arise when the values are manually recorded. In the case of the values being automatically collected there is a set of problems that can be verified. The patient sensors can be wrongly placed and therefore being responsible for collecting noise values. To minimize this problem, a trigger was designed. This trigger assesses all the received values according to the values and rules defined by the ICU. The critical events rules are defined using the collected values. With this new concept, it is possible to know the value / variable significance. In this work, an analysis was made to attest the data quality and observe the number of Critical Events (CE). This study was part of the INTCare project, and it was conducted in the ICU of Centro Hospitalar do Porto, Hospital Santo António. For this work, a huge volume of data provided by the ventilator was analysed. All the information was collected from the ICU in real-time. In this study, it was possible to observe that 2% of the values collected were noise values and 50% represented a Critical Event. This study is a sequel of a study previously conducted where the Critical Events concept was applied to mechanically ventilated patients (Portela et al., 2016).

Finally, the paper is divided into six sections. After the introduction, the main concepts associated with this work are presented. Section 3 presents the data acquisition and data quality process and their architecture. Section 4 presents the data quality analysis and Section 5 the critical events analysis, and some conclusions are drawn.

## **BACKGROUND**

### **Mechanical Ventilation**

A patient needs to be connected to a ventilator when he cannot breathe. In this work, the mechanical ventilation (artificial) is used. Mechanical ventilation in Intensive Care Units is considered an essential, life-saving therapy for patients with critical illness and respiratory failures (Prevention, 2015). According to Evans (Evans et al., 2005), the ventilators were also developed to generate alarms when a patient becomes disconnected, or the ventilation values are critical. Despite these innovations, the ventilator is not capable of determining if a value is valid or not, i.e., if the patient presents a normal value or a noise value or how critical is the collected value. A valid analysis requires some human observations. However, the humans can only see the collected values, and it is tough to analyse several values in a few minutes. To minimize this problem a set of intelligent procedures, able to detect the data quality, can be defined. These procedures are usually based on the use of intelligent agents (Cardoso et al., 2014). In this field, a set of experiments was made to define and detect critical events in the respiratory system (Portela, Gago, Santos, Silva, & Rua, 2012; Portela, Gago, et al., 2013; Portela et al., 2016).

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