Applying process mining techniques in a real healthcare case study

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Abstract The healthcare organizations are under increasing pressure to improve productivity, gain competitive advantage and reduce costs. For this reason, healthcare organizations, such as hospitals try to streamline their processes. In this paper we demonstrate the applicability of process mining in the healthcare domain, using a real case study of '*San Carlo di Nancy*' hospital in Rome (GVM Group). We apply process mining techniques to obtain meaningful knowledge about the patient careflows from so-called event logs, obtained from raw data of hospital information systems. We analyzed these logs using the ProM framework from three different perspectives: the control flow perspective, the organizational perspective and the timing perspective. The results show that process mining can be used to provide new insights that facilitate the improvement of existing careflows.

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1 Introduction

Nowdays, the hospitals try to streamline their processes in order to deliver high quality care while at the same time improving revenues and reducing costs. More and more pressure is put on hospitals to work in the most efficient way as possible, whereas in the future, an increase in the demand for care is expected. A complicating factor is that healthcare is characterized by highly complex and extremely flexible patient care processes, also referred to as '*careflows*'. In healthcare organisations, a wide range of processes with different characteristics and requirements are daily managed and executed. The delivery of complex care may involve several departments and organisations, and requires an active collaboration between different professionals and practitioners having heterogeneus skills. Healthcare is thus widely recognised as one of the most promising, yet challenging, domains for the adoption of process-oriented solutions. We demonstrates the applicability of process mining in the healthcare domain, using a real case study of '*San Carlo di Nancy*' hospital in Rome (GVM Group). We apply process mining techniques to obtain meaningful knowledge about the patient careflows from so-called '*event logs*' obtained from raw data of hospital information systems. Process mining aims at extracting process knowledge from that logs in order to discover, for example, both typical paths followed by particular groups of patients and strong collaboration between different hospitalization wards. We analyzed the different careflows both under the control flow perspective (emphasizing the differences between the process models obtained from different cluster of patients), the organizational perspective (looking at the social networks we were able to discover the relationship between the resources of the patient careflow) and the performance perspective (looking at the timing perspective of different activities performed by the patients we were able to discover bottlenecks in the patient careflow). In order to do so, we extracted the event logs from the raw datasets of '*San Carlo di Nancy*' hospital and we analyzed them using *ProM*: the process mining framework. The datasets in question are the following:

- *Ambulatori* (outpatient clinic): each row stores the information about a single healthcare service.
- *Pronto soccorso* (emergency room): each row represents a single emergency room activity.
- *Ricoveri* (hospitalizations): each row represents a single hospitalization taken by a patient.

These three datasets contain raw data about patients treated in both year 2016 and May 2017 for which all the treatment activities have been recorded. We did not use any a-priori knowledge about the careflows of the patients of '*San Carlo di Nancy*' hospital and did not have any process model at hand. The data analyzed are the standard ones of the National Health Service (Servizio Sanitario Nazionale) that the hospitals interchanged with the Regional Authorities (Enti Regione). Therefore the presented analysis can be replicated nationwide.
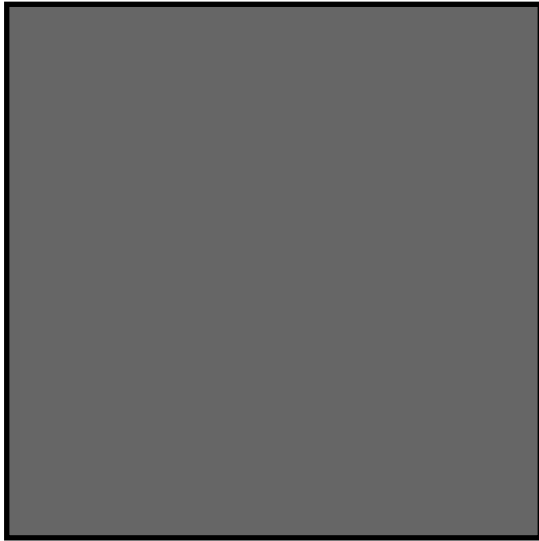
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$$a^2 + b^2 = c^2 \tag{1}$$

References

1. Author, Article title, Journal, Volume, page numbers (year)
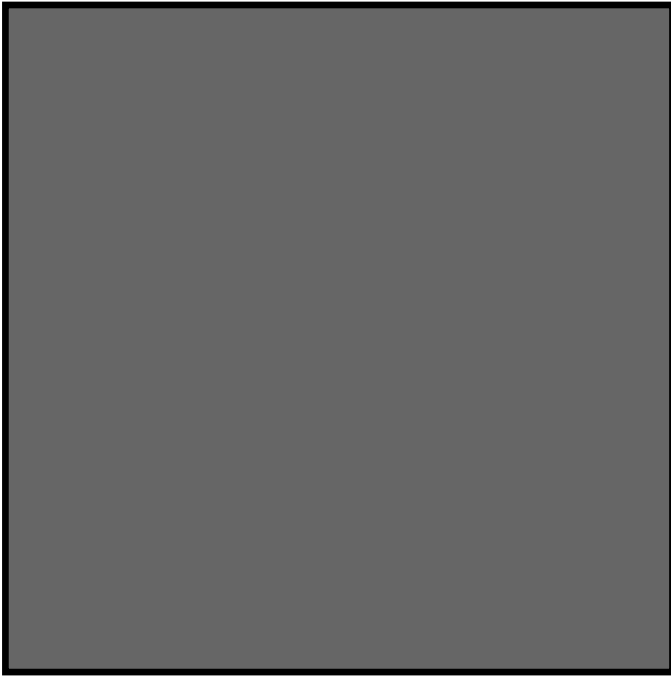2. Author, Book title, page numbers. Publisher, place (year)

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