

Performance and Work Practices Comparison of Emergency Departments through Process Mining

Davide Aloini¹, Elisabetta Benevento¹, Alessandro Stefanini^{1,2,*} and Mantas Vilkas²

¹ Department of Energy, Systems, Land and Construction Engineering, University of Pisa,
56126, Pisa (PI), Italy

² IN4ACT Chair – School of Economics and Business, Kaunas University of Technology,
44249, Kaunas, Lithuania

*alessandro.stefanini@ktu.lt

1 Introduction

Emergency Departments (EDs) have gained particular attention under the pressure of the public opinion and national authorities [1, 5]. The EDs' performance has in fact the highest impact on patient care and is highly relevant in public opinion, e.g. public debate on excessive waiting time or misdiagnosis [3]. Therefore, through the past years, the need to improve the EDs' operational efficiency has attracted much attention from researchers and practitioners [6, 8]. Health managers and national health authorities have progressively posed more attention to ED performances and created some indicators to understand the service level offered to the patients, like waiting times and similar indicators. However, they tend to evaluate and monitor ED processes by only synthetic indicators that do not provide a detailed picture of the ED systems, due to the complexity of healthcare processes [2]. Such an approach does not allow to deeply analyze process performances and to compare practices and results among different EDs. On the contrary, a more in-depth knowledge of ED performances and patient-flows may allow to identify the main process problems (e.g., bottlenecks, process anomalies, etc.), to streamline/optimize the flows, and to replicate the "best practices" from the best performing EDs [4].

Insert in this context, this on-going research intends to investigate the operational performances and to compare the managerial practices of two distinct EDs exploiting process mining techniques [7]. Process mining can support the identification of pathways, the evaluation of process performances, and the exploration of potential best practices. A real case study involving two Italian EDs is presented.

2 Research Objective

This research aims to suggest a methodology for comparing patient-flows and operational performances of distinct EDs exploiting process mining techniques. In so doing, it tries to overcome some limitations of model-driven analysis techniques when applied to emergency care [4, 5].

More in detail, the following objectives are posed for this research:

- To investigate and compare the patient-flows and the managerial practices followed by distinct EDs.
- To evaluate process performances across EDs with an appropriate set of indicators.
- To deeply explore the differences in operational performances and to identify the best practices.

3 Case Study and Preliminary Findings

The study exploits the real datasets of two medium-sized public EDs, located in north-central Italy. The two hospitals, which are part of the same health organization, have the same size, serve quite analogous areas and patients, and were both recently built. Therefore, the work organization, information systems, buildings, and resources of the EDs are practically the same. The similarity of the two EDs allowed to conduct a detailed and comprehensive comparison of performances and patient-flows more easily. For each ED, we collected a dataset that covers the same period of operations – about 8 months – and accounts for about 40,000 patient instances and 450,000 events. Preliminary results endorse the idea that Process Mining can be exploited for comparing ED performances and work practices, allowing health managers to take improvement actions.

References

1. Ganguly, S., Lawrence, S. and Prather, M. (2014). “Emergency department staff planning to improve patient care and reduce costs”, *Decision Sciences*, Vol. 45 No. 1, pp. 115-145.
2. Mans, R.S., van der Aalst, W. and Vanwersch, R.J. (2015). *Process Mining in Healthcare: Evaluating and Exploiting Operational Healthcare Processes*. Springer, New York.
3. Morley, C., Unwin, M., Peterson, G. M., Stankovich, J., & Kinsman, L. (2018). Emergency department crowding: a systematic review of causes, consequences and solutions. *PLoS one*, 13(8), e0203316.
4. Partington, A., Wynn, M., Suriadi, S., Ouyang, C. and Karnon, J. (2015). “Process mining for clinical processes: a comparative analysis of four Australian hospitals”, *ACM Transactions on Management Information Systems (TMIS)*, Vol. 5 No. 4, p. 19.
5. Rebuge, A. and Ferreira, D.R. (2012), “Business process analysis in healthcare environments: a methodology based on process mining”, *Information Systems*, Vol. 37 No. 2, pp. 99-116.
6. Rojas, E., Munoz-Gama, J., Sepulveda, M. and Capurro, D. (2016). “Process mining in healthcare: a literature review”, *Journal of biomedical informatics*, Vol. 61, pp. 224-236.
7. Van Der Aalst, W., et al. (2012). *Process mining manifesto*. Lecture Notes in Business Information Processing, 99 LNBIP (PART 1), pp. 169-194
8. Welch, S.J., et al. (2011). “Emergency department operational metrics, measures and definitions: results of the second performance measures and benchmarking summit”, *Annals of emergency medicine*, Vol. 58 No. 1, pp. 33-40.