



STREAMLINING EMERGENCY DEPARTMENT EFFICIENCY: IMPLEMENTING BUSINESS PROCESS RE-ENGINEERING TO REDUCE PATIENT WAIT TIMES

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ABSTRACT

Background: The Emergency Department (ED) plays vital roles in delivering emergency services for various clinical conditions. ED is required to provide health services even under high environmental pressures, such as overflowing patients, to speed up responsiveness. Therefore, efficiency should be a matter of concern in ED. The implementation of Business Process Re-Engineering (BPR) could significantly increase ED efficiency, specifically by reducing patient wait times.

Objective: This study aims to review the relevant literature correlated to BPR and identify its roles in order to increase efficiency from the wait times

Method: We conducted a literature review with its reliable and replicable research protocol, which allowed the researchers to extract articles from PubMed, ProQuest and Google Scholars in recent 5 years using specific key words. The full text of relevant articles is then thematically synthesized and presented.

Results: Our findings revealed that BPR implementation could affect the patients' wait times reduction significantly. The most of studies were performing Discrete Event Simulation Models, followed by new layout design, staff allocation, heuristics method, hierarchical approach, hybrid model, the technologies intervention as well as agent-based model.

Conclusion: The BPR implementation has the potential to improve efficiency in the ED. However, it should be noted that the implementation of BPR needs to consider the ED necessity and a proper integration through existing health

BACKGROUND

Health services provided by hospitals consist of several service components, one of

which is emergency services. Emergency services are an important component of healthcare facilities that play a fundamental and significant role in

providing emergency medical care to patients, especially at hospitals (Mahmood et al., 2013). Emergency departments (EDs) provide services to patients with various clinical conditions (Bouzon Nagem Assad & Spiegel, 2020; Feuerwerker et al., 2019). Emergency services are certainly in high-pressure environments, including those that involve several processes such as registration, triage, examination, treatment, and the process of discharge or transfer (Joseph & White, 2020). This condition will definitely increase along with the increasing demands for emergency services due to the increasing patient numbers.

The increase in the number of emergency departments' visits is known to elevate over time and become a global concern. A study by Al-Surimi et al. (2021) then identified that there were 150,727 patient visits to the ED back then in 2013 in Saudi Arabia. Jeffery et al. (2020), in their research showed that there has been an increase in ED visits in recent 5 years. It is stated that the annual ED visits before the pandemic ranged from 13.000 to 115.000 per year. However, during the pandemic, it is increased significantly from 22.0% to 149.0%. Indonesia itself is known to have increased visits in 2020 with the number of visits in the ED reaching as many as 8 million people and elevating significantly to 10 million people in 2021 and 16 million people in 2022. Similar conditions are expected to continue to increase every year (Merliyanti et al., 2024).

The increase in ED visits had a negative impact on both patients and hospitals. It is causing alleviation in terms of EDs capacity, therefore affecting the quality of health (Doan et al., 2019), and increasing the risk of patient mortality (Jo et al., 2015; Jones et al., 2022). It is also known to have negative consequences, which can affect

patient morbidity as well as decrease the ability to provide critical services to patients in emergency situations (Sartini et al., 2022).

The major number of EDs were also certainly caused an imbalance between supply and demand for health services. This condition has an impact on several things, such as long waiting times, patients who leave without being seen, and even the diversion of ambulances to other hospitals (Jo et al., 2015; Lowthian et al., 2012). These similar conditions also significantly contribute to work fatigue, which has an impact on hospital performance (Aldridge et al., 2016; Kelen et al., 2021; Savioli et al., 2022). Therefore, it is very important to make a useful effort in order to improve the efficiency and effectiveness of the ED.

The improvement efforts have to be made in order to increase the effectiveness and efficiency in ED. It could be done through various efforts, one of which is applying BPR approach. Hammer & Champy (1994) defined the BPR as the process of redesigning businesses processes to improve and develop existing business by measuring cost, service and speed. It involves fundamental rethinking and radical process redesign to achieve dramatic improvements in critical areas such as cost, quality, service, and speed (Bhaskar & Singh, 2014; Zaini & Saad, 2019). In the healthcare system, this approach could be applied to simplify operations, minimize redundancy, and improve overall efficiency (Pereira et al., 2020). The components of BPR in healthcare include thorough analysis and reconfiguration of workflows, the introduction of advanced technology solutions, and the alignment of organizational structure with the aim of improving patient care delivery (McNulty & Ferlie, 2002).

The utilization of BPR in emergency departments has resulted in significant outcomes and has been proven empirically. By simplifying the process and optimizing resource allocation, patients are served more efficiently, reducing waiting times, and ensuring that those in critical condition receive timely treatment (Kumar & Shim, 2007; Vasiliki et al., 2017). In addition, the implementation of BPR has facilitated to improved communication and coordination among medical staff, resulting in smoother handovers, faster consultations, and improved overall patient services (Pereira et al., 2020). Moreover, patient satisfaction levels increased, and service quality outcomes were positively impacted, reflecting the effectiveness of BPR in revolutionizing emergency medical services (Srinivas et al., 2021).

In the operational context of emergency departments, the implementation of BPR could be focused on work efficiency processes through simplification mechanisms of service flows or processes. This is aimed to achieve a faster response to emergent medical situations and reducing patient waiting times. This means ensuring that resources, from medical staff to equipment, are used optimally to improve overall ED readiness. These initiatives have the potential to have a significant impact on the efficiency and effectiveness of emergency medical care.

Several studies have been conducted related to BPR implementation in hospital units and showed useful as well as applicable results. However, there is a research gap in terms of understanding the BPR implementation in the emergency department, especially in improving service efficiency in the emergency department. Therefore, research on the BPR implementation and its effect on improving work efficiency in the

ED still needs to be carried out and identified. This study aims to review the relevant literature correlated to BPR and identify its roles in order to increase efficiency from the wait times. This study ought to address one major objective which is to identify the role of BPR in reducing wait times in emergency department.

METHODS

We conducted a literature review with its reliable and replicable research protocol, which allowed the researchers to extract the articles from PubMed, ProQuest and Google Scholars databases. We have searched for the original peer-reviewed articles, written in English or Indonesia regarding the business process re-engineering and emergency department's efficiency specifically the patients' wait times in the past 5 years (January 1st, 2019 – March, 31st 2024). We applied specific keywords as well as specific literacy operators such as 'BPR' OR 'Business Process Re-Engineering', OR 'Modelling' AND 'Emergency Department', OR 'ED', OR 'efficiency', AND 'wait times'. We included studies on interventions that were implemented in the process, such as system modification and improvement, modelling or simulation, which has positives outcomes for improve efficiency at emergency department.

We identified 388 of the thousand articles shown based on the keywords. The reviewers independently screened titles and abstracts, reviewed the full text of relevant articles and excluded 281 based on

relevancies; 23 articles were books and 18 were proceeding, and 38 were excluded based on the duplication. Therefore, 28 potential articles were obtained to be reviewed and thematically synthesized as shown in the Diagram 1. No specific journal accreditation appraisal was performed in this study.

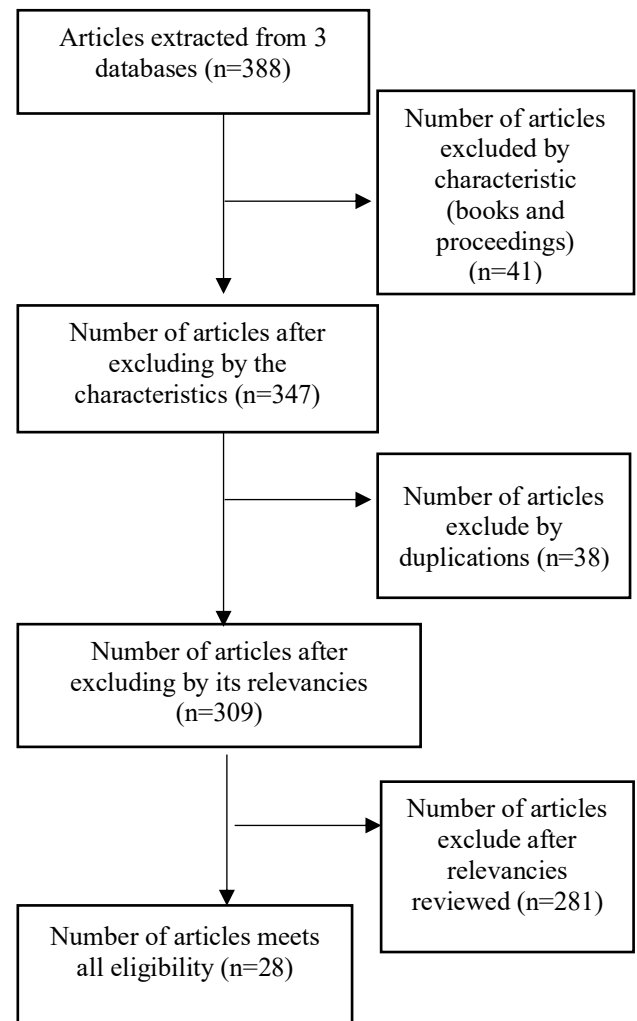


Diagram 1. Research Flow Diagram

RESULTS

Tabel 1. Overview of related studies

No	Author	Design	Setting	Intervention	Wait Times	Patient Satisfaction	LOS	Financial	Resource Utilization	Work efficiency
1	Abudalu et al. (2021)	Case Study	ED	Simulation or event modelling procedures: technology applied	x	x				
2	Amarantu et al. (2023)	Case Study	ED	Combined simulation and analytical hierarchical process	x		x			
3	Baril et al. (2019)	Experimental	ED	Discrete event simulation	x		x	x	x	
4	Kramer et al. (2020)	Case Study	ED	Discrete event simulation	x					

No	Author	Design	Setting	Intervention	Wait Times	Patient Satisfaction	LOS	Financial	Resource Utilization	Work efficiency
5	Ouda et al. (2023)	Case Review	ED	Discrete event simulation	x		x	x	x	
6	Peng et al. (2020)	Case Study	ED	Discrete event simulation	x		x			
7	Tian et al. (2023)	Case Study	ED	Event modeling procedures	x					
8	Zamani (2022)	Cross-Sectional Case Study	ED	Discrete event simulation	x		x			
9	Weng et al. (2019)	Experimental-Case Study	ED	Hybrid model	x					x
10	Sasanfar et al. (2021)	Case Study	ED	New layout design; staff allocation	x					
11	Alowad et al. (2021)	Cross-Sectional Case Study	ED	Lean strategies-an integrated voice of customer and voice of process	x	x				
12	Srinivas et al. (2021)	Case Study	ED	Discrete-event simulation modeling	x				x	
13	Derni et al. (2019)	Case Study	ED	Hierarchical colored petri net,	x		x			
14	Mistarihi et al. (2023)	Case Study	ED	Combining DMAIC methodology with discrete event simulation	x				x	x
15	Gabriel et al. (2020)	Case Study	ED	Simulation and modeling method	x		x			
16	Castanheira-Pinto et al. (2021)	Case Study	ED	Discrete event simulation model (triage process; shifting staff; layout; process stages)	x					x
17	Rehman et al. (2023)	Case Study	ED	A comprehensive simulation (arena	x					

No	Author	Design	Setting	Intervention	Wait Times	Patient Satisfaction	LOS	Financial	Resource Utilization	Work efficiency
18	Dosi et al. (2023)	Case Study	ED	simulation platform and goal programming) Discrete event simulation	x					x
19	Sulis et al. (2020)	Case Study	ED	Agent-based modeling	x		x		x	x
20	McKinley et al. (2021)	Case Study	ED	Discrete event simulation	x		x			
21	Easter et al. (2019)	Case Study	ED	Discrete event simulation	x		x			x
22	Valipoor et al. (2021)	Case Study	ED	Discrete event simulation	x		x			
23	De Boeck et al. (2019)	Exploratory Case Study	ED	Discrete event simulation	x		x			
24	Atalan & Dönmez (2020)	Case Study	ED	Discrete event simulation	x					x
25	Hamza et al. (2021)	Case Study	ED	Discrete event simulation	x		x			
26	Bruballa et al. (2019)	Case Study	ED	Agent-based model	x					x
27	Nambiar et al. (2023)	Case Study	ED	Discrete-event simulation	x		x			x
28	Ferreira et al. (2023)	Case Study	ED	Discrete-event simulation	x		x			

DISCUSSION

BPR approaches have emerged as an important strategy to reduce overcrowding in EDs while improving system efficiency (Pines & Griffey, 2015). BPR in healthcare pivots on careful re-evaluation and is an ED workflow redesign that is drastically able to improve performance outcomes (Hammer & Champy, 2009). If implemented correctly, BPR results in more efficient patient triage, simpler communication

channels, and resource optimization, ultimately contributing to reduced patient wait times in EDs.

The implementation of the re-design process is also carried out by optimizing the utilization of the emergency department's resources. The optimization of ED's resources, such as proper medical equipment could visualize several improvement scenarios as well as the redesign process itself. Thus, scenarios are represented in several studies, such as new layout design (Sasanfar et al., 2021), staff allocation (Sasanfar et

al., 2021), heuristics methods (Pereira et al., 2020), hierarchical approach (Derni et al., 2019), Lean Strategies (Alowad et al., 2021), Hybrid Model (Weng et al., 2019), agent based model (Bruballa et al., 2019; Sulis et al., 2020), simulation or event modeling procedures (Abudalu et al., 2021; Amarantou et al., 2023; Atalan & Dönmez, 2020; Baril et al., 2019; Castanheira-Pinto et al., 2021; De Boeck et al., 2019; Dosi et al., 2023; Easter et al., 2019; L. A. F. Ferreira et al., 2020; Gabriel et al., 2020; Hamza et al., 2021; Kramer et al., 2020; McKinley et al., 2021; Nambiar et al., 2023; Ouda et al., 2023; Peng et al., 2020; Srinivas et al., 2021; Sulis et al., 2020; Tian et al., 2023; Valipoor et al., 2021; Zamani, 2022), and also the technology intervention (Weng et al., 2019).

The process of improving waiting time efficiency in EDs is carried out through the identification of redundancies and overflowing queues, taking into account the technology used as a better information medium (Jansen-Vullers & Reijers, 2005). BPR is an important strategy to improve the effectiveness and efficiency of service delivery in the ED (Pereira et al., 2020). By embarking on this transformative approach, healthcare organizations undertake a fundamental rethink and radical redesign of business processes to realign service delivery with the all-important urgency inherent in emergency service dynamics (Hammer & Champy, 2009). Studies explained that the impetus behind this paradigm shift is twofold: (1) significantly reducing patient wait times, which is an important measure of ED' performance; and (2) simultaneously improving quality of care, ensuring that medical attention is provided quickly and appropriately (Hoot & Aronsky, 2008).

BPR is also empirically known to have positively contributed to rapid patient care (Jansen-Vullers & Reijers, 2005). The current state of the ED is grappling with severe challenges such as overcrowding, which further exacerbates the inefficient flow of information, misuse of vital areas, and the involvement of medical teams whose experience may not be sufficient for the urgency and complexity of tasks by officers. Several studies have uncovered many factors that contribute to protracted wait times and ineffective patient flow in the ER (Holden, 2011; Hoot & Aronsky, 2008). However, the most important thing that must be highlighted is the influx of patients with non-urgent conditions, lack of necessary physical space, and slow response to examination results leading to congestion scenarios, thus hindering the provision of appropriate and effective emergency medical care (Pereira et al., 2020).

BPR implementation is known to have a significant impact on patient waiting time (Abudalu et al., 2021; Srinivas et al., 2021; Tian et al., 2023). Most of these studies consider this holistic, patient-centered approach that is statistically able to reduce the burden on emergency services and is in line with the shift of the ED to a more responsive and agile department, thereby improving patient performance and satisfaction (Alowad et al., 2021; Feuerwerker et al., 2019; Nurfadhilah et al., 2021; Olajide et al., 2019; Srinivas et al., 2021; Volochtchuk & Leite, 2022).

Several journals we reviewed explained that BPR was implemented through a re-design process which played an important role in revolutionizing ED services. The condition is empirically known to be able to produce more efficient patient care and reduce waiting times (Pereira et al., 2020). For this

transformation to occur, it is essential to adopt a structured approach that includes process identification, discovery, and modeling, thus providing a clear framework for improvement (Jansen-Vullers & Reijers, 2005). Qualitative case studies and systematic reviews lay the foundation for evidence-based healthcare reform implementation strategies specifically adapted to the complex ER environment (Manyazewal et al., 2016). The integration of these methodologies ensures that process redesign is not only theoretical but also pragmatically embedded in the dynamics of healthcare in the real world.

As one of the empirical pieces of evidence, a previous study conducted in the ED of a hospital in Portugal found that the redesign process holds positive promise to address the growing demand for emergency services (Pereira et al., 2020). The study involved diverse stakeholders, ranging from administrative staff to frontline medical professionals and even patients, resulting in a holistic view of ED function. Crucially, stakeholder analysis identified several key problems: excessive workload, antiquated information systems, and problematic information flow between services, all of which contribute significantly to barriers that interfere with the efficiency and responsiveness of ED operations (Pereira et al., 2020).

The redesign process in the ED is based on the standard of care provided by the ED (Leggat et al., 2016). These conditions are also explained in several quantitative and qualitative analyses to ensure the impact of the design process on optimal improvement. Success factors such as financial resources, human resources, and technological solutions are indispensable in-service improvements in hospitals, ensuring that process

redesign results in major improvements in terms of service delivery efficiency (Putro & Dachyar, 2020). These thorough examinations also help ensure that the re-engineered process not only simplifies patient flow but also enforces, if not improves, the standard of care provided in the ED.

Although it has a good impact on reducing patient waiting time in the emergency department, challenges in emergency departments, particularly the daunting task of reducing patient wait times and optimizing resource utilization, require precision and foresight in BPR. Using simulation techniques, the complexity of each subprocess in the ED can be explored in various scenarios that reflect the dynamic nature of ED surgery (Pereira et al., 2020). This approach not only provides a holistic understanding of the intricacies of the system but also supports strategic decision making based on simulation results. The knowledge gained from these simulations is critical in tailoring processes to improve service delivery and patient care.

The integration of BPR is indispensable in reducing the extensive waiting times that plague ED and improving the overall quality of patient care. The use of dynamic simulation combined with comprehensive stakeholder analysis paves the way for the optimization of existing procedures and the careful management of available resources.

The BPR implementation is known to have a very significant impact. However, there are weaknesses that affect the BPR implementation at hospital, especially in emergency departments by its very limited resources, any financial and operational constraints which will lead to the lack as well as limited their scope and scale of BPR initiatives. Therefore, BPR's efforts may be limited to more incremental changes than the

transformative improvements that this methodology seeks to achieve.

CONCLUSION

This study highlighted BPR's potential roles and challenges in the emergency department. According to our findings, we have drawn the conclusion that BPR plays a significant role in reducing the wait times at the ED. The BPR implementations at ED were considered beneficial and highly important based on necessity.

However, despite its potential effect regarding BPR implementation, we found that hospitals specifically the ED should perform their analysis regarding the type and method of BPR needs to be applied based on necessity.

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Study limitations and future directions

Our study has been limited to three databases and only applied limited keywords, which could contribute negatively to missed other relevant studies. Further research might be required by conducting specific methods especially quality check identification, as well as involving more databases and more keywords to make the research more comprehensive.

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Conflict of interest

The authors have no conflict of interest related to the study, authorship, and/or article publication to declare.

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