

Improving Patient Safety Through Systems Approaches

Alanoud A. Alabdouli, Dalal M. Almansoori, Abdulla S. Mohammed, Nouf K. Alammari

Department of Industrial and Systems Engineering

Khalifa University of Science and Technology

Abu Dhabi, 127788, UAE

100038223@ku.ac.ae, dalal.almansoori@ku.ac.ae, 100052652@ku.ac.ae, 100038198@ku.ac.ae

Abstract

In recent years, there has been growing attention on patient safety due to the high rate of medical errors. In order to improve patient safety, systems approaches have been adapted to help identify patient safety risks within the scope of risk management.

In this study, a review of the literature on systems approaches is carried out in patient safety applications. The findings proved that systems approach provided valuable insights to comprehensively identify and mitigate patient safety risks. Further, the study provides the opportunities and challenges to implement the systems approaches in patient safety context. The paper presents valuable outcomes for healthcare quality and process improvement managers.

Keywords

Patient safety; systems approaches; healthcare operations; system thinking; health systems

1. Introduction

Over the past two decades, there has been growing awareness in systems approaches in the healthcare literature and practice. Health stakeholders have realized the value of consistently understanding the complex adaptive nature of healthcare systems to achieve greater health outcomes (Adam, 2014; Simsekler et al., 2018). However, systems approaches are underutilized in healthcare (Gurses et al., 2012; Simsekler et al., 2015).

Systems approaches help to understand the dynamic and complex nature of the system (Adam and De Savigny, 2012). It is a holistic approach where systems and their subsystems are interrelated, and each activity in the system has its consequences elsewhere in the system (Adam, 2014; Brimble and Jones, 2017; Simsekler et al., 2018). Systems approaches help to understand and appreciate the relationship in the system. It is used in many different fields, such as engineering, management, and ecology (Peters, 2014). Adopting systems thinking strategies in a complex adaptive nature like health systems can make transformational change, it can maximize the positive effects and mitigate the unexpected adverse effects (Simsekler, 2019; Swanson et al., 2012).

Systems approaches are the essence of Human Factors and Ergonomics (HFE) principles (Dul et al., 2012). Human factors and ergonomics experts consider individuals as an essential element of healthcare systems and agree that their strengths and shortcomings must be taken into account when improving the efficiency of the overall system (Gurses et al., 2012). It focuses on how individuals interact with parts of the system and how the system could be redesigned to optimize the whole system and reduce human error (Gurses et al., 2012). So far, several articles present various applications of systems approaches in healthcare; however, the evaluation in particular patient safety context is lacking. To shed light on this, we evaluated the use of systems approaches in patient safety context to provide insights on their opportunities and limitations.

2. Methodology

Systems thinking in patient safety context is investigated using the “snowballing” technique. Searching in databases using the keyword “systems thinking and patient safety” did not show many recent articles. Therefore, the

snowballing technique is used. The start set of articles come from different publishers, authors and years to ensure diversity. Then the reference list of the start set of articles is used to identify new papers for review. This technique helps to identify the main authors whose research area is in systems approaches (also known as systems thinking) and patient safety.

3. Literature Review

The Alliance for Health Policy and Systems Research (the Alliance) is an international partnership hosted by the World Health Organization. Its goal is to improve the health and health system in low- and middle-income countries. The Alliance promoted utilizing systems approaches in health systems through its flagship publication “Systems Thinking for Health Systems Strengthening” in the year 2009 (“Systems thinking,” 2009). This flagship report proposed ways to implement the systems thinking also addressed the gaps, challenges, and opportunities. Later in 2012, the Alliance published a journal, “Systems thinking for strengthening health systems in LMICs: need for a paradigm shift.” This journal showed through examples that the population’s health could be improved by better understanding the complex and dynamic nature of health systems. Moreover, it included tools and strategies that can help practical implementation of systems thinking in health system and can lead to transformational change (Adam and De Savigny, 2012).

Education is one of the important aspects to enhance patient safety. Recently, health sciences education started incorporating different disciplines, like operations management and systems thinking. Whereas in the past used to focus on technical learning only (Swanson et al., 2012). Systems Thinking Education Program (STEP) is an example of incorporating systems thinking in education. A study conducted to evaluate how STEP will enhance the awareness of patient safety and safety culture. The study focused on nurses’ workarounds and compared the changes before and after STEP interventions. Safety Attitudes Questionnaire was used to evaluate the perception of safety culture while systems thinking scale used to measure system thinking. The result of the study showed that after STEP, the workaround rates were substantially lower, and nurses had a better perception of safety culture. In addition to that, systems thinking score was higher after the program (Tetuan et al., 2017). To emphasize the role of education in improving patient safety, five recommendations given in (Gurses et al., 2012) to improve patient safety through HFE. These five recommendations are about educating clinicians and healthcare professionals through HFE course, HFE workshops and trainings, dual degree programs that include HFE and offering graduate studies training that focus on healthcare systems.

Systems thinking methods and tools have a wide variety of applications. Many of the tools helps people having a common understanding of the problem, and it helps to take proper action. For example, process mapping is a tool that gives a pictorial representation of the process; it can help to identify the non-value-added activities “bottlenecks.” Using this tool provides the opportunity to eliminate inefficient steps in the flow chart of the process (Peters, 2014). Many articles used the tools and methods of systems thinking to identify patient safety risks. As an example, a study conducted in Adult Attention Deficit Hyperactivity Disorder (ADHD) Service, based at the Cambridge Peterborough Foundation Trust in the UK, focused on the use of System Mapping Approaches (SMAs) and Failure Modes and Effects Analysis (FMEA) to identify patient safety risks. The system diagram had a positive impact on the FMEA exercise; without the system diagram it would be hard to visualize the system and anticipate the possible risks. However, using this tool will not capture the external risks (Mecit Can Emre Simsekler et al., 2019).

Another way of utilizing systems approach tools is by designing a systems-based Risk Identification Framework (RID Framework). The risk identification methods used currently in healthcare are ineffective; there is a need for improvement. An article published in 2018 investigated the potential of system thinking in RID Framework in real-world healthcare settings. Prospective hazard analysis (PHA) methods is one of the systems approaches that can proactively identify risks, but it is also underutilized in healthcare systems. Several tools and methods can be combined to identify the risks, like SMA, PHA, and FMEA (Simsekler et al., 2019, 2015). In this study, the systems-based tools and method used to identify the risks yield as many relevant risks as possible (M. C.Emre Simsekler et al., 2018). Another study compares Root Cause Analysis (RCA) used currently for patient safety context and Systems Theoretic Accident Modeling and Processes (STAMP) analyzed by two HFE experts on the same medication error incident. This study showed a practical example of how HFE experts can improve the patient safety incidents investigation (Canham et al., 2018).

While there are many tools and methods, the following are two particular tools, FMEA and HAZOP (see Table 1), that healthcare can benefit from the systems approaches in designing healthcare systems (NPSA, 2010).

Table 2: Systems Approaches and useful Outputs (adapted from NPSA (2010))

Approach	Identify the safety issues	Analyze and prioritize the safety issues	Develop potential design options and solutions	Evaluate design solutions
Hazard and Operability (HAZOP)	List of hazards associated with the main activities of the facility. These hazards can then be examined in more detail within the next design stage. Identify both safety and operability issues, and provides early detection of hazards, along with potential consequences.	List of hazards that affect both safety and operability, along with consequences, causes, frequency and severity. Identification of safety and operability issues.	List of recommendations to reduce potential hazards.	List of hazards that have been eliminated, hazards that have not been eliminated and any new hazards.
Failure Modes and Effects Analysis (FMEA)	✓	List of failures that can occur within a sequence of events, along with their potential consequences. The frequency of these failures can also be considered. Descriptions of errors and risks can be lengthy.	List of potential design solutions that can help to eliminate or reduce the possibility of a failure occurring.	List of failures that have been eliminated, failures that have not been eliminated and new failures that have arisen.

Patient safety can be improved by getting over the ‘blame culture’ (Simsekler, 2019). Blaming for mistakes encourages peoples to hide their mistakes. They fear the loss of trust and punishment. The ‘blame culture’ concentrate on individuals and neglect the system that could be poorly designed (IOM, 2000; Shojanian and Dixon-Woods, 2013). Some patient safety errors can be caused by the system like understaffing, equipment challenges and time pressure (Shojanian and Dixon-Woods, 2013; Tetuan et al., 2017).

4. Discussion

Systems approaches include many tools and methods. Literature shows that there is a growing awareness in systems approach despite the slow adoption of the concept. It could be due to the lack of practical guidance and knowledge on how to implement these tools and models in real-world healthcare systems. Several studies implemented and integrated multiple tools of system approach. Yet each study is implemented in a specific health setting. It might be inappropriate to generalize the findings of these studies to different settings in different countries.

Using systems thinking to improve patient safety could be achieved by proper risk management. Risk management includes risk identification, risk assessment, then developing a mitigation plan. Each of these three steps is important in risk management, but risk identification is the core of the process because unidentified risks cannot be mitigated. Many systems thinking tools can be utilized to identify the risks, but using a combination of them is more effective, potentially through the use of recent disruptive technologies, such as artificial intelligence (Ellahham et al., 2019).

From my perspective, educating clinicians and healthcare professionals about HFE is the key to achieve the potential transformational change in health systems. It will help the health systems effectively mitigate risks and reduce medical errors. Enhance the communication among the healthcare individuals will also increase the quality of the work and helps in eliminating blame culture.

5. Conclusion

Moving from classical thinking to systems-based-thinking can improve patient safety and enhance the health system in many ways. Understanding the complexity of the health system and appreciating the system's interrelations is an essential step toward system thinking. On the other hand, 'blame culture' and lack of HFE professionals in healthcare could affect the nature of the system and slow the transition; therefore, more efforts and communications are needed from different health organizations to overcome the raised obstacles.

References

- Adam, T., 2014. Advancing the application of systems thinking in health. *Health and Quality of Life Outcomes* 12, 1–5. https://doi.org/10.1186/1478-4505-12-50_old
- Adam, T., De Savigny, D., 2012. Systems thinking for strengthening health systems in LMICs: Need for a paradigm shift. *Health Policy and Planning* 27, 2006–2008. <https://doi.org/10.1093/heapol/czs084>
- Brimble, M., Jones, A., 2017. Using systems thinking in patient safety: A case study on medicines management. *Nursing Management* 24, 28–33. <https://doi.org/10.7748/nm.2017.e1621>
- Canham, A., Thomas Jun, G., Waterson, P., Khalid, S., 2018. Integrating systemic accident analysis into patient safety incident investigation practices. *Applied Ergonomics* 72, 1–9. <https://doi.org/10.1016/j.apergo.2018.04.012>
- Dul, J., Bruder, R., Buckle, P., Carayon, P., Falzon, P., Marras, W.S., Wilson, J.R., van der Doelen, B., 2012. A strategy for human factors/ergonomics: Developing the discipline and profession. *Ergonomics* 55, 377–395. <https://doi.org/10.1080/00140139.2012.661087>
- Ellahham, S., Ellahham, N., Simsekler, M.C.E., 2019. Application of Artificial Intelligence in the Health Care Safety Context: Opportunities and Challenges. *Am J Med Qual* 1062860619878515. <https://doi.org/10.1177/1062860619878515>
- Gurses, A.P., Ozok, A.A., Pronovost, P.J., 2012. Time to accelerate integration of human factors and ergonomics in patient safety. *BMJ Quality and Safety* 21, 347–351. <https://doi.org/10.1136/bmjqs-2011-000421>
- IOM, 2000. *To Err is Human: Building A Safer Health System*. National Academy Press, Washington.
- NPSA, 2010. *Lessons from high hazard industries for healthcare*. National Patient Safety Agency.
- Peters, D.H., 2014. The application of systems thinking in health: Why use systems thinking? *Health and Quality of Life Outcomes* 12, 1–6. https://doi.org/10.1186/1478-4505-12-51_old
- Shojania, K.G., Dixon-Woods, M., 2013. Bad apples: Time to redefine as a type of systems problem? *BMJ Quality and Safety* 22, 528–531. <https://doi.org/10.1136/bmjqs-2013-002138>
- Simsekler, M.C.E., 2019. The Link Between Healthcare Risk Identification and Patient Safety Culture. *Int J Qual Health Care* 32, 574–587. <https://doi.org/10.1108/IJHCQA-04-2018-0098>
- Simsekler, M. C. Emre, Card, A.J., Ruggeri, K., Ward, J.R., Clarkson, P.J., 2015. A comparison of the methods used to support risk identification for patient safety in one UK NHS foundation trust. *Clinical Risk* 21, 37–46. <https://doi.org/10.1177/1356262215580224>
- Simsekler, M. C.Emre, Card, A.J., Ward, J.R., Clarkson, P.J., 2015. Trust-level risk identification guidance in the NHS East of England. *International Journal of Risk and Safety in Medicine* 27, 67–76. <https://doi.org/10.3233/JRS-150651>
- Simsekler, M. C. Emre, Gurses, A.P., Smith, B.E., Ozonoff, A., 2019. Integration of multiple methods in identifying patient safety risks. *Safety Science* 118, 530–537. <https://doi.org/10.1016/j.ssci.2019.05.057>

- Simsekler, Mecit Can Emre, Kaya, G.K., Ward, J.R., Clarkson, P.J., 2019. Evaluating inputs of failure modes and effects analysis in identifying patient safety risks. *International Journal of Health Care Quality Assurance* 32, 191–207. <https://doi.org/10.1108/IJHCQA-12-2017-0233>
- Simsekler, M. C.Emre, Ward, J.R., Clarkson, P.J., 2018. Design for patient safety: a systems-based risk identification framework. *Ergonomics* 61, 1046–1064. <https://doi.org/10.1080/00140139.2018.1437224>
- Simsekler, M. C. Emre, Ward, J.R., Clarkson, P.J., 2018. Evaluation of system mapping approaches in identifying patient safety risks. *Int J Qual Health Care* 30, 227–233. <https://doi.org/10.1093/intqhc/mzx176>
- Swanson, R.C., Cattaneo, A., Bradley, E., Chunharas, S., Atun, R., Abbas, K.M., Katsaliaki, K., Mustafee, N., Mason Meier, B., Best, A., 2012. Rethinking health systems strengthening: Key systems thinking tools and strategies for transformational change. *Health Policy and Planning* 27, 54–61. <https://doi.org/10.1093/heapol/czs090>
- Systems thinking, 2009. . Alliance for Health Policy and systems Research. *World health organization* 1, 373–383. <https://doi.org/10.1201/b21448>
- Tetuan, T., Ohm, R., Kinzie, L., McMaster, S., Moffitt, B., Mosier, M., 2017. Does Systems Thinking Improve the Perception of Safety Culture and Patient Safety? *Journal of Nursing Regulation* 8, 31–39. [https://doi.org/10.1016/S2155-8256\(17\)30096-0](https://doi.org/10.1016/S2155-8256(17)30096-0)

Biographies

Alanoud Alabdouli is a Graduate Student at the Department of Industrial & Systems Engineering at Khalifa University of Science & Technology, Abu Dhabi. She is doing a Masters in Engineering Systems & Management. She had a Bachelor's degree of science in Mechanical Engineering from Khalifa University in 2017. Alanoud's research interests include Operation Research, Additive Manufacturing, Spare Parts Supply Chain and Logistics.

Dalal Almansoori is a Graduate Student at the Department of Industrial & Systems Engineering at Khalifa University of Science & Technology, Abu Dhabi. She is currently doing a Masters in Engineering Systems & Management. Dalal has a Chemical engineering background and obtained a bachelor's of science in chemical engineering from UAE University. Her research interests focus on Energy, sustainability and healthcare operations.

Abdulla Mohammed, is an Asset Engineer at National Petroleum Construction Company (NPCC), Abu Dhabi, UAE. Currently, he is pursuing his Master Degree in Engineering Systems and Management at Khalifa University, Abu Dhabi, UAE. He obtained his bachelor degree in Mechanical Engineering at United Arab Emirates University, Abu Dhabi, UAE.

Noof Alammari, is a Power Projects Engineer at Abu Dhabi Transmission and Despatch Company (TRANSCO), Abu Dhabi, UAE. Currently, she is pursuing her Master degree in Engineering in Systems and Management. She obtained her bachelor degree in Electrical and Electronics Engineering from Khalifa University, Abu Dhabi UAE.