Internal Medicine and Medical Investigation Journal
E-ISSN: 7750-2474
Homepage: www.imminv.com

ORIGINAL ARTICLE

Invstigating the Impact of Using Supply Chain Infrstructure on Advances in Patient Safety Given the Mediating Role of Healthcare Settings in Public Hospitals of Alborz University of Medical Sciences

Running Title: Supply Chain Infrstructure

Zahra Farhadi[1], Abasat mirzaei[2,3*], Maral Khoshniat-Shanjani[4]

[1] *Master of Health Services Management, Islamic Azad University, South Tehran Branch, Tehran, Iran.*

[2] *Assistant professor, Department of Health Care Management, Faculty of Health, Tehran Medical Science, Islamic Azad University, Tehran, Iran.*

[3] *Assistant professor, Health Economic Policy Research Center, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran.*

[4] *Master of Clinical Psychology, Science and Research Branch of Islamic Azad University, Tehran, Iran.*

[*] **Corresponding Author:** Abasat mirzaei, E-mail: amacademic@yahoo.com

ARTICLE INFO

Article history Received:
March 07, 2019
Accepted: Sept 29, 2019
Published: Dec 25, 2019
Volume: 4
Issue: 4

Keywords:
Supply Chain Infrastructure, Advances in Patient Safety, Healthcare Settings

ABSTRACT

Introduction: Using supply chain infrastructure in order to decrease medical error and create the ability to trace bad events in community care. In addition, patient safety has become an important focus area within recent decades. Most of the studies about patient safety, which have been carried out so far, have particularly focused on safety in hospital environments. The current study aimed to determine the impact of using supply chain infrastructure on advances in patient safety given the mediating role of healthcare settings in public hospitals of Alborz university of medical sciences.**Methods/Materials**: Statistical population of the present research comprises all managers, nurse managers, and those responsible for medical records of all public hospitals of Alborz University of Medical Sciences. The number of managers and employees is estimated to be 150. The sample size is 108 people based on Morgan Table. Smart-PLS statistical software was used to test the hypotheses. **Results**: According to the results, using supply chain infrastructure had a significant positive effect on advances in patient safety. Moreover, making use of supply chain infrastructure has a significant positive effect on advances in patient safety given the mediating role of healthcare settings. **Conclusion**: If the infrastructure required in hospitals is created with the quality and safety care which leads to appropriate services, the patients will be valued.

INTRODUCTION

Since a few decades ago when the medical association published "Mistakes are Natural (There are always reports on mistakes)" report, a high priority has been placed on patient safety by the health system (1). Since then, patient safety has been perceived as top priority, especially on intensive care, for health systems because medical error has been reported as the third cause of death in Canada and the Us (2, 3). Despite considerable investment in innovative designs of patient safety, advancement has been limited and attention to bad events in collective healthcare environments (For example, homecare, initial care, long-term care, complicated care and rehabilitation) has been studied less than in intensive care environments. However, community-based healthcare services play an important role in managing healthcare, particularly because both chronic diseases rate and complexity of comorbidity (presence of some diseases at the same time) among patients are still increasing. Similarly, the growing complexity of patients' population urgently requires extensive care coordination which raises exclusive challenges for supporting patients and ensuring their safety. In comparison with intensive care sector, less research has been conducted on patient safety in terms of community.

Visibility is the key feature of a very efficient supply chain. A powerful system of supply chain that is fully visible follows each product, patient and care process digitally and directly and provides clinical experts with automatic symptoms so that they can make decisions that support safe care. This causes the whole chain to be "transparent" and "visible" for all stakeholders, and most importantly, for patients and team providers (4). Patient safety has turned into an important area of concentration within the past few decades, and currently, medical error makes up the third cause of death in Canada and the US. In many researches, patient satisfaction in just considered the only quality factor, and perceptions of services and patients' remarks have been ignored (5). In recent years, as concerns have increased, healthcare subject has become a critical issue regarding delivering high-qual-

ity services, patients' satisfaction and safety, pharmaceutical shortages, and increase in expenses (6). The hospital is known as the largest and most important operational unit of health system. Therefore, full attention to the way its supply chain quality is evaluated is of utmost importance.

Fig. 1: Conceptual Model of the Research (Source: Anne et al., 2018)[8]

The results of many studies suggest that hospitals and governments are suffering heavy costs due to non-compliance with patient safety principles. Enhancing patient safety is a shared international priority because a lot of errors are currently being committed all around the world in patient care and treatment measures (7). The studies on patient safety focusing on community healthcare have determined the existing changes in healthcare as a considerable risk plan for bad events due to insufficient access to information between patients and providers or "handoffs" among providers, which are recognized as opportunities for improving patient safety (8, 9). The visible health systems require international standards acceptance for the transparency of information they provide so that they can present more accurate tracing for patient's detailed transactions (4).

We can only achieve a very clear and visible healthcare system when the clinical conditions in which care is delivered have infrastructure devices to support clinical experts in providing safe care. Introduction of supply chain infrastructure has already led to effective results in quality, safety, and reduction of intensive care hospitals' costs (10-12).The purpose of this research is to investigate the opportunity for supply chain infrastructure and processes in order to reduce the risk of medial error and create traceability of bad events in community care.

MATERIALS AND METHODS

This is a functional research in terms of the results and a descriptive one in terms of the method. Also, the present research is a cross-sectional one in terms of time and belongs to quantitative studies based on the nature of its data. Moreover, the current research studies the subjects in their natural environments, and the data are collected from the subjects themselves. In addition, this is considered a field research. The time limit of developing the questionnaire is fall of 2018. The managers, nurse managers, and authorities of medical documents of all public hospitals of Alborz University of Medical Sciences (Shahid Madani, Imam Hassan Mojtaba, Imam Ali Complex, Shahid Rajaei, Kamali, Fatemeh Zahra, Imam Jafar Sadegh, Sarallah, Dr. Shariati hospitals) make up the statistical population of the present research. It is estimated that the population is made up of 150 people in a year. In order to calculate the sample size, Morgan Table was employed regarding the size of the research population. Finally, 108 people were selected through random sampling method.

Table 1: Determining the Sample Size in Hospitals

Authorities / Hospitals	Managers	Nurse Managers	Medical Documents Authorities
Shahid Madani	3	6	4
Imam Hassan Mojtaba	2	4	3
Imam Ali Complex	1	7	5
Shahid Rajaei	1	6	1
Kamali	2	8	6
Fatemeh Zahra	2	7	4
Imam Jafar Sadegh	-	4	3
Sarallah	2	8	3
Dr. Shariati	2	10	3
Total	15	60	32

Data collection was done through documentary and method and questionnaire. the research variables including using supply chain infrastructure, advances in patient safety, and healthcare settings were extracted through a questionnaire from Anne et al. (4). In addition, Cronbach's Alpha has been employed in order to evaluate the research reliability.

Table 2: Cronbach's Alpha Coefficient

Variable	Cronbach's Alpha	Variable Status
Using Supply Chain Infrastructure	0.757	Acceptable
Advances in Patient Safety	0.693	Acceptable
Healthcare Settings	0.801	Acceptable

The obtained values of Cronbach's Alpha were acceptable for the sub-indexes and thus, the questionnaire reliability is approved. Different analyses have been used for data analysis and statistical inference. Therefore, Spss22 and Smart-PLS software applications have been employed to test the research hypotheses.

RESULTS

After the investigation of the statistical sample, the following results were obtained:

People between 30 and 40 years old constituted the most group age (55.6%). Men had a higher share (58.3%) in the sample under study. The people have between 10 and 15 years of job experience (44.4%). Bachelor degree is the most frequent degree (51.9%) among the participants.

In order to test the research hypotheses, the variables' normality is firstly investigated. Hence, this condition is initially examined for the research variables.

Table 3: Kolmogorov–Smirnov Test for Normality of Research Variables

Indexes	Number	Mean	Standard Deviation	Kolmogorov-Smirnov	P-value
Using Supply Chain Infrastructure	108	3/88	0.48	0/992	0/272
Advances in Patient	108	3/65	0.55	0/735	0/652
Healthcare Settings	108	3/64	0.48	0/659	0/778

Regarding the fact that the significance level of Kolmogorov-Smirnov in the table above is bigger than 0.05 for the research variables, it could be said that distribution of the abovementioned variables does not have a significant difference with normal distribution. Therefore, it can be concluded that distribution of the research variables is normal, but regarding the research sample size, Smart-PLS software has been used to investigate the research hypotheses. The model of research for examining the relations between variables has been developed as follows:

First Hypothesis Evaluation: Using supply chain infrastructure in effective on advances in patient safety.
Concerning table (4-6), the results of PLS analyses show that making use of supply chain infrastructure has positive effect on advances in patient safety with 95 percent of reliability (T= 6.122, P<0.01, PC = 0.384). As a result, H0 hypothesis is rejected, and H1 is accepted.
Second Hypothesis Evaluation: Using supply chain infrastructure is effective on advances in patient safety given the mediating role of healthcare settings.

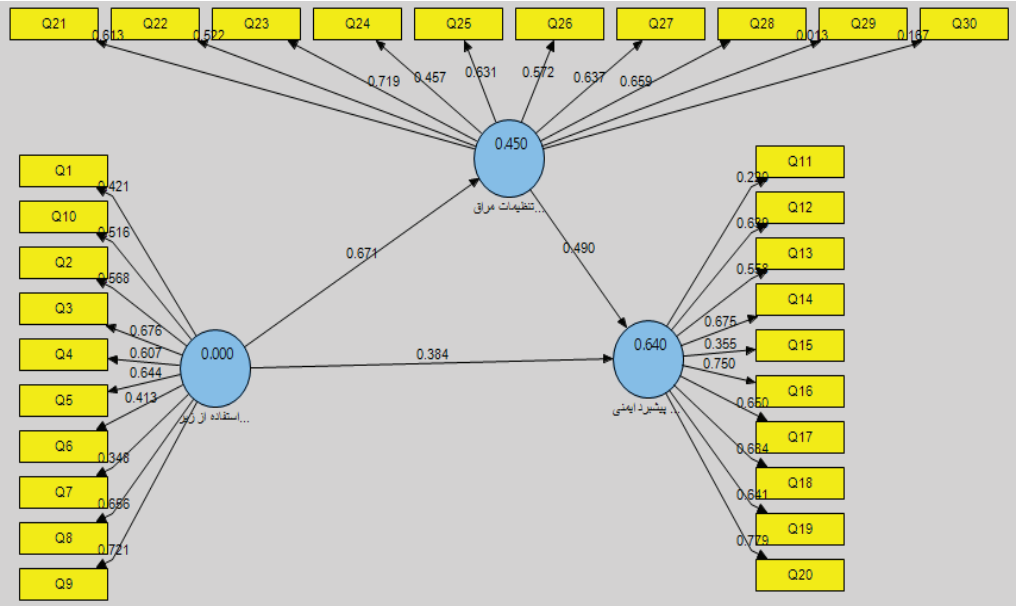

Fig. 2: Values of the Relations Strength between Research Variables in the Final Model

Where the significance level of the relations above has been illustrated in the following figure:

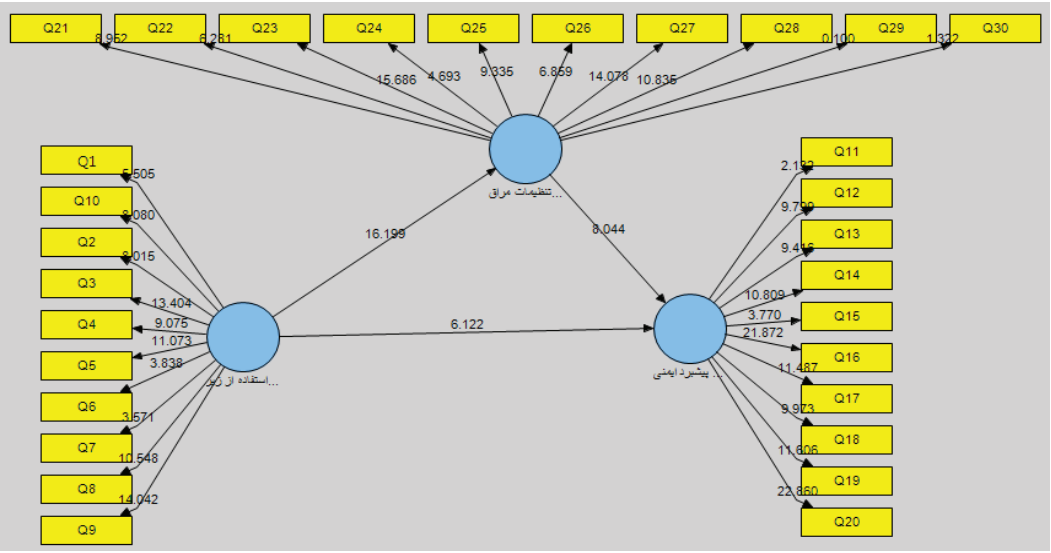

Fig. 3: T Values of the Relations between Research Variables in the Final Model

Table 4: Research Hypotheses Evaluation

Relations between Concepts and Indexes in the Model	Effect Strength	T value	Significance Level	Result
H_1: Using supply chain infrastructure in effective on advances in patient safety	0.384	6.122	P<0.01	Accepted
Effect strength shows the relation strength between variables, and this coefficient ranges from 0 to 1. The closer this value to 1, the stronger the relations between variables. T value, which is the result effect strength divided by standard deviation, shows the significance of the relation between variables. T values between -1.96 and 1.96 show lack of a significant effect between relevant latent variables. T values between 1.96 and 2.576 indicate the significance level at 95 percent confidence between relevant latent variables. T values equal to or bigger than 2.576 indicate the significance effect with more than 99 percent of confidence between relevant latent variables.				

The second hypothesis of the present research is related to the mediating role of healthcare settings, which is evaluated in the following. In statistical tests of mediating variables, two questions should be answered: a) How much is the indirect effect of X on Y through M? b) Does M variable (mediating variable) have a mediating role? Or, in other words, is the indirect effect of X (independent variable) on Y (dependent variables) through M significant?

To answer the first question, that is the indirect effect of independent variable on dependent variable, Sobel method (1982) can be used. In this method, the amount of indirect effect is calculated through the following equation in which "a" is the effect of independent variable on the mediator and "b" is the effect of mediating variable on the dependent one.

$$B_{indirect} = a \times b$$

In addition to calculation of the indirect effect, significance of the indirect effect can also be calculated using Sobel, Baron and Kenny, and Goodman tests. It is noteworthy that all software applications calculate significance of the direct effect of variables and present them to their outputs but do not provide significance of the indirect effect and sometimes provide the amount of indirect effect based on the equation above. Therefore, significance of the indirect effect has to be calculated manually whose equation will be presented in the following based on Sobel method. Concerning the explanations above, the mediating hypotheses will be examined in the following.

Regarding the calculation of the rate of indirect effect of using supply chain infrastructure on advances in patient safety with healthcare settings as a mediator, as seen on the relevant chart, the value of path coefficient for the relation between two variables of using supply chain infrastructure and healthcare settings was equal to 0.671 and for the relation between two variables of healthcare settings and advances in patient safety was equal to 0.49. So, as calculated below, the rate of indirect effect of using supply chain infrastructure on advances in patient safety through healthcare settings was equal to 0.329.

$$B_{indirect} = a \times b \rightarrow 0.671 * 0.49 = 0.329$$

According to the obtained results, significance of the indirect effect will be investigated in the following. Regarding the fact that T-value is 130.3, i.e. out of 1±/96 span, it could be said that the indirect effect of using supply chain infrastructure on advances in patient safety through healthcare settings is significant and this hypothesis is confirmed. In other words, using supply chain infrastructure through healthcare settings can lead to advances in patient safety. it should be noted that as the direct effect of using supply chain infrastructure on advances in patient safety has been confirmed, it can be said that the role of healthcare settings variable is slight mediation, that is using supply chain infrastructure is both directly and indirectly effective (through healthcare settings) on advances in patient safety.

Structural Model Test

1- T-values: Values bigger than 1.96 indicate validity of the relation between structures, and consequently, confirms the research hypotheses at a 95 percent confidence level.

2- R2 Criterion: This criterion is used to connect the measuring part and structural part of modelling structural equations and indicates the effect an exogenous variable has on an endogenous variable. Regarding the fact that R2 values of advances in patient safety variable (0.64) and healthcare settings variable (0.45) is almost moderate, it could be said that the structural fitting of the model by R2 is also moderate.

3- Q2 Criterion: This criterion was introduced by Steven Gazer (1975) and determined the model's prediction power, i.e. the models that have acceptable structural fitting must have the ability to predict the indexes relevant to the model's endogenous structures. 0.02, 0.15, and 0.25 values indicate weak, average, and strong prediction ability, respectively. Given the fact that Q2 value is bigger than 0.25 for all dependent variables, it can be concluded that the structural model has a high prediction power and is acceptable.

Evaluating Total Fitting of the Model

1- GOF Criterion: This criterion is related to the total part of structural equation models. It means that, using this criterion, the researcher can control fitting of the total part after investigating the fitting of measurement part and structural part of the total model of research. 0.01, 0.25, and 0.35 indicate weak, average, and strong total fitting, respectively. GOF value in the present research model is as follows:

$$GOF = \sqrt{\overline{communality} \times \overline{R^2}} = 0.423$$

Regarding the fact that GOF value is equal to 0.423, it can be said that the model's total fitting level is perfectly acceptable.

DISCUSSION

Similar advances in community care environments can have the potential for safety and care quality advances and reduction of bad events occurrence in this field. In addition, such infrastructure can easily document the results of quality, safety, and care in the society. Currently, there are few or no reports about bad events like initial care. Such transparency will not only inform the system's leaders about the best methods related to patient results but also provide the highest value for patients. Since the rate of chronic diseases is still on the rise and community care models are, still evolving, clinical devices provide an important opportunity for reaching highly reliable community-based quality, safety, and healthcare and make health experts aware of the present issues. Anne et al. (4) pointed out that in addition to the current efforts to increase awareness and encourage "safety culture" on healthcare, system infrastructure had to be designed in a way that clinical experts could provide the safest care possible. Pheng et al. (13) came to the conclusion that three factors of people, process, and technology had a positive effect on two factors of quality and cost which are among important factors in supply chain of services. Thomas et al. (14) stated that health information technology could facilitate access to health information and enhance the quality of service. They also reported that using the technology of patients' electronic registration would lead to more accurate data collection, faster data collection, more economical use of financial resources, and faster and easier retrieval of patients' information. The important limitations of this study should be emphasized. First, the variables of the study include well- known risk factors, but other patients or procedure factors could be considered. Population behaviors could be consider in addition to other factors. Second, it was a single- center study, which is limits data comparison, especially when taking into account the patients' profiles. Third, the short duration of the experiment was another limitation of the study.

CONCLUSION

In this section, we interpret the results obtained from hypotheses tests based on the theoretical frameworks and previous studies as well as the models and variables employed in the present research.

The first hypothesis of this study concerned the effect of using supply chain infrastructure on advances in patient safety. The results are indicative of the positive effect of using supply chain infrastructure on advances in patient safety. The results of this hypothesis are in line with the research done by Anne et al. (4). The second hypothesis of the current research concerned the effect of using supply chain infrastructure on advances in patient safety given the mediating role of healthcare settings. According to the results, using supply chain infrastructure has a significant positive effect on advances in patient safety given the mediating role of healthcare settings. The results of this hypothesis are also in line with those of the research conducted by Anne et al. (4) So, the results of the current study revealed that if the infrastructure required in hospitals is created with the quality and safety care which leads to appropriate services, the patients will be valued.

Authors' contributions

Research design, data collection, analysis, writing, and review of the manuscript. Both authors contributed equally to this research.

Conflict of interest disclosures

The authors declare that they have no conflicts interest.

Ethical Approval

The necessary ethical approval was obtained from the ethics committee of the hospital community.

Acknowledgements

The authors would like to thank all for supporting in this research.

REFERENCES

1. Donaldson MS, Corrigan JM, Kohn LT. To err is human: building a safer health system. 2000.
2. Makary MA, Daniel M. Medical error—the third leading cause of death in the US. Bmj. 2016;353.
3. Barker KN, Flynn EA, Pepper GA, Bates DW, Mikeal RL. Medication errors observed in 36 health care facilities. Archives of internal medicine. 2002;162(16):1897-903.
4. Snowdon AW, Tallarigo D. Leveraging supply chain infrastructure to advance patient safety in community health-care settings. Leadership in Health Services. 2018.
5. Brown CR. Where are the patients in the quality of health care? : Oxford University Press; 2007.
6. Stock GN, McFadden KL, Gowen III CR. Organizational culture, critical success factors, and the reduction of hospital errors. International Journal of Production Economics. 2007;106(2):368-92.
7. Milligan FJ. Establishing a culture for patient safety–The role of education. Nurse education today. 2007;27(2):95-102.
8. Wagner LM, Rust T. Safety in long-term care settings. Broadening the. 2008.
9. Kingston-Riechers J, Ospina, M., Jonsson, E., Childs, P., McLeod, L. and Maxted, J.M. . Patient Safety in Primary Care , Canadian Patient Safety Institute & B.C. Safety and Quality Council, Edmonton, AB.
2010.
10. A S. The Impact of Supply Chain Transformation in Health Systems: Mercy Health, US, 2018 [Available from: https://issuu.com/worldhealthinnovationnetwork/docs/final_for_release_mercy_ case_edit_f

11. Snowdon A. The Impact of Supply Chain Transformation in Health Systems: National Health Service , 2018 [Available from: https://issuu.com/worldhealthinnovation-network/docs/final_for_release_ nhs_case_feb_14_8
12. Snowdon A. The Impact of Supply Chain Transformation in Health Systems: Alberta Health Services, 2018 [Available from: https://issuu.com/worldhealthinnovation-network/docs/final_for_release_ahs_case_feb_14_9.
13. Pheng TK, Hamdani Y, Zailani S, editors. Investigation on service supply chain in private hospitals Malaysia. Proceedings of the 2014 International Conference on Industrial Engineering and Operation Management, Bali, Indonesia; 2014.
14. Tomasi E, Facchini LA, Maia MdFS. Health information technology in primary health care in developing countries: a literature review. Bulletin of the World Health Organization. 2004;82:867-74.