



Model of Healthcare Supply Chain Agility based on Information Technology

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Abstract

Advent of information technology elements in each area, necessity of speed and accountability, increasing changes in the market and consumer needs, necessity of further flexibility in the organizations and their products and services reflect movement towards agility concept more than ever. The present paper has designed a healthcare supply chain agility model based on information technology. This paper is an applied research in terms of objective, a survey research in terms of data collection, and a descriptive – analytic research in terms data analysis. Hospitals of the Medical Sciences Universities affiliated to the Ministry of Health in Tehran constitute research territory and the statistical universe is comprised of 200 senior and middle managers of these organizations. The research findings revealed that the most important dimensions of agile healthcare supply chain based on information technology are respectively, customer relationship, inventory management, orders processing, customer services, transportation, purchase and procurement, and production/services scheduling. Also the results showed that use of an IT-based supply chain is effective on improvement of organization performance.

Keywords: Supply chain, agility of supply chain, information and communication technology, performance, healthcare sector.

Introduction

In the current turbulent world, the mere thing that does not change is variation. In a business world that is increasingly directed by three words, i.e. customer, competition, and change, companies are seeking a solution for their business problems¹. The intense competition with which all the manufacturing and service businesses are faced stems from technological changes and innovations in the market and customer demand changes. This situation has changed priorities in the business and strategic vision, and has challenged accuracy of traditional models and even new models of business and management². On the other hand, advent of information technology elements in each area, necessity of speed and accountability, increasing changes of market and consumer needs, necessity of further flexibility in the organizations and their products and services reflect movement towards agility concept more than ever. This concept originates from new organizations needs. In fact, creating network in the physical and virtual space and removing wastes in the organization are among the most important new developments and approaches in the management and organization area³.

Ability to respond market changes rapidly is called agility that is regarded as the main factor of success and company survival in today market. To be consistent with rapid changes in the competitive markets, organizations must give up traditional management method, be united with each other through dynamic partnerships and endeavor to fulfill variable needs of competition market and reach the win-win objective. In the

recent years, many organizations have accepted agile supply chain as a powerful tool for elaboration, analysis, and improvement of company performance. According to many researchers and the results of many researches carried out on agile supply chain, when agility is raised as a winning strategy for growth and even survival of some organizations, selection of agility approach in the supply chain seems rational. According to them, agility in the supply chain refers to the ability of the supply chain as a whole and its members for rapid consistency with dynamism and fluctuations in the customer needs³⁻⁶. As a result, alternate supply chains of companies will be converted into success tools in the competition⁷.

According to Liv et al., nowadays volume of products and economic scale are not necessarily the powerful solution to cost and competitive advantages; rather management of supply chain is the solution. So, supply chain is a network of upstream to downstream organizations that are engaged in different processes and activities that create value in the form of products and services for the final customer. Moreover, inside each supply chain, companies must cooperate with each other so as to reach a level of agility that is beyond agility of each company. All companies, from suppliers of raw materials to manufacturers and vendors, must be involved in the process of achieving agile supply chain. In the other words, one can state that an agile supply chain embraces a set of companies that are separate from each other but have some dependencies upon each other. These companies are linked to each other by ongoing flow of materials and information feedback flow. The agile supply chain underscores increase in flexibility and adaptability and is able to

respond market changes rapidly and effectively⁸.

On the other hand, another element that is highly effective on the organization performance and creates value for the organizations is information technology. As regards agility of supply chain, information technology acts as a coordinator and integrator of different parts of supply chain and its efficiency will have a direct effect on the efficiency of supply chain performance. Studies show that most successful organizations have used information technology plans for improving customer services and information quality.⁹ In general, information technology has had a great effect on improvement supply chain agility and many researchers have confessed it^{2,7,8,10}.

Management of healthcare supply chain is more sophisticated compared to other industries due to its effect on people health. In the healthcare sector, supply chain issue has a salient position because this sector is responsible for protecting health and life of the society¹¹.

The healthcare supply chain has been comprised of three main actors namely, manufacturers, buyers, healthcare providers. Manufacturers include pharmaceutical companies, surgical products companies, medical equipments manufacturers, capital equipments and information systems manufacturers. Buyers include group purchasing organizations, drug wholesalers, surgical and medical devices distributors, distributors with independent contracts, representatives of manufacturers; and healthcare services providers include hospitals, hospital systems, integrated delivery networks (IDNs), and alternate site facilities^{12,13}.

One can claim that management of supply chain in the healthcare sector has been highly welcomed which is mainly due to sophistication of systems in the healthcare institutes, importance of efficiency in these organizations, pressure for cost reduction, and finally expertise- orientation process and strengthening customer position. Studies show that near 97 percent of hospitals in the developed countries apply concepts and tools of supply chain management¹⁴.

This paper seeks to achieve a standard for agile supply chain based on information to measure performance of supply chain in the healthcare institutes and comply with global standards. Accurate management of supply chain is among the most important processes because as long as an organization does not improve its inputs through a high quality supply chain, improvement of its outputs that fulfill customer satisfaction and quality cannot be expected. So, this paper offers a supply chain agility model based on information technology for organizations in the healthcare sector and finally studies its effect on the improvement of organization performance.

Research Questions: What are dimensions and components of

the IT-based healthcare agile supply chain?, How is the situation of IT-based agile supply chain dimensions in the studied population?, How is the final model of IT-based supply chain effects on the performance of the studied population?

Research Model: By using Aliei model, figure-1 presents the initial model of dimensions and components of the IT-based agile supply chain in the healthcare sector. Now, by using questionnaire and experts opinions in the healthcare sector, the research proposed model is tested.

Methodology

The present paper is an applied research in terms of objective, a survey research in terms of data collection, and a descriptive – analytic research in terms of data analysis. The research data has been gathered by using the researcher-made questionnaire. Hospitals of the Medical Sciences Universities affiliated to the Ministry of Health in Tehran comprise research territory and the statistical universe is comprised of 200 senior and middle managers of these organizations. The gathered data was analyzed via analysis methods of descriptive and deductive statistics and SPSS and Amos software.

Results and Discussion

Findings: Dimensions and components of healthcare agile supply chain based on information technology.

As shown by diagram 2, use of information and communication technology has been estimated by seven components namely, customer relationship, procurement, inventory management, production / services schedule, transportation, orders processing, and customer services by using structural equations method. Coefficients of each component have been shown. With regard to the coefficients of different dimensions of using information and communication technology in the supply chain, one can state that the most important dimensions are respectively, customer relationship with coefficient (1), orders processing with coefficient (0.96), and customer services with coefficient (0.95). The value of chi-square statistic of this model is 395.5 and its degree of freedom equals¹⁴.

Situation of dimensions of IT-based agile supply chain in the studied hospitals:Customer relation: Table-2 presents situation of customer relation in the studied hospitals through lens of their managers. As seen, in ranking transportation services based on on-time goods delivery, although its significance level is less than 0.05, value of t statistic is less than 1.96. so, one can say that in this component, the studied hospitals do not have a good situation. However, the value of t statistics in other components and customer relation index are more than 1.96 and they are significant at the significance level 0.05.

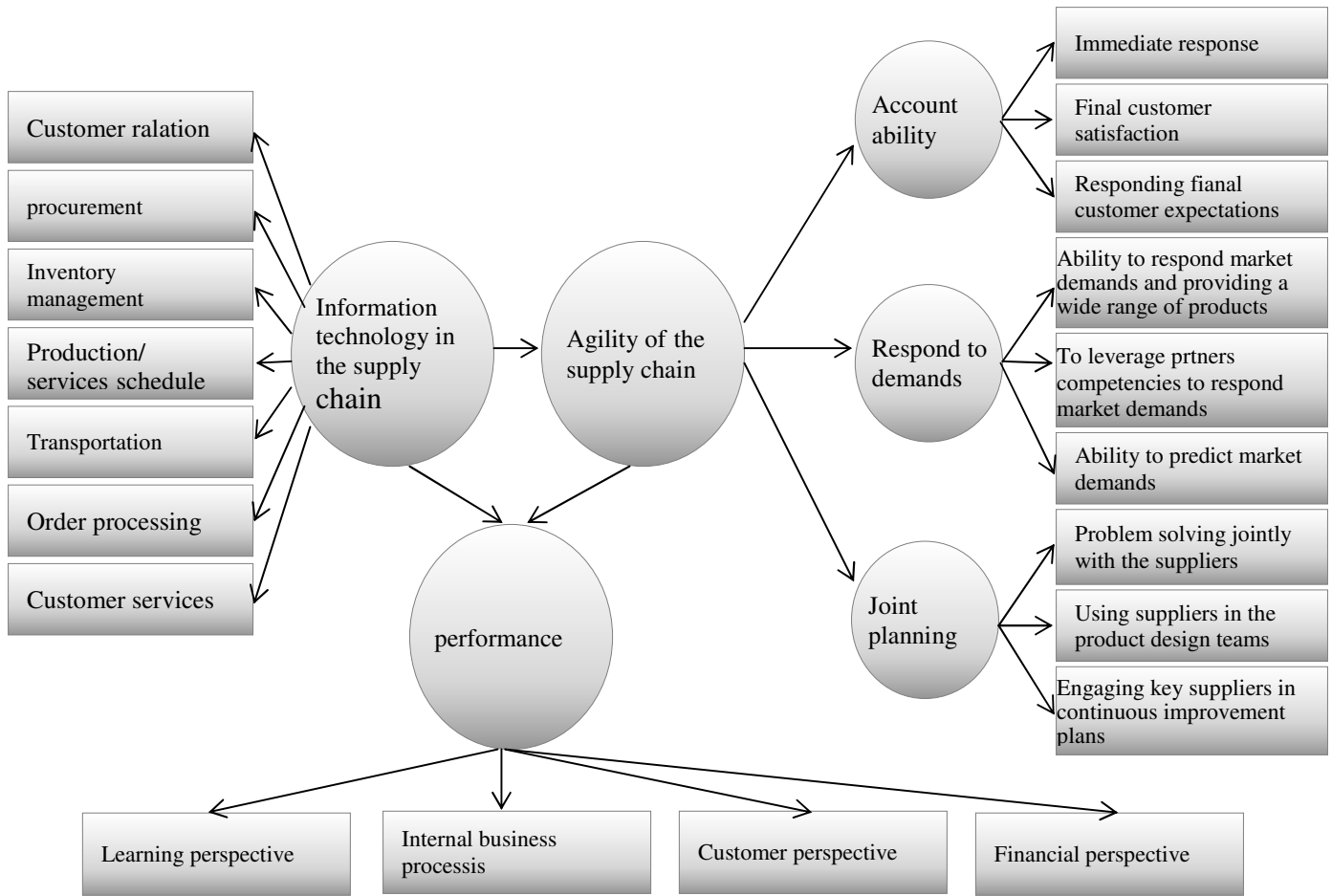


Figure-1
The research model

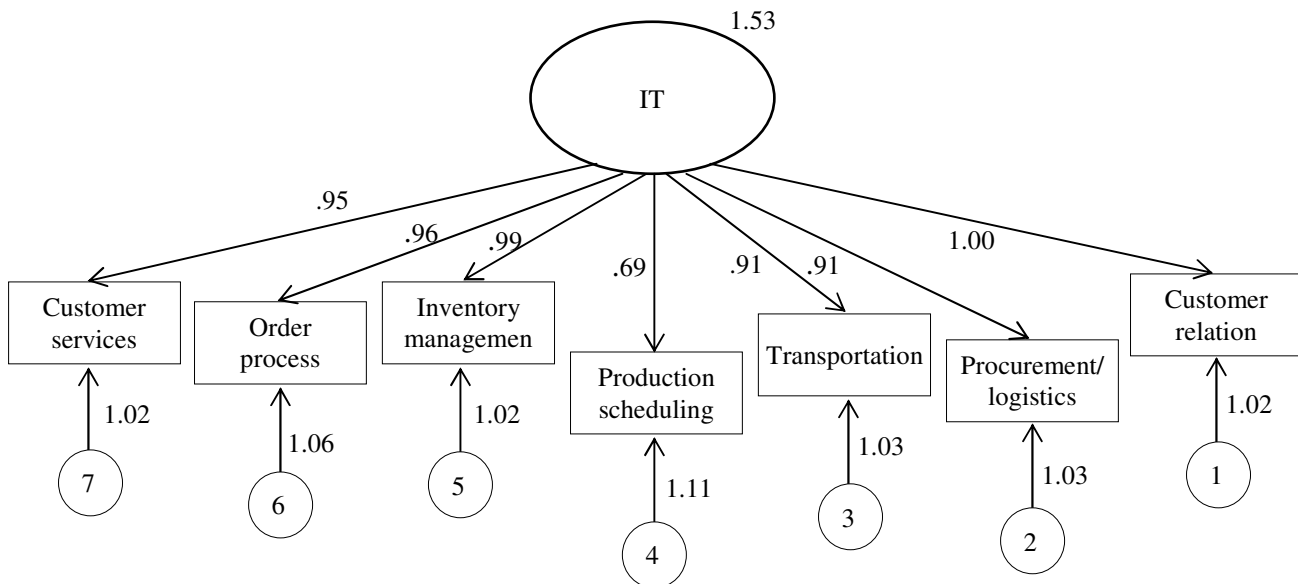


Figure-2
Dimensions and components of healthcare agile supply chain based on information technology

Table-1
Indices of goodness of fit of information and communication technology components model

PGFI	TLI	CFI	IFI	RFI	NFI	RMR	AGFI	GFI
0.699	0.867	0.911	0.912	0.863	0.909	0.610	0.797	0.799

Table-2
Situation of customer relation in the studied hospitals

Customer Relation	Degree of Freedom	Sig.	T statistic
Procurement	199	0.000	24.088
Inventory of raw materials in stock	199	0.000	6.284
Considering concerns related to suppliers	199	0.000	6.284
Ranking transportation services based on on-time goods delivery	199	0.000	-6.284
Providing suppliers information via questionnaire	199	0.000	10.924
Ranking suppliers based on overall performance	199	0.000	11.169
Products return due to defect	199	0.000	15.363
Customer relation index	199	.025	2.266

Procurement and logistics: Table-3 shows that the studied hospitals have a proper situation in the products return to the supplier, guaranteeing by the supplier, and in general, procurement and logistics through the lens of the respondents.

Table-3
Situation of procurement in the studied hospitals

Procurement	Degree of Freedom	Sig.	T statistic
Electronic relation with the supplier	199	.000	-20.936
Purchasing from online shop	199	.024	-2.270
Relation with the suppliers	199	.024	-2.270
Comparing offered bids by the suppliers	199	.050	-1.969
Return of imperfect products to the supplier	199	0.000	12.792
Guaranteeing by the suppliers	199	0.000	4.849
Procurement and logistics	199	.016	2.425

Inventory management: Table-4 shows that on-time delivery and useful inventory components do not have a proper situation in the studied hospitals; however, its t statistic and significance level indicate proper situation of inventory management dimension in the hospitals.

Table-4
Situation of inventory management in the studied hospitals

Inventory Management	Degree of Freedom	Sig.	T statistic
On-time delivery	199	.000	-5.234
Inventory of raw materials	199	.000	8.159
Necessary useful inventory	199	.024	-2.270
Inventory of final product	199	.000	5.860
Inventory management index	199	.035	2.123

Production / services scheduling: In table-5, the value of t statistic and significance level indicate that the situation of hospitals is not proper in terms of IT compatibility with retailers, consistency between production schedule and different sites in the country and consistency between production schedule and international sites.

Table-5
situation of production / services scheduling in the studied hospitals

Production / Services	Degree of Freedom	Sig.	T statistic
Consistency between production schedule and retailers	199	0.000	7.865
Consistency between production schedule and warehouse	199	0.000	9.657
IT compatibility with the retailers	199	.010	-2.612
Consistency between production schedule and different sites in the country	199	.001	-3.370
Consistency between production schedule and international sites	199	.006	-2.806
Production / services scheduling index	199	.000	10.167

Transportation: Table-6 shows that the studied hospitals have a proper situation in terms of transportation index and its components.

Orders processing: Table-7 presents orders processing index and its related components. As seen, the studied hospitals have a proper situation in terms of this index. However, it must be worked on some components such as studying general trend of customer orders or suggestions of customers and retailers.

Table-6
Situation of transportation in the studied hospitals

Transportation	Degree of Freedom	Sig.	T statistic
Regional distribution points	199	.024	2.270
Regional payment points	199	.111	1.602
Credits management	199	.046	2.009
Transportation index	199	.017	2.415

Table-7
Situation of orders processing in the studied hospitals

Orders Processing	Degree of Freedom	Sig.	T statistic
Situation of orders	199	.000	4.849
Customer credit check	199	.000	3.732
Supplier credit check	199	.000	10.580
Customer referrals by previous customers	199	.000	9.127
General trend of customer orders	199	.018	-2.384
Researching into suggestions of retailers	199	.000	-7.304
Researching into suggestions of customers	199	.000	-5.561
Orders processing index	199	.008	2.670

Customer services: Table-8 shows that the studied hospitals have a proper situation in terms of customer services and its components.

Table-8
Situation of customer service in the studied hospitals

Customer Service	Degree of Freedom	Sig.	T statistic
Receiving customer complaints	199	.000	5.132
Providing technical services	199	.000	4.481
Managing foreign service providers	199	.000	5.029
Customer service index	199	.057	1.918

Final model of the effects of IT-based supply chain on performance improvement: In this section, the research final model is fitted by using structural equations method. As seen, use of information technology has been effective on improving

performance of the studied hospitals through the lens of respondents. Figure-3 shows coefficients of each variable. The value of chi-square statistic of this model is 722.9 and its degree of freedom is 43.

Indices of goodness of fit of the final model presented in table 9 shows that the model has a good fitness.

Discussions: Organizations encounter challenges related to the innovation of new product, reduction of product life cycle, diversity of products and demanding customer in the markets. This has led to the increasing turbulence and instability of markets and has made companies to resort to supply chain management for progress and survival. Managers of supply chain must admit unreliability of the organizational environment and design strategies that enable them to create balance between demand and supply in the market. Agility of supply chain refers to the ability of managing turbulence and instability of organizational environment in order to fulfill customer needs by acceptable costs. Most organizations have concluded that increasing turbulence and instability have been converted into one of the ordinary features of today markets. Nowadays, parent companies have focused on creating and developing an agile supply chain so as to meet variable demands of customers by an acceptable cost.

Today, enterprises are in a global environment which has sophistication and uncertainty. This uncertainty has a deep effect on the company activities particularly its supply chain. On the other hand, various changes and intense competition of companies reflect necessity of acceleration of company operations and its flexibility more than ever. Agility of supply chain is among the most important factors in achieving agility for the whole company and may realize strategic goals of company in the competition world.

Conclusion

The present paper presented a supply chain agility model based on information and communication technology in the healthcare sector. First several components were provided by using Aliei model and literature review. The final model showed that all recognized seven dimensions are approved by the experts. Therefore, customer relation, inventory management, orders processing, and customer services were recognized as the most important dimensions of using information and communication technology. These results are consistent with Aliei findings to high extent. Then situation of the studied hospitals in terms of these dimensions and their components was investigated. It was revealed that the hospitals have a relatively proper situation in all dimensions. However, in each dimension, several components did not have a proper situation. So managers of these organizations must pay more attention to these components.

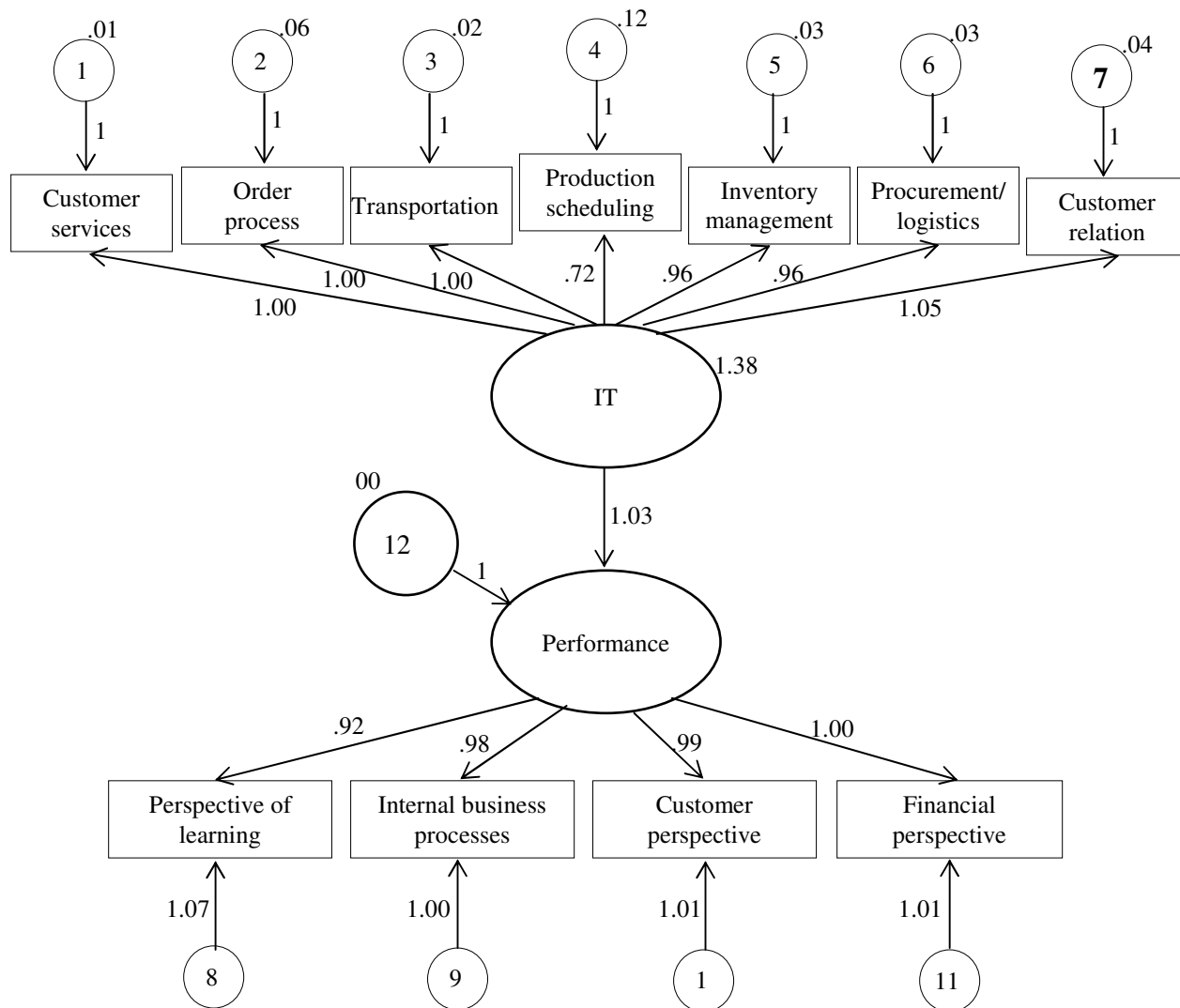


Figure-3
Final model of the effects of IT-based supply chain on performance improvement

Table-9
Indices of goodness of fit of the final model

PGFI	TLI	CFI	IFI	RFI	NFI	RMR	AGFI	GFI
0.379	0.891	0.914	0.915	0.884	0.910	0.009	0.359	0.582

Finally, the effects of IT-based supply chain on improving performance of the hospitals were studied and the research final model showed that all seven dimensions of IT-based supply chain are effective on four dimensions (learning perspective, internal business processes, customer perspective, and financial perspective) of performance in these organizations.

It was mentioned that agility which means rapid reaction with high flexibility and speed of processes particularly supply chain is a main factor for achieving a competitive advantage in the international trade. Our analysis shows that enterprises must

focus on key dimensions and components of agility of IT-based supply chain rather than mere implementation of agility theoretical issues.

The findings in this study are in accordance with Taghizadeh, Ershadi¹⁵, Aghaei et al¹⁶, Arockiasamy¹⁷, Mohammad et al¹⁸ and Nikhil et al¹⁹.

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