



AN INVESTIGATION INTO RESILIENCE STRATEGIES IN THE MEDICAL TOURISM SUPPLY CHAIN

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ABSTRACT

The present study has adopted a mixed method approach to investigate the risks occurring in the supply chain for Iranian medical tourism, and suggests resilience strategies for their prevention and improvements to the current situation. The participants were experts in the medical tourism supply chain chosen via purposive and snowball sampling. The results obtained via thematic analysis of interviews, as well as failure modes and effects analysis (FMEA) and failure analysis after occurrence (FAAO) techniques, led to identifying 75 risks which were classified into five major categories: supply, demand, internal, external and supply chain management risks. Additionally, a literature review and interview results revealed several resilience strategies categorized as pre-risk coping or post-risk recovery strategies for tackling the risks. Furthermore, the resilience number of the medical tourism supply chain increased from 0.4 (pre-risk occurrence) to 0.5 (post-risk occurrence). Implications and suggestions for future research are presented.

KEYWORDS

coping strategies, medical tourism supply chain, recovery strategies, supply chain resilience, supply chain risks

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1. INTRODUCTION

Tourism, which is defined as travelling outside one's place of residence for different purposes such as business or entertainment for at least one night (Bovy & Stern, 1990), has evolved and modernized remarkably over recent decades (Andrades & Dimanche, 2017; Liu et al., 2017). Tourism is currently considered as one of the top 10 industries in the world since it plays an

undeniably important role in generating considerable income and foreign exchange for governments (Burke, 2018; Ghaderi et al., 2018; Jones & Wynn, 2019; Okafor et al., 2022).

Medical tourism as an important type refers to travelling outside one's country to receive treatments which are not available in one's own (Habibi et al., 2022). As a growing global phenomenon and a significant branch of tourism, medical tourism has recently

attracted considerable attention by both academia and professionals (de la Hoz-Correa et al., 2018) due to several reasons including, but not limited to, destination appeal and culture (Campra et al., 2022), technological developments, increased waiting time for receiving medical treatments in developed countries, the low cost of medical services in developing countries, and international exchange rates (Gholami et al., 2020).

Tourism supply chains cover a wide range including restaurants, hotels and travel agencies which aim to efficiently fulfil tourists' expectations (Ahmadimanesh et al., 2019). Coordination among these is considered as a very valuable competitive advantage, therefore managing supply chains could help organize and coordinate their operations (Mandal & Saravanan, 2019). Previous studies have found many challenges in medical tourism supply chains including limitations relating to physical infrastructure (Vishnu et al., 2020) and medicine supply (Jaberidoost et al., 2013), the competence of the medical staff (Ahmadimanesh et al., 2019), environmental disasters (Lubowiecki-Vikuk et al., 2023), medical errors, patients' safety (Farrokhvar, 2013) and intellectual property (Vishnu & Regikumar, 2016). These challenges could cause serious problems for reducing expenses and promoting tourism sustainability, which can consequently cause risks and negatively affect the efficiency and competitive advantage of this business.

A considerable body of empirical research has focused on risk management in supply chains (e.g. Fan & Stevenson, 2018; Pfohl et al., 2011; Pournader et al., 2020; Rao & Goldsby, 2009). However, although risks in supply chains for medical tourism have negatively influenced the health system economy by neglecting infrastructure and natural resources, as well as reducing job opportunities, the number of foreign tourists and contribution to gross domestic product (GDP) (Doshmangir et al., 2018), they have received considerably less research attention vis-à-vis risks from other supply chains (e.g. production). Therefore, it is highly essential to take into account these risks and propose useful effective resilience strategies so as to improve the quality of health care (Bauer, 2017), generate more foreign exchange, create a better trade balance and promote medical tourism (Ramirez de Arellano, 2011).

Given the utmost importance of risks in the medical tourism supply chain, several studies have meticulously examined them and offered practical and constructive solutions. For example, some works have identified the major risks in the supply chains (e.g. Kumar et al., 2019; Silva et al., 2020). Another line of research has gone further by not only identifying the risks but also providing some general classifications (e.g. Elleuch et al., 2014; Vishwakarma et al., 2016). In addition, others have considered the risks and threats

and offered strategies and measures for controlling them (e.g. Tukamuhabwa Rwakira, 2015; Wang, 2018). A careful review of the literature indicates that few studies have proposed a detailed classification of the risks identified (e.g. Raja Sreedharan et al., 2019; Vishnu et al., 2020) and, to the best of our knowledge, empirical literature on efficient coping and recovery strategies is still in its infancy. Therefore, the present study focuses on the medical tourism supply chain in Iran, as a popular destination for medical purposes, and identifies the existing risks. The resilience strategies used by different components of the supply chain are also explored and other potentially useful strategies are suggested.

2. LITERATURE REVIEW

2.1. MEDICAL TOURISM

Medical tourism, which refers to national and international trips made for medical purposes (Büyüközkan et al., 2021), using regular tourism services (Loh, 2015), consists of two key parts, namely, tourism and medicine. The tourism part includes components such as hotels, travel agencies, transportation companies and airlines (Kaczmarek et al., 2021). The medical element includes components such as hospitals as well as medical, facilitator and insurance companies (Secundo et al., 2019). This type of tourism is a highly profitable, economic activity based on the integrated services of the medical and tourism sectors (Momeni et al., 2018) to provide health care with the best quality, lowest cost and minimum waiting time for patients (Nikraftar et al., 2016).

Recent research indicates that lack of attention to educating professional physicians, investing in medical infrastructure, building modern clinics and hospitals, providing advanced medical equipment, and monitoring medical regulations can result in serious risks to supply chains (Davoudi & Hasanabadi, 2020). In addition, risks could be created by global economic crises and terrorist attacks (Paraskevas & Arendell, 2007). These can in turn lead to a significant decrease in tourism demand and negatively influence businesses (Jiang et al., 2019), therefore, supply chains in medical tourism are very susceptible to a wide range of risks from different sources.

2.2. RESILIENCE IN SUPPLY CHAINS

Previous research has shown that risks can have destructive effects on supply chains (e.g. de Souza et al., 2019). Businesses can use resilience strategies to reduce the possibility of encountering risks and disruption as

well as how to overcome them, which may in turn help businesses return to a sustainable state (Hall et al., 2023; Senbeto & Hon, 2020). Resilience strategies help supply chains become more responsible and improve a situation when unexpected events are encountered. As Sharma et al. (2021) maintain these strategies require attention to be paid to coordination, crisis management techniques, constructive relationships among all stakeholders, a supportive network, identification of risks and opportunities, and effective interventions.

Resilience in a supply chain can be defined as its ability to prepare for and adapt to unexpected events as well as respond to and recover from disruptions by keeping operations at a desirable level while controlling structure and function (Ali et al., 2017). Depending on when supply chains take measures to deal with risks, resilience strategies could be classified as either coping or recovery (Hohenstein et al., 2015). Coping strategies are specific behavioral efforts for preventing, controlling, tolerating, reducing or minimizing unexpected, stressful events (Folkman & Lazarus, 1980). Accordingly, there are three categories of coping strategy: assertive coping, avoidance and adaptive coping, which could be used based on the condition of an organization (Webster et al., 2016). A significant body of research has shown that these strategies could help prevent the occurrence of disruptions (Meneghel et al., 2019).

After the occurrence of a risk, supply chains must be resilient and able to quickly turn around by using recovery strategies. More specifically, they can use their resources to respond to risks and disruptions as soon as they occur or take effective measures in the long run which could help them stabilize and return to a sustainable condition (Scholten et al., 2014). Recovery strategies include remanufacturing, repurposing, repairing, reconditioning, cannibalization, redesigning, refurbishing and recycling services and products (Thierry et al., 1995).

Given that risks can inflict irreversible damage to industries and supply chains (Ritchie & Jiang, 2019; Truong Quang & Hara, 2017), it is vital to identify them and propose effective coping and recovery strategies. A review of the literature indicates that little attention has been paid to risks and strategies in medical tourism. Hence, the present study aims to address this research gap by identifying the risks relating to the medical tourism supply chain in Iran and examining different coping and recovery strategies to deal with them. The risks in the supply chain have reduced the number of medical tourists in some time periods, and this can justify the significance of focusing on resilience strategies. The findings of the present study could be beneficial for Iran and possibly other countries by suggesting practical strategies for enhancing resilience.

The current study was guided by the following research questions (RQs) relating to the hospital in this study:

RQ₁: What are the risks in the medical tourism supply chain?

RQ₂: How could these risks be classified?

RQ₃: What coping strategies are used in the medical tourism supply chain?

RQ₄: What is the resilience number before the occurrence of the risks?

RQ₅: What recovery strategies are used in the medical tourism supply chain?

RQ₆: What is the resilience number after the occurrence of the risks?

3. METHODS

The statistical population of the present study is the supply chain for medical tourism in Iran. A total of 18 experts in this supply chain were selected through purposive and snowball sampling. The inclusion criteria were having either an academic degree in management or at least five years of experience in this field. Detailed information about the participants (e.g. gender, age, academic degree, organizational position and working area) can be found in Appendix A. In addition, since the customers are considered as an integral part of the supply chain, their opinions were also checked by referring to the results of surveys previously conducted by other participants (e.g. hospitals and medical equipment companies).

The current case study used a mixed-method approach since the medical tourism supply chain is multi-faceted, i.e. it has several different elements closely related to each other, and this approach will be suitable in providing more in-depth and comprehensive findings. More specifically, qualitative and quantitative data were collected using interviews and questionnaires, respectively. Following Ravansetan (2017), the study was conducted in seven major steps from March 2020 to September 2022.

Phase one: Identifying the risks

This phase was exploratory, interpretative and qualitative. Semi-structured interviews were conducted with the 18 participants to explore their views on the risks related to the medical tourism supply chain in Iran. Theoretical saturation was achieved when 15 experts had been interviewed, although followed by three more for further assurance. Each interview took about 45–60 minutes and was conducted in the participants' first language, i.e. Persian, to ensure understanding. First the data were transcribed, next the transcripts were meticulously

read several times, then the data were coded and recoded many times to ascertain higher-order codes from lower-order ones. Member checking was used to examine the validity of the results and, additionally, any discrepancies between the raters were resolved through discussion which led to an inter-rater reliability of 0.91.

Phase two: Prioritizing the risks

This phase was applied, positivistic and quantitative. Based on the interview results, 12 supply chain experts were chosen from the 18 who took part in the previous phase and was based on their academic degree, professional experience and familiarity with the concepts of risk and resilience. It should be noted that care was exercised to choose at least one expert from each part of the medical tourism supply chain. The experts responded to a five-point Likert scale questionnaire developed based on the interview results. The questionnaire comprised 75 items relating to the importance of the risks in terms of their probability of occurrence, severity and detection (Appendix B). Since the questionnaire was constructed based on experts' views, it was considered to have adequate construct validity. Cronbach's alpha coefficients for the three sub-scales ranged from 0.91 to 0.96. The data were then analyzed using failure modes and effects analysis (FMEA).

Phase three: Determining the strategies for coping with risks

This phase was similar to phase one, i.e. it was exploratory, interpretative and qualitative. After computing the risk priority number (RPN), 30% of the those with the highest RPN were chosen. The participants' views on the coping strategies extracted from the research literature were obtained, and their suggestions as to other useful strategies were added. The validity of the results was checked using member checking. Triangulation of sources (e.g. different experts) and methods (e.g. interviews, questionnaires and survey data) were used to investigate the reliability of the results. The transcribed data were carefully read many times to obtain different coping strategies.

Phase four: Calculating the resilience number before risk occurrence

This phase was similar to the second phase since it was applied, positivistic and quantitative. 12 experts responded to a five-point Likert scale researcher-designed questionnaire with 72 items by assigning coping strategies to resilience parameters (Appendix C). The questionnaire used in this phase was developed based on experts' opinions, thus it had sufficient construct validity. Cronbach's alpha coefficients for the different sub-scales ranged from 0.96 to 0.99.

The resilience number was calculated based on Carvalho Remigio's (2012) equation:

$$RI = \left(\frac{\sum_{i=1}^m S_i}{5N_i} \right) \times \left(\frac{\sum_{j=1}^n S_j}{5N_j} \right) \times \left(\frac{\sum_{z=1}^p S_z}{5N_z} \right)$$

where: RI – resilience index, S_i – scores of resilience strategies relating to probability of occurrence, S_j – scores of resilience strategies relating to severity, S_z – scores of resilience strategies relating to detection, N – number of resilience strategies, m – number of resilience strategies related to the probability of occurrence, n – number of resilience strategies related to severity, p – number of resilience strategies related to detection.

Phase five: Prioritizing the risks after their occurrence

In this phase, the identified risks after their occurrence were prioritized using a researcher-made questionnaire with 75 items (Appendix D). The participants were asked to assess their importance in terms of time, cost and quality of recovery on a five-point Likert scale. Given that the questionnaire was designed based on experts' views, it had sufficient construct validity. Cronbach's alpha coefficients for different sub-scales were 0.91–0.96 and the data were then analyzed using failure analysis after occurrence (FAAO).

Phase six: Determining the recovery strategies

The RPN was calculated. Then, 30% of the risks with the highest RPNs were selected, followed by a determination of relevant recovery strategies. The participants were asked whether they used the researchers' suggested strategies and/or any others. The interview responses were carefully listened to, transcribed and thematically analyzed, which led to extracting several recovery strategies.

Phase seven: Calculating the resilience number after risk occurrence

The experts assigned recovery strategies to one or more parameters (i.e. time, cost and quality of recovery) and rated them on a five-point Likert scale. The data collection instrument in this phase was a questionnaire (56 items) with adequate construct validity, with a design based on experts' views (Appendix E). Cronbach's alpha coefficients for the different sub-scales ranged from 0.97 to 0.98.

The resilience number was calculated based on Carvalho Remigio's (2012) equation:

$$RI = \left(\frac{\sum_{i=1}^m S_i}{5N_i} \right) \times \left(\frac{\sum_{j=1}^n S_j}{5N_j} \right) \times \left(\frac{\sum_{z=1}^p S_z}{5N_z} \right)$$

where: RI – resilience index, S_i – scores of resilience strategies relating to probability of occurrence, S_j – scores of resilience strategies relating to severity, S_z – scores of

resilience strategies relating to detection, N – number of resilience strategies, m – number of resilience strategies related to the probability of occurrence, n – number of resilience strategies related to severity, p – number of resilience strategies related to detection.

4. RESULTS

This section presents a summary of the results obtained from all phases of the study. Each sub-section is dedicated to one of the seven phases.

Table 1. Major categories and sub-categories of supply chain risks

| Major categories | Sub-categories | Codes |
|------------------|--|--|
| Supply | Supplier | 1. Problems related to working with suppliers |
| | | 2. Dependence on a limited number of suppliers |
| | | 3. Problems related to outsourcing |
| | | 4. Delays in supply |
| | | 5. Inadequate supply |
| | Medicine and medical equipment | 6. Drug compatibility |
| | | 7. Drug and equipment referral |
| | | 8. Differences in the quality of medical items |
| | | 9. Counterfeit medicine |
| | | 10. Drug supply |
| | | 11. Problems related to drug therapy |
| | | 12. Pharmaceutical recall |
| | | 13. Insufficient raw materials |
| Internal | Financial | 14. High taxes |
| | | 15. Accounting errors |
| | | 16. Errors in allocating budgets |
| | | 17. Receivable accounts |
| | | 18. Cash purchase |
| | Human resources | 19. Dependence on a particular employee |
| | | 20. Recruitment |
| | | 21. Violation of laws |
| | | 22. Inadequate human resources |
| | | 23. Inappropriate training |
| | | 24. Mistakes made |
| | | 25. Health and safety |
| | | 26. Dissatisfaction with human resources |
| | | 27. Delays by the logistics staff |
| | 28. Poor skills and inadequate knowledge | |
| | Pricing | 29. Fluctuations in exchange rates |
| | | 30. Pricing policies |
| | Marketing | 31. Ineffective marketing |
| | Organizational equipment | 32. Infrastructure |
| | | 33. Maintenance |
| | | 34. Equipment essential for production |

Table 1 (cont.)

| Major categories | Sub-categories | Codes |
|--|---------------------------------|---|
| Internal (cont.) | Providing services and products | 35. Services |
| | | 36. Differences in doctors' prescriptions |
| | | 37. Product development |
| | | 38. Intellectual property |
| | | 39. Insufficient scientific research |
| | | 40. Inadequate welfare facilities |
| | | 41. Suppliers' inability to adapt to competitive conditions |
| Demand | Customer | 42. Failing to identify customer needs |
| | | 43. High-risk patients |
| | | 44. Demanding customers |
| | | 45. Customers' ignorance about the service procedure |
| | Demand | 46. Random fluctuations in demand |
| | | 47. Adding to/changing one's needs |
| Supply chain management | Transportation | 49. Transport |
| | | Inventory |
| | 51. Inventory shortage | |
| | 52. Warehousing | |
| | Information technology | 53. Information technology |
| | | 54. Information system |
| | Coordination | 55. Lack of coordination between supply chain components |
| | | 56. Lack of coordination within the organization |
| | Strategic | 57. Partial perspective |
| | | 58. Process interference |
| | | 59. Decision making |
| External | Competitors | 60. Competitors |
| | | 61. Black market |
| | Social | 62. Negative news from the media |
| | | 63. Urban security |
| | Cultural | 64. Cultural differences |
| | | 65. Behavioral problems in the supply chain |
| | Political | 66. Problems in customs clearance |
| | | 67. Sanctions |
| | | 68. Terrorism |
| | | 69. Government policies |
| | Environmental | 70. Natural disasters |
| | | 71. Environmental issues |
| | Legal/regulatory | 72. Ineffective supervision |
| | | 73. Non-compliance with contracts |
| | | 74. Laws and regulations |
| 75. Poor coordination among regulatory organizations | | |

Source: authors.

Table 2. The risk priority numbers (RPNs) assigned to risks before their occurrence

| Codes | RPN | Codes | RPN | Codes | RPN |
|-------|-----|-------|-----|-------|-----|
| 44 | 125 | 35 | 40 | 8 | 24 |
| 43 | 80 | 68 | 40 | 3 | 24 |
| 29 | 80 | 46 | 36 | 26 | 24 |
| 17 | 80 | 45 | 36 | 62 | 24 |
| 1 | 64 | 71 | 36 | 75 | 24 |
| 13 | 64 | 27 | 36 | 74 | 24 |
| 72 | 60 | 6 | 36 | 63 | 24 |
| 33 | 60 | 14 | 36 | 21 | 24 |
| 10 | 60 | 24 | 36 | 48 | 24 |
| 30 | 60 | 34 | 36 | 38 | 24 |
| 66 | 60 | 64 | 36 | 32 | 24 |
| 67 | 60 | 41 | 32 | 9 | 20 |
| 23 | 60 | 16 | 30 | 65 | 18 |
| 58 | 60 | 55 | 30 | 12 | 18 |
| 70 | 50 | 11 | 30 | 31 | 18 |
| 73 | 48 | 40 | 27 | 50 | 16 |
| 36 | 48 | 39 | 27 | 2 | 15 |
| 21 | 48 | 53 | 27 | 56 | 15 |
| 20 | 45 | 59 | 27 | 51 | 12 |
| 25 | 45 | 60 | 27 | 15 | 12 |
| 49 | 45 | 47 | 27 | 52 | 12 |
| 4 | 45 | 42 | 27 | 7 | 10 |
| 54 | 40 | 57 | 27 | 19 | 9 |
| 69 | 40 | 61 | 27 | 18 | 8 |
| 28 | 40 | 5 | 24 | 37 | 6 |

Source: authors.

Coding the risks

To answer RQ₁ and RQ₂, the interview results related to phase one were thematically analyzed, resulting in 107 codes. After removing several overlapping codes, a total of 75 remained, which were classified into five major risk categories and 21 sub-categories (Table 1).

Failure modes and effects analysis (FMEA)

In the second phase, a panel of experts, including 12 from the medical tourism supply chain in Iran, completed the FMEA questionnaire to prioritize the identified risks before their occurrence. More specifically, they determined the 'occurrence probability', 'severity'

and 'detection' of the risks, and assigned numerical values to them. Accordingly, the RPN was computed by multiplying the numerical values assigned by the experts. Average RPNs were assigned to each risk based on their priority (Table 2).

Determining resilience strategies before risk occurrence (coping strategies)

In order to answer RQ₃, 30% of the FMEA outputs ($N = 22$) with the highest RPNs were selected for implementing corrective measures in the third phase. The expert panel identified pre-risk resilience strategies before risk occurrence (Table 3).

Table 3. Coping strategies

| Risks | Resilience strategies |
|---|---|
| 44. Demanding customers | 1. Designing VIP and private rooms for health tourists |
| | 2. Increasing flexibility in hotel services |
| | 3. Establishing a unit for respect |
| | 4. Assigning one particular host/hostess for each department |
| | 5. Providing communication facilities such as the internet, TV and Internet protocol television (IPTV) |
| 43. High-risk patients | 1. Obtaining informed consent before operations |
| | 2. Rejecting high-risk patients |
| | 3. Providing physical and mental health records |
| 29. Fluctuations in exchange rates | 1. Having alternative plans |
| | 2. Inexpensive workforce |
| 17. Receivable accounts | 1. Continuous management of resources and consumption |
| | 2. Using enterprise resource planning (ERP) software |
| | 3. Accepting cash for some services |
| 1. Problems related to working with suppliers | 1. Having alternative plans in case of problems with a supplier |
| | 2. Securing international contracts to claim damages |
| | 3. Considering additional suppliers |
| | 4. Using a 'black and white' list |
| 13. Insufficient raw materials | 1. Depot inventory |
| | 2. Tracking deficiencies |
| | 3. Securing appropriate agreement contracts |
| 72. Ineffective supervision | 1. Supervision of the treatment manager and supervisors |
| | 2. Paying attention to rules and regulations of the supervisory agencies |
| | 3. Auditing and online assessment of activities |
| 33. Maintenance | 1. Purchasing high-quality products with guarantees |
| | 2. Maintenance |
| 10. Drug supply | 1. Supplying products from the local market |
| | 2. Forming drug and treatment committees |
| | 3. Using similar products |
| 30. Pricing policies | 1. Setting prices in proportion to increasing costs |
| | 2. Providing services with different prices for various customer groups |
| 66. Problems in customs clearance | 1. Cooperating with the government for importing medical items |
| | 2. Selecting and working with companies specialized in import |
| | 3. Having a minimum number of documents for clearance |
| 67. Sanctions | 1. Cooperating with friendly countries |
| | 2. Promoting collaborations with the Board of Trustees in foreign exchange savings when treating patients |

| | |
|---|---|
| 23. Inappropriate training | 1. Knowledge management for equipping employees and increasing their awareness |
| | 2. Frequent and regular training |
| | 3. Assessing the effectiveness of training courses |
| | 4. Implementing PDP (Personnel development plan) system (ISO 1015) |
| 58. Process interference | 1. Promoting cooperation in the supply chain |
| | 2. Running workshops for managers |
| 70. Natural disasters | 1. Having alternative plans |
| | 2. Predicting epidemics, pandemics and nuclear threats |
| | 3. Depot inventory |
| | 4. Performing maneuvers for improving preparedness |
| 73. Non-compliance with contracts | 1. Securing appropriate agreement contracts |
| | 2. Promoting relations with suppliers |
| | 3. Receiving guarantees |
| | 4. Determining damages in case of non-fulfillment of obligations |
| 36. Differences in doctors' prescriptions | 1. Using the treatment protocols of the Health Ministry |
| | 2. Adapting the hospital medicine handbook with medical items approved by doctors |
| | 3. Organizing clinical committees in hospitals |
| 21. Inadequate human resources | 1. Redundancy in the workforce |
| | 2. Applying professional mobility for human resources |
| | 3. Having a succession plan |
| | 4. Establishing and maintaining relationships with universities and institutions and securing contracts |
| 20. Recruitment | 1. Recruiting workforce via exams |
| | 2. Running training and internship courses |
| 25. Health and safety | 1. Annual examination |
| | 2. Providing human resources with insurance |
| | 3. Developing a framework for examining current and future health conditions |
| | 4. Monitoring occupational risks (ISO 18000) |
| | 5. Using personal protective equipment |
| | 6. Providing a suitable place to relax |
| 4. Delays in supply | 1. Considering additional suppliers |
| | 2. Improving transportation conditions |
| | 3. Securing long-term and legal contracts |
| | 4. Promoting supply chain accountability |
| 49. Transport | 1. Insuring cargos and patients |
| | 2. Securing contracts with reliable and committed couriers |
| | 3. Careful and ongoing monitoring of transportation of cargo, equipment and patients |
| | 4. Using roofed vehicles and equipped |
| | 5. Assigning trucks by companies |

Source: authors.

Determining the resilience number before risk occurrence

For answering RQ_4 , the experts rated coping strategies and assigned them to resilience parameters in the fourth phase. The mode of the

experts' ratings was calculated and substituted in the equation of the resilience number. The resilience parameters at the pre-risk time include 'occurrence probability', 'severity' and 'detection' of the risks (Table 4).

Table 4. The modes of experts' rating of resilience strategies before risk occurrence

| Resilience parameters | Risk code, strategy No. | Score | Resilience parameters | Risk code, strategy No. | Score | |
|------------------------|-------------------------|-------|-----------------------|-------------------------|-------|---|
| Occurrence probability | 44-1 | 4 | Severity | 44-2 | 3 | |
| | 44-3 | 3 | | 43-1 | 5 | |
| | 44-4 | 4 | | 29-1 | 3 | |
| | 44-5 | 3 | | 29-2 | 4 | |
| | 43-2 | 5 | | 17-3 | 4 | |
| | 17-1 | 5 | | 1-1 | 4 | |
| | 17-2 | 4 | | 1-2 | 3 | |
| | 13-3 | 3 | | 1-3 | 5 | |
| | 72-1 | 4 | | 10-1 | 4 | |
| | 72-2 | 4 | | 10-2 | 4 | |
| | 72-3 | 4 | | 10-3 | 4 | |
| | 33-1 | 5 | | 30-1 | 4 | |
| | 33-2 | 4 | | 30-2 | 3 | |
| | 66-1 | 4 | | 67-1 | 5 | |
| | 66-2 | 5 | | 67-2 | 5 | |
| | 66-3 | 5 | | 70-2 | 5 | |
| | 23-1 | 4 | | 70-3 | 3 | |
| | 23-2 | 4 | | 70-4 | 4 | |
| | 23-4 | 4 | | 73-1 | 3 | |
| | 58-1 | 4 | | 73-3 | 4 | |
| | 58-2 | 4 | | 73-4 | 5 | |
| | 73-2 | 5 | | 36-3 | 4 | |
| | 36-1 | 5 | | 21-2 | 4 | |
| | 36-2 | 5 | | 25-2 | 5 | |
| | 21-1 | 5 | | 4-3 | 4 | |
| | 21-3 | 3 | | 4-4 | 4 | |
| | 21-4 | 3 | | 49-1 | 5 | |
| | 20-1 | 3 | | Detection | 43-3 | 5 |
| | 25-5 | 3 | | | 29-1 | 4 |
| | 25-6 | 3 | 1-4 | | 4 | |
| 4-2 | 4 | 13-2 | 3 | | | |
| 49-2 | 4 | 23-3 | 5 | | | |

| | | | | | |
|--------------------------------|------|------|-------------------|------|---|
| Occurrence probability (cont.) | 49-3 | 3 | Detection (cont.) | 23-4 | 4 |
| | 49-4 | 4 | | 20-2 | 4 |
| | 49-5 | 3 | | 25-1 | 4 |
| | | 25-3 | | 4 | |
| | | 25-4 | | 4 | |
| | | | | | |

Source: authors.

Carvalho Remigio's (2012) equation was used for calculating the resilience number:

$$RI = \left(\frac{\sum_{i=1}^m S_i}{5N_i} \right) \times \left(\frac{\sum_{j=1}^n S_j}{5N_j} \right) \times \left(\frac{\sum_{z=1}^p S_z}{5N_z} \right)$$

where: RI – resilience index, S_i – scores of resilience strategies relating to probability of occurrence, S_j – scores of resilience strategies relating to severity, S_z – scores of resilience strategies relating to detection, N – number of resilience strategies, m – number of resilience strategies related to the probability of occurrence, n – number of resilience strategies related to severity, p – number of resilience strategies related to detection.

The resilience number, which falls in the range of 0 to 1, was calculated based on experts' responses to

the questionnaire items. A value of 0 indicates that the organization is not resilient while a value of 1 shows its complete resilience. Therefore, 0–0.33 indicates poor resilience, 0.33–0.67 shows moderate resilience, and 0.67–1 indicates strong resilience. The amount of resilience for the medical tourism supply chain in Iran in the present study was computed as 0.4 before risk occurrence, which indicates the moderate resilience of its medical tourism supply chain.

Failure analysis after occurrence (FAAO)

In the fifth phase, similar to the second one, an expert panel performed FAAO by determining its main parameters, namely, time, cost and quality of recovery. Then, the effect coefficients were computed by multiplying the scores for time, cost and quality of recovery (Table 5).

Table 5. The effect coefficients assigned to risks after their occurrence

| Codes | Impact coefficient | Codes | Impact coefficient | Codes | Impact coefficient |
|-------|--------------------|-------|--------------------|-------|--------------------|
| 32 | 100 | 18 | 45 | 58 | 36 |
| 23 | 80 | 69 | 45 | 9 | 32 |
| 62 | 80 | 31 | 45 | 38 | 32 |
| 44 | 64 | 61 | 45 | 26 | 32 |
| 35 | 64 | 47 | 45 | 19 | 27 |
| 60 | 64 | 68 | 40 | 13 | 27 |
| 28 | 64 | 7 | 36 | 1 | 27 |
| 25 | 64 | 56 | 36 | 52 | 27 |
| 14 | 64 | 4 | 36 | 51 | 27 |
| 33 | 60 | 20 | 36 | 53 | 27 |
| 8 | 60 | 21 | 36 | 64 | 27 |
| 24 | 60 | 16 | 36 | 72 | 27 |
| 70 | 60 | 59 | 36 | 54 | 27 |
| 30 | 50 | 74 | 36 | 45 | 27 |
| 46 | 48 | 2 | 36 | 43 | 27 |
| 10 | 48 | 49 | 36 | 65 | 24 |
| 6 | 48 | 12 | 36 | 55 | 24 |
| 17 | 48 | 5 | 36 | 11 | 24 |

Table 5 (cont.)

| Codes | Impact coefficient | Codes | Impact coefficient | Codes | Impact coefficient |
|-------|--------------------|-------|--------------------|-------|--------------------|
| 3 | 48 | 37 | 36 | 39 | 24 |
| 29 | 48 | 34 | 36 | 50 | 24 |
| 73 | 48 | 27 | 36 | 21 | 24 |
| 36 | 48 | 57 | 36 | 63 | 24 |
| 67 | 48 | 48 | 36 | 42 | 24 |
| 71 | 45 | 41 | 36 | 15 | 20 |
| 40 | 45 | 66 | 36 | 75 | 18 |

Source: authors.

Determining resilience strategies after risk occurrence (recovery strategies)

In order to answer RQ₅, 30% of the risks ($N = 23$) with the highest effect coefficients were selected as FAAO

outputs for taking corrective measures in the sixth phase. The panel of experts then identified the resilience strategies after risk occurrence for medical tourism in Iran (Table 6).

Table 6. Recovery strategies

| Risks | Resilience strategies |
|--|--|
| 32. Infrastructure | 1. Using donors' support for expanding services and facilities |
| | 2. Getting loans and bank facilities |
| | 3. Reducing costs |
| | 4. Using field equipment |
| 23. Inappropriate training | 1. Improving the quality of training courses |
| | 2. Holding in-service training classes |
| 62. Negative news by media | 1. Transparency in sharing negative news |
| | 2. Sharing positive news relating to the subject |
| | 3. Establishing effective campaigns in cyberspace |
| 44. Demanding customers | 1. Increasing awareness of customers' wants by using survey forms |
| | 2. Improving responsiveness to customers' needs by using supporting services |
| 35. Services | 1. Detecting and solving problems |
| | 2. Holding weekly meetings with the patients' physicians |
| | 3. Providing patients with free and fast treatments |
| 60. Competitors | 1. Offering special suggestions to customers |
| | 2. Letting customers pay over an extended time period |
| | 3. Cooperating with competitors |
| 28. Poor skills and inadequate knowledge | 1. Running theoretical training courses |
| | 2. Organizing practical workshops |
| 25. Health and safety | 1. Using overtime to compensate for an injured worker |
| | 2. Using temporary workers |
| | 3. Training safety rules |
| 14. High taxes | 1. Obtaining tax exemptions |
| 33. Maintenance | 1. Detecting and solving problems |
| | 2. Postponing related services |
| | 3. Outsourcing services for a limited time |

| | |
|--|--|
| 24. Mistakes made | 1. Identifying and analyzing errors |
| | 2. Using warnings, reprimands and dismissals |
| | 3. Providing patients with free and fast treatments |
| 8. Differences in the quality of medical items | 1. Seeking feedback from customers, followed by mass production |
| | 2. Conducting initial tests and then using a drug |
| 70. Natural disasters | 1. Using supporting capacities |
| | 2. Establishing field hospitals |
| | 3. Forming crisis management teams |
| | 4. Postponing related services |
| | 5. Using other buildings (e.g. mosques and schools) |
| 30. Pricing policies | 1. Providing some services in cash |
| | 2. Offering profitable ancillary services |
| | 3. Providing complementary services |
| 46. Random fluctuations in demands | 1. Using supply management policies (e.g. flexible capacity and inventory) |
| | 2. Using demand management policies (commercial promotions and proportional pricing) |
| 10. Drug supply | 1. Using alternative drugs |
| | 2. Purchasing from the black market |
| 6. Drug compatibility | 1. Analyzing patients' conditions |
| | 2. Providing patients with free and immediate treatments |
| 17. Receivable accounts | 1. Using legal capacities |
| | 2. Not directly cooperating with hospitals and working with intermediaries |
| | 3. Managing financial resources to compensate for budget shortages |
| | 4. Barter |
| 3. Problems related to outsourcing | 1. Using legal capacities |
| | 2. Using supporting capacities |
| | 3. Securing flexible contracts |
| | 4. Using additional outsourcing |
| 29. Fluctuations in exchange rates | 1. Converting cash into properties |
| | 2. Planning for customers at different levels |
| | 3. Considering the average exchange rate and providing service packages |
| 73. Non-compliance with contracts | 1. Using legal capacities |
| | 2. Using supporting capacities |
| | 3. Working with supporting suppliers |
| 36. Differences in doctors' prescriptions | 1. Forming clinical committees in hospitals for analyzing prescriptions |
| 67. Sanctions | 1. Cooperating with friendly countries |
| | 2. Using cheaper foreign exchange provided by the government |

Source: authors.

Determining the resilience number after risk occurrence

To answer RQ₆, the resilience number was obtained for after risk occurrence based on the experts' rating of the strategies specified in FAAO in the

seventh phase. Finally, the mode of the scores was calculated and substituted in the equation for the resilience number. Resilience parameters after risk occurrence were cost, time and quality of recovery (Table 7).

Table 7. Scores of resilience strategies after risk occurrence

| Resilience parameters | Risk code, strategy No. | Score | Resilience parameters | Risk code, strategy No. | Score |
|-----------------------|-------------------------|-------|-----------------------|-------------------------|-------|
| Recovery quality | 32-1 | 5 | Recovery time | 23-2 | 4 |
| | 32-4 | 3 | | 62-3 | 5 |
| | 23-1 | 4 | | 44-1 | 5 |
| | 62-1 | 5 | | 35-1 | 4 |
| | 62-2 | 4 | | 35-2 | 4 |
| | 62-3 | 5 | | 35-3 | 4 |
| | 44-2 | 4 | | 25-2 | 4 |
| | 35-1 | 4 | | 70-1 | 4 |
| | 60-1 | 4 | | 10-1 | 5 |
| | 60-2 | 4 | | 17-2 | 3 |
| | 60-3 | 4 | | 17-4 | 4 |
| | 28-1 | 5 | | 3-3 | 3 |
| | 28-2 | 5 | | 73-3 | 4 |
| | 25-1 | 4 | | Recovery cost | 32-2 |
| | 33-3 | 5 | 32-3 | | 3 |
| | 24-1 | 5 | 25-3 | | 4 |
| | 70-2 | 4 | 14-1 | | 5 |
| | 70-3 | 5 | 24-2 | | 4 |
| | 70-4 | 4 | 8-1 | | 4 |
| | 46-1 | 4 | 8-2 | | 5 |
| | 46-2 | 4 | 70-5 | | 4 |
| | 10-2 | 3 | 30-1 | | 5 |
| | 6-1 | 4 | 30-2 | | 4 |
| | 17-3 | 4 | 30-3 | 4 | |
| 3-3 | 4 | 17-1 | 3 | | |
| 36-1 | 5 | 29-1 | 5 | | |
| 67-1 | 5 | 29-2 | 4 | | |
| 67-2 | 5 | 29-3 | 3 | | |

Source: authors.

The resilience number was calculated based on Carvalho Remigio's (2012) equation:

$$RI = \left(\frac{\sum_{i=1}^m S_i}{5N_i} \right) \times \left(\frac{\sum_{j=1}^n S_j}{5N_j} \right) \times \left(\frac{\sum_{z=1}^p S_z}{5N_z} \right)$$

where: RI – resilience index, S_i – scores of resilience strategies relating to probability of occurrence, S_j – scores of resilience strategies relating to severity, S_z – scores of

resilience strategies relating to detection, N – number of resilience strategies, m – number of resilience strategies related to the probability of occurrence, n – number of resilience strategies related to severity, p – number of resilience strategies related to detection.

The resilience number was computed as 0.5 after risk occurrence, which indicates the moderate resilience of the medical tourism supply chain in Iran after risk occurrence.

5. DISCUSSION

The present study aimed to investigate the risks occurring in the supply chain of Iranian medical tourism and suggest coping and recovery strategies for preventing their occurrence and improving the current situation. Regarding RQ_1 , the participants referred to 75 risks, 36 of which had not been addressed in past research. Some of the risks found in this study were also reported in previous studies: delay in supply (Jaberidoost et al., 2013; Silva et al., 2020), poor skills and inadequate knowledge (Benazzouz et al., 2018; Wasswa & Namulindwa, 2020) and natural disasters (Kumar et al., 2019; Raja Sreedharan et al., 2019). However, risks including, but not limited to, demanding customers, high-risk patients, customer unawareness, inability to adapt with competitive conditions, different qualities of medical items, lack of coordination among different components of the supply chain, and negative news on the media have been highlighted in the present study.

As for RQ_2 , the results showed that 75 risks were identified and classified in five major categories: supply, demand, internal, external and supply chain management risks. The proposed classification of risks in this study could be considered as comprehensive as it includes those which were not recognized in past research. For example, a recent study by Vishwakarma et al. (2016) categorized risks related to the health tourism supply chain in India into six groups: supply and supplier, strategic, logistics and network, government, and market and financial, while paying almost no attention to those concerning customers and their demands, human resources, environment, and medicine and medical equipment. Azizi Usefvand et al.'s (2017) study also failed to take into account external, internal, demand and supply chain management risks and only referred to those of supplier, producer, distributor and final customer.

Based on the findings, environmental risks, in comparison to others, had higher RPNs, which indicates their utmost importance in supply chains and this finding is in line with past studies highlighting their crucial importance (Wang et al., 2013; Zamora et al., 2013). The economic structure of developing countries like Iran is highly susceptible to undesirable environmental factors such as severe economic sanctions. Under such circumstances, businesses as well as factors relating to production and manufacturing are adversely affected. Hence, the efficient management of supply chain risks and sufficient support provided by governments can substantially promote the performance of private-sector companies which could consequently play a crucial role in the development and growth of those countries.

Regarding RQ_3 , the results yielded several key coping strategies such as having minimum necessary documents for clearance, creating support campaigns

in cyber space, providing some services in cash, offering special suggestions to customers and applying for tax exemptions. These were not found in past research. In line with previous studies (e.g. Lambaino, 2019; Tukamuhabwa Rwakira, 2015), other risks such as considering additional suppliers, depot inventory, redundancy in the workforce and knowledge management for equipping employees and increasing their awareness were also identified. Coping strategies are very effective as managers frequently encounter the undesirable impacts of uncertainties, risks and accidents in their supply chains. Therefore, significant measures in response to risks should be taken, i.e. they should have adequate resilience for reducing the risks and maintaining optimal performance before risk occurrence. A large number of the coping strategies found in this study were related to the categories of internal and supply risks, which were also reported by Tukamuhabwa et al. (2017). This finding indicates that these risks should be tightly controlled by businesses and prevented through reducing uncertainty. In addition, some coping strategies concerned environmental risks, i.e. those which cannot be controlled or prevented by supply chains. Therefore, it is essential to pay especial attention to the determining roles of policies, planning and the cooperation of governmental organizations.

As for RQ_4 , the results of calculations indicated that the resilience number for the medical tourism supply chain was 0.4 before risk occurrence which indicates the moderate resilience of the Iranian medical tourism supply chain. Quantifying resilience helps monitor the supply chain at specific time intervals and evaluates the effectiveness of resilience strategies. In addition, assigning a resilience number to the supply chain of medical tourism in Iran may facilitate its comparison with supply chains in other countries.

In response to RQ_5 , the participants referred to several different recovery strategies including using field equipment, establishing effective campaigns in cyberspace, obtaining tax exemptions and using a temporary workforce, which have not been reported in previous research. Additionally, they stated other strategies which existed in previous studies: cooperating with competitors (Tukamuhabwa et al., 2017), using supporting capacities (Carvalho et al., 2012), using supply management policies (e.g. flexible capacity and inventory), and using demand management policies (commercial promotions and proportional pricing) (Lambaino, 2019; Tukamuhabwa Rwakira, 2015). In this study, while most recovery strategies after risk occurrence were related to the categories of internal and demand risks, only a limited number concerned environmental risks. As environmental risks (e.g. those relating to politics and the economy) require national, comprehensive solutions, it is very important to take them into account, and this can help medical tourism

supply chains adapt to the existing conditions and mitigate their undesirable effects.

Regarding RQ_6 , the results of calculations showed that the resilience number of the Iranian medical tourism supply chain was moderate after risk occurrence ($RI = 0.5$). In fact, little attention has been paid to such risks as they require spending considerable time and a large budget to develop and use recovery strategies.

6. CONCLUSIONS

This study investigated the existing risks in the supply chain for Iranian medical tourism and suggested several coping and recovery strategies in order to prevent them and improve the current situation. A total of 75 risks along with their importance were identified. The findings indicated that resilience in the supply chain could be improved by examining how risks are created in organizations and could affect the behavior of the supply chain. Based on the findings, it is suggested that a risk management system be established to identify uncertainties which may directly or indirectly have resulted in their creation. In addition, significant measures could be taken to enhance patients' satisfaction with service quality. For example, surveys may be conducted to investigate and possibly accommodate patients' demands and preferences. Furthermore, the services provided to patients can be monitored on a regular basis to evaluate several factors such as service quality, average treatment time, patient recovery rate and customers' feedback.

Furthermore, using the coping and recovery strategies reported in this study can help prevent risks in the supply chain for medical tourism and play an important role in adapting to current conditions. These strategies could be useful for various components of the supply chain. For instance, suppliers can enhance resilience by ensuring efficient distribution, promoting inter- and intra-organization cooperation and managing inventories. Moreover, hospitals, as a major center for providing patients with medical services, can improve their infrastructure, manage receivable accounts, and increase the monitoring of their different parts, which may help enhance the resilience of the supply chain. Furthermore, regarding financial strategies, the government can provide subsidies for hospitals in both private and public sectors to decrease the costs of medical centers and suppliers, and this can encourage decision makers in supply chains to greater efficiency and enhance their income.

Given that tourists in medical tourism aim to find the best destination for receiving treatment services, it is highly recommended to consider the risks reported in this study and elsewhere (e.g. Jaberidoost et al., 2013;

Silva et al., 2020) and take significant measures to overcome them, and this can in turn increase the number of tourists. For example, regarding human resources, it is recommended to employ qualified staff by administering recruitment exams and carefully considering the applicants' résumés, which can significantly help employ more competent personnel. In this vein, different factors relating to applicants' behavior, personality and competence could be evaluated by using psychological tests. Further, it is suggested that supply chain managers make comprehensive plans for human resources, introduce current employees to new ones, and establish objective evaluation criteria.

Since some of the suggested strategies (e.g. improving cooperation, assigning trucks by companies) are not widely adopted in the supply chain, future research could investigate not only the challenges and barriers to implementing these strategies but also their potential benefits. In doing so, further research could assess the impact of the risks identified in this study on performance.

This study has some limitations. First, only some members of the medical tourism supply chain in Iran (i.e. five out of nine components: hospitals, pharmaceutical companies, medical equipment companies, hotels and international facilitator companies) were involved. Thus, it is suggested that future studies focus on a larger number, or possibly all, of the supply chain components to achieve a greater in-depth understanding in medical tourism. Second, given the utmost importance of environmental risks, it is recommended that further research pays more attention to these risks by examining their undesirable effects on the whole chain.

The data in this study were collected via semi-structured interviews and questionnaires. To build upon this, future research could use other data collection techniques such as observation, life history narratives and ethnography to gather more detailed information about the risks. Last but not the least, care should be taken in generalizing the findings since the current study was performed in Iran, a country with its own unique political, social and economic features.

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APPENDIX A. PARTICIPANTS' DEMOGRAPHIC FEATURES

| Participant No. | Gender | Age | Academic degree | Organizational position | Working area |
|-----------------|--------|-----|----------------------|------------------------------------|--|
| P ₁ | Male | 37 | PhD | Manager | Hospital |
| P ₂ | Male | 45 | General practitioner | Manager | Hospital |
| P ₃ | Female | 45 | BA | Manager | Hospital |
| P ₄ | Female | 40 | MA | Expert | Hospital |
| P ₅ | Male | 32 | PhD | Technical director of the pharmacy | Hospital |
| P ₆ | Female | 28 | BA | Expert | Hospital |
| P ₇ | Male | 40 | BA | Manager | Hotel |
| P ₈ | Male | 37 | BA | Managing director | International facilitator company |
| P ₉ | Male | 36 | BA | Managing director | Pharmaceutical and medical equipment company |
| P ₁₀ | Male | 34 | BA | Branch manager | Pharmaceutical and medical equipment company |
| P ₁₁ | Male | 37 | MA | Manager | Hospital |
| P ₁₂ | Male | 39 | MA | Supply chain manager | Pharmaceutical and medical equipment company |
| P ₁₃ | Male | 30 | BA | Sales manager | Pharmaceutical and medical equipment company |
| P ₁₄ | Male | 38 | MA | Managing director | Medical equipment company |
| P ₁₅ | Female | 26 | BA | Sales expert | Pharmaceutical and medical equipment company |
| P ₁₆ | Female | 43 | BA | Supervisor | Hospital |
| P ₁₇ | Female | 27 | BA | Nurse | Hospital |
| P ₁₈ | Male | 38 | MA | Managing director | Pharmaceutical and medical equipment company |

APPENDIX B. FMEA QUESTIONNAIRE

Dear participant,

Please kindly rate each risk in terms of its probability of occurrence, severity, and detection. Your answers will be completely confidential. Thank you very much for your beneficial cooperation.

| Very poor | Poor | Medium | Good | Very good |
|-----------|------|--------|------|-----------|
| 1 | 2 | 3 | 4 | 5 |

| Concept | Probability of occurrence | Severity | Detection |
|--------------------------------|---------------------------|----------|-----------|
| Demanding customers | | | |
| High-risk patients | | | |
| Fluctuations in exchange rates | | | |

| Concept | Probability of occurrence | Severity | Detection |
|---|---------------------------|----------|-----------|
| Receivable accounts | | | |
| Problems related to working with suppliers | | | |
| Insufficient raw materials | | | |
| Ineffective supervision | | | |
| Maintenance | | | |
| Drug supply | | | |
| Pricing policies | | | |
| Problems in customs clearance | | | |
| Sanctions | | | |
| Inappropriate training of human resources | | | |
| Process interference | | | |
| Natural disasters | | | |
| Non-compliance with contracts | | | |
| Differences in doctors' prescriptions | | | |
| Inadequate human resources | | | |
| Recruitment of human resources | | | |
| Health and safety of human resources | | | |
| Transport | | | |
| Delays in supply | | | |
| Information system | | | |
| Government policies | | | |
| Poor skills and inadequate knowledge of human resources | | | |
| Services | | | |
| Terrorism | | | |
| Random fluctuations in demands | | | |
| Customers' ignorance about the services procedure | | | |
| Environmental issues | | | |
| Delays by the logistics staff | | | |
| Drug compatibility | | | |
| High taxes | | | |
| Mistakes made by human resources | | | |
| The essential equipment for production | | | |
| Cultural differences | | | |
| Suppliers' inability for adapting to competitive conditions | | | |
| Errors in allocating budget | | | |
| Lack of coordination between supply chain members | | | |
| Problems related to drug therapy | | | |

| Concept | Probability of occurrence | Severity | Detection |
|--|---------------------------|----------|-----------|
| Inadequate welfare facilities | | | |
| Insufficient scientific research | | | |
| Information technology | | | |
| Decision making | | | |
| Competitors | | | |
| Adding to/changing one's needs | | | |
| Failing to identify customers' needs | | | |
| Partial perspective | | | |
| Black market | | | |
| Inadequate supply | | | |
| Differences in the quality of medical items | | | |
| Problems related to outsourcing | | | |
| Dissatisfaction of human resources | | | |
| Negative news by media | | | |
| Poor coordination among regulatory organizations | | | |
| Laws and regulations | | | |
| Urban security | | | |
| Violation of laws by human resources | | | |
| Seasonal demand | | | |
| Intellectual property | | | |
| Infrastructure | | | |
| Counterfeit medicine | | | |
| Behavioral problems in the supply chain | | | |
| Pharmaceutical recall | | | |
| Ineffective marketing | | | |
| Inventory corruption | | | |
| Dependence on a limited number of suppliers | | | |
| Lack of coordination within the organization | | | |
| Inventory shortage | | | |
| Accounting errors | | | |
| Warehousing | | | |
| Drug and equipment referral | | | |
| Dependence on a particular employee | | | |
| Cash purchase | | | |
| Product development | | | |

APPENDIX C. RESILIENCE NUMBER QUESTIONNAIRE

Dear participant,

Please kindly rate each risk in terms of its probability of occurrence, severity, and detection. Your answers will be completely confidential. Thank you very much for your beneficial cooperation.

| Very poor | Poor | Medium | Good | Very good |
|-----------|------|--------|------|-----------|
| 1 | 2 | 3 | 4 | 5 |

| Resilience parameters | Resilience strategy | | | | | |
|---------------------------|--|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Probability of occurrence | Designing VIP and private rooms for health tourists | | | | | |
| | Establishing a unit for respect | | | | | |
| | Assigning one particular host/hostess for each department | | | | | |
| | Providing communication facilities such as the Internet, TV, and IPTV | | | | | |
| | Rejecting high-risk patients | | | | | |
| | Continuous management of resources and consumptions | | | | | |
| | Using enterprise resource planning (ERP) software | | | | | |
| | Securing appropriate agreement contracts | | | | | |
| | Supervision of the treatment manager and supervisors | | | | | |
| | Paying attention to rules and regulations of the supervisory agencies | | | | | |
| | Auditing and online assessing of activities | | | | | |
| | Knowledge management for equipping employees and increasing their awareness | | | | | |
| | Frequent and regular training | | | | | |
| | Implementing PDP system (ISO 1015) | | | | | |
| | Having a minimum number of documents for clearance | | | | | |
| | Selecting and working with companies specialized in import | | | | | |
| | Cooperating with government for importing medical items | | | | | |
| | Purchasing high-quality products with guarantee | | | | | |
| | Maintenance | | | | | |
| | Promoting cooperation in the supply chain | | | | | |
| | Running workshops for managers | | | | | |
| | Promoting relations with suppliers | | | | | |
| | Using treatment protocols of the Health Ministry | | | | | |
| | Adapting the hospital medicine handbook with medical items approved by doctors | | | | | |
| | Having a succession plan | | | | | |
| | Redundancy in workforce | | | | | |
| | Establishing and maintaining relationships with universities and institutions and securing contracts | | | | | |
| | Recruiting workforce via exams | | | | | |
| | Using personal protective equipment | | | | | |
| | Providing a suitable place for human resources to relax | | | | | |

| Resilience parameters | Resilience strategy | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Probability of occurrence | Securing contracts with reliable and committed couriers | | | | | |
| | Using roofed vehicles and equipped | | | | | |
| | Assigning trucks by companies | | | | | |
| | Improving transportation conditions | | | | | |
| | Careful and ongoing monitoring of transportation of cargo, equipment, and patients | | | | | |
| Risk intensity | Increasing flexibility in hoteling services | | | | | |
| | Obtaining informed consent before operation | | | | | |
| | Having alternative plans | | | | | |
| | Inexpensive workforce | | | | | |
| | Accepting cash for some services | | | | | |
| | Having alternative plans in case of problems with the supplier | | | | | |
| | Securing international contracts to claim damages | | | | | |
| | Considering additional suppliers | | | | | |
| | Depoting inventory | | | | | |
| | Securing appropriate agreement contracts | | | | | |
| | Supplying products from the local market | | | | | |
| | Using similar products | | | | | |
| | Forming drug and treatment committees | | | | | |
| | Providing services with different prices for various customer groups | | | | | |
| | Setting prices in proportion to increasing costs | | | | | |
| | Promoting collaborations with the Board of Trustees in Foreign Exchange Savings to Treat Patients | | | | | |
| | Cooperating with friendly countries | | | | | |
| | Predicting epidemics, pandemics, and nuclear threats | | | | | |
| | Performing maneuvers for improving preparedness | | | | | |
| | Receiving guarantees | | | | | |
| | Determining damages in case of non-fulfillment of obligations | | | | | |
| | Organizing clinical committees in hospitals | | | | | |
| | Applying professional mobility for human sources | | | | | |
| | Providing human resources with insurance | | | | | |
| | Insuring cargos and patients | | | | | |
| Securing long-term and legal contracts | | | | | | |
| Promoting the supply chain accountability | | | | | | |
| Recognition power | Providing physical and mental health records | | | | | |
| | Having alternative plans | | | | | |
| | Using a black and white list | | | | | |
| | Tracking deficiencies | | | | | |
| | Assessing the effectiveness of training courses | | | | | |

| Resilience parameters | Resilience strategy | 1 | 2 | 3 | 4 | 5 |
|---------------------------|--|---|---|---|---|---|
| Recognition power (cont.) | Implementing PDP system (ISO 1015) | | | | | |
| | Running training and internship courses | | | | | |
| | Annual examination of human resources | | | | | |
| | Developing a framework for examining the current and future health conditions of human resources | | | | | |
| | Monitoring occupational risks (ISO 18000) | | | | | |

Source: authors.

APPENDIX D. FAAO QUESTIONNAIRE

Dear participant,

Please kindly rate each risk in terms of its time, cost, and quality of recovery. Your answers will be completely confidential. Thank you very much for your beneficial cooperation.

| Very poor | Poor | Medium | Good | Very good |
|-----------|------|--------|------|-----------|
| 1 | 2 | 3 | 4 | 5 |

| Concept | Time of recovery | Cost of recovery | Quality of recovery |
|---|------------------|------------------|---------------------|
| Infrastructure | | | |
| Inappropriate training of human resources | | | |
| Negative news by media | | | |
| Demanding customers | | | |
| Services | | | |
| Competitors | | | |
| Poor skills and inadequate knowledge of human resources | | | |
| Health and safety of human resources | | | |
| High taxes | | | |
| Maintenance | | | |
| Differences in the quality of medical items | | | |
| Mistakes made by human resources | | | |
| Natural disasters | | | |
| Pricing policies | | | |
| Random fluctuations in demands | | | |
| Drug supply | | | |
| Drug compatibility | | | |
| Receivable accounts | | | |
| Problems related to outsourcing | | | |
| Fluctuations in exchange rates | | | |

| Concept | Time of recovery | Cost of recovery | Quality of recovery |
|---|------------------|------------------|---------------------|
| Non-compliance with contracts | | | |
| Differences in doctors' prescriptions | | | |
| Sanctions | | | |
| Environmental issues | | | |
| Inadequate welfare facilities | | | |
| Cash purchase | | | |
| Government policies | | | |
| Ineffective marketing | | | |
| Black market | | | |
| Adding to/changing one's needs | | | |
| Terrorism | | | |
| Drug and equipment referral | | | |
| Lack of coordination within the organization | | | |
| Delays in supply | | | |
| Recruitment of human resources | | | |
| Inadequate human resources | | | |
| Errors in allocating budget | | | |
| Decision making | | | |
| Laws and regulations | | | |
| Dependence on a limited number of suppliers | | | |
| Transport | | | |
| Pharmaceutical recall | | | |
| Inadequate supply | | | |
| Product development | | | |
| The essential equipment for production | | | |
| Delays by the logistics staff | | | |
| Partial perspective | | | |
| Seasonal demand | | | |
| Suppliers' inability for adapting to competitive conditions | | | |
| Problems in customs clearance | | | |
| Process interference | | | |
| Counterfeit medicine | | | |
| Intellectual property | | | |
| Dissatisfaction of human resources | | | |
| Dependence on a particular employee | | | |
| Insufficient raw materials | | | |
| Problems related to working with suppliers | | | |
| Warehousing | | | |

| Concept | Time of recovery | Cost of recovery | Quality of recovery |
|---|------------------|------------------|---------------------|
| Inventory shortage | | | |
| Information technology | | | |
| Cultural differences | | | |
| Ineffective supervision | | | |
| Information system | | | |
| Customers' ignorance about the services procedure | | | |
| High-risk patients | | | |
| Behavioral problems in the supply chain | | | |
| Lack of coordination between supply chain members | | | |
| Problems related to drug therapy | | | |
| Insufficient scientific research | | | |
| Inventory corruption | | | |
| Violation of laws by human resources | | | |
| Urban security | | | |
| Failing to identify customers' needs | | | |
| Accounting errors | | | |
| Poor coordination among regulatory organizations | | | |

APPENDIX E. RESILIENCE NUMBER QUESTIONNAIRE

Dear participant,

Please kindly rate each strategy in terms of its appropriateness and effectiveness. Your answers will be completely confidential. Thank you very much for your beneficial cooperation.

| Very poor | Poor | Medium | Good | Very good |
|-----------|------|--------|------|-----------|
| 1 | 2 | 3 | 4 | 5 |

| Resilience parameters | Resilience strategy | 1 | 2 | 3 | 4 | 5 |
|-----------------------|---|---|---|---|---|---|
| Recovery time | Holding in-service training classes | | | | | |
| | Establishing effective campaigns in cyberspace | | | | | |
| | Increasing awareness about customers' wants by using survey forms | | | | | |
| | Detecting and solving problems | | | | | |
| | Providing patients with free and immediate treatments | | | | | |
| | Holding weekly meetings with the patients' physicians | | | | | |
| | Using temporary workforce | | | | | |
| | Using supporting capacities | | | | | |

| Resilience parameters | Resilience strategy | 1 | 2 | 3 | 4 | 5 |
|-----------------------|---|---|---|---|---|---|
| Recovery time | Using alternative drugs | | | | | |
| | Not directly cooperating with hospitals and working with intermediaries | | | | | |
| | Barter | | | | | |
| | Using additional outsourcing | | | | | |
| | Working with supporting suppliers | | | | | |
| Recovery cost | Getting loans and bank facilities | | | | | |
| | Reducing costs | | | | | |
| | Training safety rules | | | | | |
| | Obtaining tax exemptions | | | | | |
| | Using warnings, reprimands, and dismissals | | | | | |
| | Seeking feedback from customers, followed by mass production | | | | | |
| | Conducting initial tests and then using the drug | | | | | |
| | Using other buildings (e.g., mosques and schools) | | | | | |
| | Providing some services in cash | | | | | |
| | Offering profitable ancillary services | | | | | |
| | Providing complementary services | | | | | |
| | Using legal capacities | | | | | |
| | Converting cash into properties | | | | | |
| | Planning for customers at different levels | | | | | |
| | Considering the average exchange rate and providing service packages | | | | | |
| Recovery quality | Using donors' support for expanding services and facilities | | | | | |
| | Using field equipment | | | | | |
| | Improving the quality of training courses | | | | | |
| | Transparency in sharing negative news | | | | | |
| | Sharing positive news relating to the subject | | | | | |
| | Establishing effective campaigns in cyberspace | | | | | |
| | Improving responsiveness to customers' needs by using supporting services | | | | | |
| | Detecting and solving problems | | | | | |
| | Offering special suggestions to customers | | | | | |
| | Letting customers pay over an extended time period | | | | | |
| | Cooperating with competitors | | | | | |
| | Running theoretical training courses | | | | | |
| | Organizing practical workshops | | | | | |
| | Using overtime to compensate for the injured workforce | | | | | |
| | Postponing the related services | | | | | |
| | Outsourcing services for a limited time | | | | | |
| | Identifying and analyzing errors | | | | | |
| | Forming crisis management teams | | | | | |

| Resilience parameters | Resilience strategy | 1 | 2 | 3 | 4 | 5 |
|--------------------------|---|---|---|---|---|---|
| Recovery quality (cont.) | Establishing field hospitals | | | | | |
| | Using demand management policies (e.g., flexible capacity and inventory) | | | | | |
| | Using demand management policies (commercial promotions and proportional pricing) | | | | | |
| | Purchasing from the black market | | | | | |
| | Analyzing patients' conditions | | | | | |
| | Managing financial resources to compensate for budget shortages | | | | | |
| | Securing flexible contracts | | | | | |
| | Cooperating with friendly countries | | | | | |
| | Using cheaper foreign exchange provided by the government | | | | | |
| | Forming clinical committees in hospitals for analyzing prescriptions | | | | | |