© Ashurova Z. Governance mechanisms of medical tourism e-services: resilient networking // Ukrainian Scientific Journal of Information Security, 2020, vol. 26, issue 1, pp. 50-56.

DOI: 10.18372/2225-5036.26.14670

GOVERNANCE MECHANISMS OF MEDICAL TOURISM E-SERVICES: RESILIENT NETWORKING

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Abstract. *Medical tourism is one of the rapidly growing sectors and has a huge economic potential for the Korean economy through the expansion of the Korean medical tourism service (MTS) network for the Commonwealth of Independent Countries (CIS) region. Previous explorations are focusing on specific areas of medical tourism. A few academic studies devoted to the governance aspects of this complex sector. The paper suggests a modeling framework for investigating the governance process in the field of MTS delivery to make it efficient and resilient. The purpose of this study is to analyze the domestic and foreign factors impacting Korean medical tourism service delivery governance and how this medical service delivery (supply side) matches to CIS tourists demand. What are the gaps in the delivery of Korean MTS for CIS and how to reduce these gaps through enhancing the Governance process and making it robust including e-governance mechanisms interactions with social networks? Most facilities of technological infrastructures are proprietary of government, or private sector and according to combined network approach might be stratified into diverse layers on pertinent beds while connected to other systems of the same or different field. Research and practical benefits of the study are also obvious: gaining insight into the properties and processes of the real governing systems and pertinent security issues. As a plus, this model approach proved the valuable fact that in contrast to small social networks, those of large scale generally exhibit good expansibility with inherited topological vulnerabilities. This property might be a platform to establish strong cooperation, promote the delivery of services through national borders, and provide pertinent safety and security. Moreover, all interdisciplinary challenges intuitively utilize and enhance medical tourism network extension. In particular, there is insufficient research on the enhancing governance process in the medical tourism delivery as well as the limitation of employing Comprehensive Network Analysis (CNA) to assess the medical Tourism governance mechanisms and their resilience.*

Keywords: *Medical tourism, efficiency, resilience, Comprehensive mega-network, stem network, e-service.*

Introduction

Recently the Republic of Korea became one of the most desired medical tourism destinations for CIS countries due to the provision of high-quality medical services, advanced technology, well-trained professional staff, and convenient infrastructure. Expansion and improvement of medical services delivery attract CIS tourists, mostly from Russia, Kazakhstan, and Uzbekistan. Korean Medical tourism industry supported by the government has a good capacity for fast growth in the nearest future. Medical tourism (MT) is considered as traveling to a different country to improve health conditions and use the destination's infrastructure, attractions, and facilities [1]. Nowadays Medical Tourism is one of the rapidly growing sectors and has huge economic potential for the Korean economy through the proliferation of the Korean medical tourism service (MTS) network for the CIS region. Previous explorations are focusing narrowly on areas such as economic, medical, marketing, and other aspects of medical tourism. Being a convergent activity Medical tourism comprising at least two economic sectors: tourism and medicine. A few academic studies devoted to governance aspects of this complex issue.

The governance process is improved efficiently due to using contemporary ICT empowered by intelligent systems and data mining methods. As medical tourism requires a larger volume of data and more accurate and immediate communication than other forms of tourism, the importance of ICT to improve service quality is predicted to grow. ICT services are enhancing tourism and

medical services. ICT services comprise artificial intelligence, cloud data, linked data, social networks, IoT, and mobile applications impacted significantly on smart tourism [1,2]. Smart technologies enable us to search and obtain tour-related information on the web and social media [3,4]. Today Medical tourism e-services offer different types procedures as Web (interactive sites) services, One-stop service (mostly provided by official institutions), SNS (social networks, blogs, business pages, e-forums), Media platforms, E-payment, E-booking, E-logistics, E-visa, Applications, Telemedicine (teleconsultation), Real-time information sources (transportation timetable, temperature, etc.), Virtual tours, SMS alerts with highlights, Radio/TV broadcasting.

The expanding role of ICT and Technology influence on the development of Medical Tourism, enlarging capabilities of providing services to millions of foreigners timely, effectively. Thus, it requires the improvement of smart governance mechanisms for the e-Medical tourism service.

There are a lot of governance peculiarities related to the convergence of smart tourism and health care industries. The delivering mechanisms and facilities of technological infrastructures are proprietary of federal, regional, local governments. In this respect a review of the current governance and medical tourism literature was made and observed an absence of a comprehensive methodological framework for the analysis of the governance of medical tourism service delivery (MTSD). The subject has a networked nature and required thorough coordination of many actors and therefore the networked approach. This study aims to fill up this gap by suggesting and engineering a comprehensive mega-network modeling framework for investigating the medical tourism service delivery governance process. The framework is focusing on enhancing coordination of the organizational structure mechanisms of the demand and supply sides to establish robust interaction and deliver pertinent medical tourism services. The study has implications for future research and provides valuable information for practitioners in the medical tourism sector.

Research Results

This study suggesting a comprehensive mega-network is a modeling framework for investigating the governance process in the field of medical tourism service delivery. This approach portrays cross-sectoral and multi-level governance processes of medical tourism services. Within the framework of the CMN concept it is necessary to analyze and engineer organizational mechanisms for delivery of medical tourism services and comprehensive methods and models. MTSDG is a pretty complicated system that needs a special thorough approach for its analysis. Network theory can be an efficient instrument to analyze such a multi-actor subject [5] (Fig.1).

Good network models are extremely important for studies of real complex systems. Such models should be easy enough for implementation and have a limited number of metrics while demonstrating the common properties of real systems. Moreover, models are having to be developed to check schemes, algorithms, and topologies designed for massive networks. In addition, research and practical benefits are also obvious: gaining insight into the properties and processes of the real governing systems. This model approach was applied to explore one of the biggest Social network "VK" [6]. One of the valuable facts is that in contrast to small social networks, large scale social graphs generally exhibit good expansibility. The latter property might be a platform to establish robust cooperation, promote the delivery of services through national borders. Moreover, all cross-disciplinary challenges intuitively utilize and enforce medical tourism network expansion [7]. The phases of the process of governance in the delivery process of medical tourism services:

1. Analysis of demand and supply in MTS:
   – Analyses/ needs and related problems. (demand country).
   – Analyses/ needs and related problems (Supply country).
   – Comparison of demand and supply and decision making.
2. Preparation of action programs/projects.
3. Implementation of program.
4. Post rehabilitation assessment.

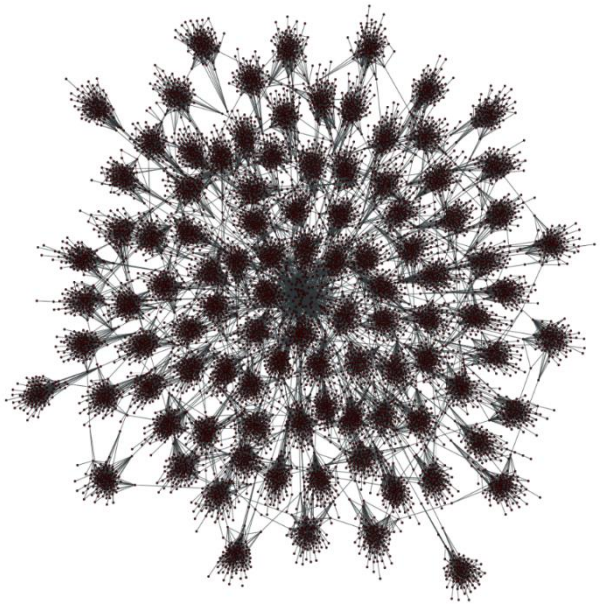

Fig. 1. Aggregate complex network as a model of large-scale systems [5]

In this model different governance mechanisms (CIS and Korea) are described. The possible matching mechanisms of their demand and supply of MT services delivering in Korean hospitals and also the connection of main actors with patients from CIS during the medical service delivery process are shown. The Korean stakeholders' interaction during the MTS governance process can be reflected in Table 1.

Table 1

The Korean stakeholders' interaction during the MTS governance process

Phases of governance process for MTS Delivery (ROK) Governance Organizational structures	Analyses of demand and supply									
	I				II		III	IV	V	VI
	1	2	3	4	5	6	7	8	9	10
Public sector: - Ministry of healthcare and Welfare - Korea Tourism organization - Korea Health Industry Development Institute - Regional MT institutions (Medicity Daegu, etc.)										
Private sector: - Hospitals (Severance, Asan Medical Center, etc.) - Facilitators (AscleIntermed, EBOOKERS KOREA INC., etc.)										
Social sector NGO(Samdong International, etc.) SNS										

A detailed procedure composing interaction of actors from public and non-public sectors [8]

1 phase Analysis and selection process (I, II, III).

I. Analysis and selection process (in CIS country)

1. Analyses/ needs and related problems.

(1. Analyses/ needs and related problems, DD (domestic demand covered domestically) + DF (demand covered by foreign countries). 2. Selection of the country (CIS or foreign including Korea)).

2. Selection of the country.

3. Selection of the hospital.

4. Selection of the doctor.

5. Budget, insurance, travel and other issues.

II. Analysis of supply (analysis of Korean supply for Korean demand and CIS demand)

6. Analysis of Selected CIS country for Korean supply (is a Korea capacity enough for satisfaction of the CIS demand).

7. Analysis of Infrastructure supply: hospitals, clinics.

8. Korean marketing strategies on MTS policies.

III. Comparison of CIS demand for Korean MTSD and KOREA supply for CIS, Comparison of governance mechanisms for MTSD.

2 phase. Formulation of JOINT action programs/projects and structures/networks (IV, V, VI)

8. Preparation of action programs/projects by CIS and Korea.

9. Design/optimization of organizational structure and networks in both countries.

10. Drafting the budget and other cost issues 3 phase. Implementation and follow up.

The research aimed to explore the importance of enhancement of governance mechanisms for Medical tourism service delivery (MTSD), to identify governance mechanisms and process of MTSD; to determine methods for enhancement of Governance; to identify the gaps in Korean MTSD for CIS; to propose governance mechanisms for reduction these gaps and to provide meaningful implications for policy development and governance strategies in the industry. This was achieved by collecting empirical data on the perceptions of CIS tourists, Korean providers, experts, and professionals related to the medical tourism industry. The methodology comprised comprehensive networked method research based on questions. The study was conducted involving Korean and CIS medical tourism providers and managers at hospitals. To achieve the purpose of this study, the Comprehensive Networking research method and an in-depth interview method have been used. The main subjects of the research are key actors involved in the process of Korean Medical tourism service delivery. Randomly selected CIS tourists, who visited Korea for medical service, Korean medical staff, Tourism organizations promoting medical tourism, Medical tourism agencies, and hospital managers.

The model was prepared based on the below questions given to key actors engaged in MTSD governance during the interview:

1. Formal or informal source of information on MTS for CIS tourists (colleagues, friends, family members, doctors, neighbors, tourist organization, hospital, internet, etc) at different stages of MTSD. How often tourists use informal networks (social networks and e-participation) in e-governance mechanisms and tools.

2. Role of online social media, global and social networks.

3. The sequence of steps in getting information on MTSD from informal source (colleagues, friends, family members, etc) and then contacted the formal organizations and their sites like Visit Medical Korea, air companies, insurance, and banks, etc).

4. Have tourists checked possibilities in their own countries and then contacted ROK hospitals or directly ask Korean providers?

5. Who in CIS and ROK coordinated the preparation and organization of the tourist travel and treatment in ROK?

6. What were the organization, governance, and quality of the treatment?

7. Organization of the visa process and what kind of support provided.

8. Air ticketing and meeting at the airport.

9. Organization and support for insurance and banking matters.

10. Postsurgery treatment and rehabilitation.

11. Assessment and monitoring. Information on results of treatment via social networks, informal and formal structures.

12. Role of e-services (e-visa, e-ticket, e-health, e-tourism, telemedicine, etc) and online social networks.

Findings

A special ontology that clarified thesaurus, taxonomy, semantic network was designed. Based on this ontology a pertinent Comprehensive MegaNetwork (CMN) which concentrated on principal structural links of the subject has been elaborated. CMN integrates multilevel stem networks with communities and the actors. Thus, the model for overlapping communities with heterogeneous topologies in formal and informal network layers was proposed.

MTS Model

Graph G=(V, E) where V-nodes, E-links, is composing all participants engaged in the governance of the MTS process directly or non-directly (doctors, patients, tourist managers, etc.). For network generation R-MAT [9] has been used (Fig 2). The simple model is composing one doctor per 20 patients, I patient has 10 relatives, etc. The meganetwork model is, composing thousands of participants of doctors, patients, tourist managers, insurance agents, pilots and flight attendants, hotel staff, etc. Optimization of network structure /topology and its sustainability, clusterization, and security issues have been investigated.

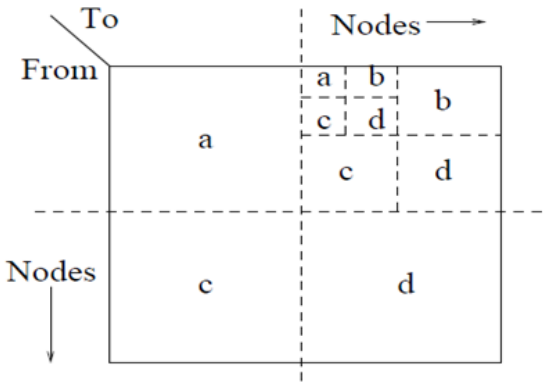

Fig. 1. R-MAT algorithm for meganetwork generation

Stem MTS Model

Further to scientific discussion the authors within the existing methodology framework developed and applied a stem network (SN) concept [10]. This concept takes into account the intrinsic multilayered thematic and dynamic nature of real multi-actor systems. Multiple nodes of multiplex networks are called stems. The stem network is described by the triple ***B=(S, T, C)***, "bed", where ***S*** is a nonempty set of stems, ***T*** is a nonempty set of thematic layers, ***C = (C1, C2, ..., Ct)*** is a set of binary relations on the ***S***, where C_i corresponds thematic layer ***i***. In traditional words SN-network is a network that is permitted to have multiple nodes, having multithread links of the same nature.

The Stem MTS (CMTS) might converges humans, natural, and machine agents and must coordinate and connect a huge and different variety of them. In the present paper just to model MTS a ***combined*** stem network (CSN) is proposed and defined as a specific integration of interdependent SN-networks $V= (B_1, B_2... B_m)$, described on ***m*** "beds" with nonoverlapping sets of stems, thematic layers, and binary relations. Some stems from different "beds" might be united into a group which is called a bouquet. Such a group of real objects - multiple (pair, triple....) includes nonrepeatable as a rule) coactive stems of different beds (S_{ik}, S_{lj},...), where S_{ik} is a stem ***i*** from the bed ***k***. Thus, bouquets are partitioned into stems that firm nodes of networks of the same nature. Links within a stem, between different stem nodes of the same layer of the same network, and between stems taken from different networks are put in different categories Links - between the stems inside a bouquet represent binary relations (interactions) such as "dependence" (***D***-links), which differ from couplings - "connections" (***C***-links) that govern the interaction between the stems of a bed; couplings of "bindings"-type (***B***-links) describe the relationship between the nodes of the same stem.

The concept categorizes system actors as stems, the latter are stratified into nodes according to each thematic layer.

Naturally Human Beings (HB) networks incorporate professional, family, and friendly connections. While transportation a container might change airlines, railways, boat lines, bus lines, etc... It is impossible to combine human beings with gadgets by relative links neither gadgets with HB through electric signals. Such a detailing of links promotes clarification of network robustness while waiting for attacks on separate elements of a network (nodes, stems, bouquets, beds, layers, links-bindings, links-connections, and links-dependencies) and their combinations. The novel network concept promotes easier understanding and clarification of the implicit and complicated structure the property graphs propose. Also, it is of significance that all the familiar graphs: pseudographs, multigraphs, property graphs, color edged graphs bear no multiple vertices. These graph approaches concentrate on subjects of instrument traits while the combined stem network focuses on subjects of nature.

The vulnerability of MTS Model

To study the problems of safety and sustainable development of medical tourism service systems it has been important to take into account the internal properties of stems - capacities. First, capacities are needed to hold loads in a network in terms of centralities (degree centrality load, bridge centrality load, vicinity centrality load…). Second, those provide robustness while countering diverse attacks. Time factor t is also included in consideration for reflecting CSN dynamics. Attack schemes of the CSN structures in the context of safety problems have been reviewed in the frame of a simple analysis of major offensive actions, which are important for studying of SMTS structures described by combined stem networks.

The proposed model and its tools will allow covering effectively topological problems of information security economics within the framework of the modern network information systems [11].

The proposed model allows the following. Elements of SMTS network are considered as stems (Fig.3), that stand-alone or interconnected and interdependent within and across countries, states, regions, local territories, and sites.

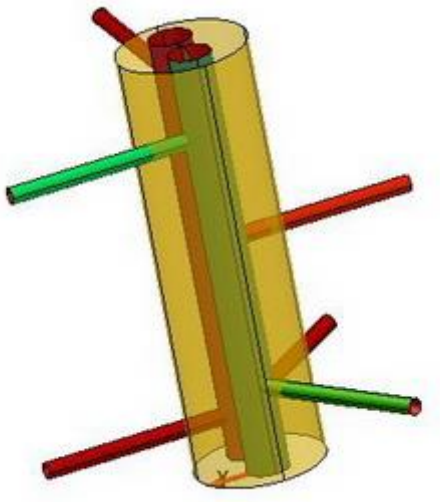

Fig. 3. 3 actors of a 2-bed Stem MTS Model

Here (S, T, R) is a stem network, where S - is a set of stems, T – is a set of layers, $R = (R1, \dots, Rn)$ set of binary relationships on S.

Most facilities of technological infrastructures are proprietary of the private sector or federal, regional, or local governments, and might be stratified into diverse layers on pertinent beds while connected to other systems of the same or different field. Contrary to traditional complex network failures and attacks a combined stem network might comprise not only removals of nodes but stems and bouquets as a whole. The removal of a ***C***-link in a stem network does not necessarily tear a path between the attached nodes because of ***B***-links. The recent research [9] assumed that elements in the dynamic network can fail independently of other elements (internal failure) or due to external causes (if it has a substantially damaged neighborhood).

It is necessary to underline that our model by Figure 3 demonstrates that in case of emergency the "conscious" partner stem (human or sensor) within a bouquet can give a signal for the system to start an intentional recovery process.

Conclusion

Smart governance mechanisms describe a modeling framework for investigating the governance process in the field of Global E-Health Service delivery. It engaged interactions of different actors from the private sector, national, provincial, local governments, civic society organizations, and informal structures which might be stratified into diverse layers while connected to other actors of the same or different fields. Research and practical benefits are obvious: gaining insight into the properties and processes of the real governing systems. This model approach proved the valuable fact that in contrast to small social networks, huge scale social graphs generally exhibit good expansibility with inherited topological vulnerabilities. This property might be a platform to establish robust cooperation, promote the delivery of services through national borders. Moreover, all cross-disciplinary challenges intuitively utilize and enforce global medical network expansion. Serious economic potential for the ROK economy is looked through the interaction of the Korean medical service network with those of the Commonwealth of Independent States (CIS).

Methodological framework and comprehensive mega network concept enhancing cross-sectoral governance process and security issues in the medical tourism sphere were developed:

1. A comprehensive analysis of complexity for the delivery of governance processes was undertaken.

2. A review of existing methods and models of governance and organization in the area of medical tourism was done.

3. The gaps were found due to the transition peculiarities of transition countries. The gaps have been identified between these mechanisms. The more and deeper gaps the more incompatibilities between these market mechanisms. To reduce the gaps, it was analyzed and developed governance mechanisms that allow coordinating the Medical Service layer and MT service consumer layers. They are the following types:

1. The Direct/Horizontal governance mechanisms.

2. Leading Coordinating Agency/Organization composing additional coordination functions.

3. Program mechanism coordinating centrally all actors engaged in the program.

4. Establishment of the intersectoral entity in MTSD (Extension of a hospital for another country).

A methodological mechanism composing, and modeling interactions of different organizations and social networks engaged in different phases of governance processes in the areas of medical tourism services was designed.

There is insufficient research on the enhancing governance process in medical tourism delivery as well as the limitation of employing a Comprehensive Network Analysis to assess the medical tourism service delivery governance mechanisms.

The study also emphasized the value of spontaneous recovery for dynamic networks. The CSN approach is able to detail the neighborhood for further analysis of damage and spontaneous recovery processes concomitant to network element fails. All these clarify CSN robustness issues and promote stem network safety strategies.

Conclusions of the study are as follows: 1/ the results of the research had shown that the factors affecting the choice of CIS medical tourists in determining the Korean medical tourism destinations in addition to high quality at reasonable cost factors such as usage of informal structures and social networks for initial information on the destination and hospitals (relatives, friends, colleagues…) and then later tourists use formal structures from the public, private or civil societies on the medical

service (quality, cost, professionalism) and safety, insurance, visa, logistics, tourism environment, and services. The overall satisfaction of CIS medical tourists with

Korean medical tourism services had been analyzed. They were satisfied with the medical tourism service (quality of service, the professionalism of hospital staff), facilities, and communication with doctors, nurses, and coordinators. At the same time, they were not happy with the absence of Russian language-based applications helping with e-booking, searching accommodation, transportation, restaurant information, cost, and absence of Korean insurance and banking loans for CIS tourists. Also visa procedures for some CIS countries are complicated. Russian and Kazakhstan tourists can enjoy a non-visa regime now. Satisfaction with medical tourism service differs and depends on medical services provided by those Medical Institutions, Insurance, and banking structures. Their satisfaction and dissatisfaction expressed first of all via social networking at all MTSD phases which make social media a very important factor for the advertisement of Korean MTS.

Methodological and practical implications for the governance process in the delivery of MTS were discussed based on the above findings.

The study has shown that the more gaps in MTSD of CIS and MTS of ROK the less fitness and more coordination require for reduction of this gap. The study suggesting four types of coordination mechanisms using interactions of governance and social networks and their online meganetworks. The Meganetwork modeling framework could be used for enhancing the e-governance process of MTS and its interactions with social networks. Online social networks and e-citizen participation should become an organic part of e-governance mechanisms in MTSD.

At the same time the complex combinations of networks involved into MTS processes are exposed to multifaceted aggregated threats. Such a contemporary natural threat is SARS-CoV-2 spread which covers the world. As noted in [12] network scope is the most prospective approach in the analysis of epidemic processes. To perform this and distribute protection funds relevantly one may apply analysis [13 ,14] and the assessments proposed in [14].

The study can be used as a platform for the development of an efficient and resilient MTS industry, marketing, and governance strategies.

And finally, all emerged cross-disciplinary challenges indirectly stimulate and enforce medical tourism network expansion.

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UDC 004.632:614

Ашурова З. Механизмы управления электронными услугами медицинского туризма: стойкое сетевое взаимодействие

Аннотация. *Медицинский туризм является одним из быстрорастущих секторов и обладает огромным экономическим потенциалом для корейской экономики благодаря расширению сети корейских медицинских туристических услуг (МТУ) для региона Содружества Независимых Стран (СНГ). Предыдущие исследования были сосредоточены на конкретных областях медицинского туризма. Несколько научных исследований, посвященных аспектам управления этим сложным сектором. В статье предлагается основа моделирования для исследования процесса управления в сфере предоставления услуг МТУ, чтобы сделать его эффективным и устойчивым. Целью данного исследования является анализ внутренних и внешних факторов, влияющих на управление доставкой услуг медицинского туризма в Корее, а также на соответствие этих услуг (со стороны предложения) спросу туристов из стран СНГ. Каковы пробелы в доставке корейской МТУ для СНГ и как сократить эти пробелы путем усиления процесса управления и обеспечения его надежности, включая механизмы электронного управления, взаимодействия с социальными сетями? Большинство объектов технологической инфраструктуры являются собственностью правительства или частного сектора и в соответствии с комбинированным сетевым подходом могут быть разделены на различные слои на подходящих пластах при подключении к другим системам той же или другой области. Исследования и практические выгоды от исследования также очевидны: понимание свойств и процессов реальных управляющих систем и соответствующих проблем безопасности. В качестве плюса этот модельный подход доказал тот ценный факт, что в отличие от небольших социальных сетей, сети большого масштаба обычно демонстрируют хорошую расширяемость с унаследованными топологическими уязвимостями. Это свойство может стать платформой для установления тесного сотрудничества, содействия предоставлению услуг через национальные границы и обеспечения соответствующей безопасности. Более того, все междисциплинарные проблемы интуитивно используют и расширяют сеть медицинского туризма. В частности, недостаточно исследований по совершенствованию процесса управления в сфере медицинского туризма, а также по ограничению использования комплексного сетевого анализа (КСА) для оценки механизмов управления медицинским туризмом и их устойчивости.*

Ключевые слова: *медицинский туризм, эффективность, устойчивость, комплексная мега-сеть, стволовая сеть, электронный сервис.*

Ашурова З. Механізми управління електронними послугами медичного туризму: стійка мережева взаємодія

Анотація. *Медичний туризм є одним з швидко зростаючих секторів і володіє величезним економічним потенціалом для корейської економіки завдяки розширенню мережі корейських медичних туристичних послуг (МТУ) для регіону Співдружності Незалежних Держав (СНД). Попередні дослідження були зосереджені на конкретних областях медичного туризму. Кілька наукових досліджень, присвячених аспектам управління цим складним сектором. У статті пропонується основа моделювання для дослідження процесу управління в сфері надання послуг МТУ, щоб зробити його ефективним і стійким. Метою даного дослідження є аналіз внутрішніх і зовнішніх факторів, що впливають на управління доставкою послуг медичного туризму в Кореї, а також на відповідність цих послуг (з боку пропозиції) попиту туристів з країн СНД. Які прогалини в доставці корейської МТУ для СНД і як скоротити ці прогалини шляхом посилення процесу управління і забезпечення його надійності, включаючи механізми електронного управління, взаємодії з соціальними мережами? Більшість об'єктів технологічної інфраструктури є власністю уряду або приватного сектора і відповідно до комбінованим мережевим підходом можуть бути розділені на різні верстви на відповідних пластах при підключенні до інших систем тієї ж або іншої області. Дослідження і практичні вигоди від дослідження також очевидні: розуміння властивостей і процесів реальних керуючих систем і відповідних проблем безпеки. Як плюса цей модельний підхід довів той цінний факт, що на відміну від невеликих соціальних мереж, мережі великого масштабу зазвичай демонструє хорошу розширюваність з успадкованими топологічними уразливими. Ця властивість може стати платформою для встановлення тісної співпраці, сприяння наданню послуг через національні кордони і забезпечення відповідної безпеки. Більш того, всі міждисциплінарні проблеми інтуїтивно використовують і розширюють мережу медичного туризму. Зокрема, недостатньо досліджень щодо вдосконалення процесу управління в сфері медичного туризму, а також щодо обмеження використання комплексного мережевого аналізу (КМА) для оцінки механізмів управління медичним туризмом і їх стійкості.*

Ключові слова: *медичний туризм, ефективність, стійкість, комплексна мега-мережа, стовбурова мережа, електронний сервіс.*

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Отримано *15 квітня 2020 року*, затверджено редколегією *29 квітня 2020 року*