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COVID-19: Reshaping Medical Tourism through Artificial Intelligence (AI) and Robotics

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The tourism and travel sector is a large and thriving industry, with almost 5 billion international tourist arrivals recorded in 2019, with an annual growth of 4% on the previous year. Yet it suffered a major downturn, globally due to Covid 19. Since the concept of healthcare has existed, humans have been willing to travel to access it. From the spas of the ancient Sumerians, Greeks, and Romans, to the supposed curative properties of alpine and seaside health resorts in early modern Europe, the idea of traveling long distances for health reasons, and marketing destinations for that purpose, is certainly nothing new However, lately, medical tourism has been growing due to the low-cost treatment, Specialization of medical agencies, hospitals, and medical professionals in the host countries. This type of tourism was valued at USD 16.761 million in 2018, and it is expected to reach USD 27,247.6 million by 2024. However, the appearance of COVID 19 has completely changed the tourism sector, where a loss of USD 910 billion to USD 1.2 trillion from export revenues from tourism was reported Moreover, the different types of Tourism and travel industry are taking advantage of Artificial intelligence (AI) in order to perform a variety of administrative and customer service tasks. For medical tourism the development of these technologies (AI, robotic, and so on) play a key role in supporting the medical agencies in connecting physicians and prospective medical tourists. In addition to make it more feasible and credible option for patients, respond to questions and provide valuable information to customers, and allows to reduce the time would be impossible for humans. Furthermore, international remote surgeries will allow various clinical centers to pool their expertise and offer remote surgeries from a central operating theatre that is convenient to access for patients and persuade patients to invest in the local economy.

Keywords: *Medical Tourism, COVID-19, AI, Robotics.*

Introduction

Based on the 2020 UN World Tourism Organization statistics (UNWTO), it is needed to conduct research on medical tourism packages, and what kinds of consumers are attracted in buying such packages following and how the industry may be changing from pre COVID to post COVID times (see: Darpy & Volle, 2007; Hassan, 2015, Hassan & Noaman, 2017, Jabbour, 2018; Melkonian, 2019; Research and Markets, 2020; UNWTO, 2020a, 2020b). Lately, one needs to understand the dynamics of this sector, and what motivates people to purchase or invest in these packages especially according to the technological advances host

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countries bring to improving the proposed advertised services (Maslow, 1943; Herzberg et al., 1959; Cohen, 1972; Plog, 1994; McIntosh et al., 1995; Griffith, & Albanese, 1996; Swarbrooke, & Horner, 1999; Woodside, & King 2001; Schiffman & Kanuk, 2010; Lunt et al., 2020; Gopalan et al., 2021). This is namely with introducing AI technologies in the typical medical tourism services, as AI is said to improve the quality and efficacy of the treatments (see: Liu et al. 2019). This is why the main aim of this study is to gather information on COVID 19 and its impact on the medical tourism sector, the importance of AI and Robotics in reshaping medical tourism and how it will facilitate the procedure for medical tourists (OMT, 2019; UNWTO, 2020a, 2020b).

Hypotheses: Our hypotheses are as follows:

H0: No relationship between AI and robotics and medical tourism
H1: Positive relationship between AI and robotics and medical tourism
H2: Negative relationship between AI and robotics and medical tourism

Literature Review

Medical Tourism

Medical tourism is defined as the process of traveling outside the country of residence for the purpose of receiving medical care. It is developing rapidly and is becoming a global trend industry that generates billions of dollars, and is a very small niche in terms of the tourism sector (see: Ghassemi et al., 2020).

Besides, this sector is a market of hundreds of hotels, hospitals, clinics and agencies all seeking to make money and the market is growing at a rate of 15-25%. According to international health travel data provider Patients Beyond Borders, the global medical tourism market is worth between $65bn and $87.5bn and, medical procedures range from cosmetic surgery and dentistry to cardiovascular procedures and experimental cancer treatments (Hassan, 2015, Hassan & Noaman, 2017). So, government health and tourism ministries around the world are increasingly focusing on their attempts to get (or enlarge) their slice of this lucrative pie (Hassan & Noaman, 2017, Labonté et al., 2018).

Despite the tremendous growth in interest in medical tourism over the past decade, there is no standard procedure for measuring the pivotal factors of medical tourism destinations (Subasinghe et al., 2020). Medical tourism is a growing global phenomenon that is highly dependent on innovation and knowledge management (Subasinghe et al., 2020). Being both innovative and systematic in medical tourism requires enrichment of thought in knowledge management in hospitals.

Interest in medical tourism is growing rapidly and medical tourists have many alternative destinations for treatment, as some hospitals offering low cost and high quality services are more likely to compete in this market, whether in Lebanon or in the Middle East (see: https://www.lorientlejour.com). On the other hand,

providing such time-consuming, cost consuming, quality and other services taking into account knowledge management areas is a complicated task for general and functional managers of hospitals. According to statistics reported by the literature (Ghassemi et al., 2020), there are more than 30 countries with hundreds of hospitals and clinics around the world providing services to medical tourists. This information indicates the importance of being systematic and innovative in hospital management (see: https://www.lorientlejour.com) to attract as many medical tourists as possible. Recently, medical tourism has gained attention as a serious topic to consider. This industry is growing in Asia every year, and many countries compete to attract more medical tourists by offering low cost services (Ghassemi et al., 2020). Many countries and companies are involved in medical tourism, but this type of tourism does not show any precise fundamental indicators. Iran is one of the suitable destinations in the Middle East for medical tourists as it offers both high quality hospital attractions and healthcare services (see: https://www.lorientle jour.com). This is also taking into account the World Health Organization (WHO) guidelines in terms of current sanitation and pandemic restriction policies that must be included in tourism destination strategies. Other international tourism regulation institution guidelines must be taken in to account as well, especially during the current COVID endemic phase.

In many studies of medical tourism, the emphasis is on time, cost, quality and innovation, (Ghassemi et al., 2020), but there are no procedures or metrics to measure them. One study (Ghassemi et al., 2020) proposed cost and quality as factors in medical tourism, but the main concern is how to standardize international hospitals in this area. Besides the main objectives of the study, the novelty of the current study is commendable in different ways. For the first time in the literature, by applying "innovation based on knowledge management" elements proposed following fairly well known research (Ghassemi et al., 2020) that we will examine if it is an orientation on time management, costs and quality (TIME, COST and QUAL) in innovation processes increase the innovation speed (IS) and operational performance (OP).

Sadly, in 2020, COVID-19 spread around the world (see: https://www.un.org). The United Nations World Tourism Organization (UNWTO, 2020a, 2020b) has estimated that the sector globally has registered a further 60% to 80% decline by the end of 2020, calling it “the worst crisis than the tourism industry, has faced internationally" (see: https://www.unwto.org). Based on the results, in order to provide new products and services in the pandemic and post-pandemic era, it is fundamental to take into account the factors related to time, cost and quality and to improve performance operational. This problem had recently been investigated (see: https://www.cairn.info). The researcher illustrated how the growing number of COVID-19 infections negatively affected the planning and strategies of all industries, including that of In-Vitro Fertilization, or IVF (see: https://www.rev med.ch). There is almost no open international border and the market share is expected to decline until 2021, and possibly more in 2022 because patients avoid unnecessary travel as per recent UNWTO statistics (UNWTO, 2020a, 2020b). Thus, the future of this industry promises a rather uncertain forecast for the next few years (see: https://www.unwto.org).

IOT and Medical Tourism

IOT is conquering every aspect of human life and work environment. This is no exception to the healthcare industry. In fact, the term of Internet of Medical Things (IOMT) was highlighted by the Department of Health, Abu Dhabi (2020) during the 12th annual World Medical Tourism & Global Healthcare Congress in 2019. The wearable and sensors that form parts of IOT are indicated to be beneficial to healthcare professionals are gaining effective benefits (Junata & Tong, 2018). The use of fitness-tracking bands, smart watches and smart textile can easily collect data on patients' health conditions and connect with the healthcare professionals in other parts of the world. While these technological devices may apply to any individuals, the usage is prominent for health tourists who may opt to have follow-up with their doctors in another country remotely, as data can be transmitted to them on real-time basis (Psiha & Vlamos, 2017).

Trust is a key issue in medical tourism – while some patients may be swayed by the possibility of lower costs or an advanced treatment alone, for the most part it is vital that travelling patients have confidence that the quality of care they receive won't be second-rate (ex. Hassan, 2015, Hassan & Noaman, 2017). This is why accreditation that global healthcare facilities match up to the best health systems in the world – primarily through the Joint Commission International standard – plays a central role in the sector. The sharing of patients' electronic health records (EHRs) with remote physicians, another way of improving patient confidence, is also a core feature of many travel agencies that specialize in medical tourism.

The data from the sensor was then transmitted via IOT sensor platform, to a dedicated android app developed on a Google Nexus 5X smart phone. However, the development is yet to be compatible with smart phone options. An example of such technology usage in health care is the cloud-based wearable IOT sensor systems that measure asthma patients' exposure to aldehydes, in real-life settings (Li et al., 2019). The recent 5G medical technology development further enhances the patterns of production and consumption of health tourism services, such as smart wearable (e.g. clothes that measure heart rate, blood pressure, body temperature, skin moisture, etc.) and active device location tracking (Psiha & Vlamos, 2017). Such development is highly applicable and useful for health tourism, as it allows continuous communication and data updates through cloud computing between the health tourists (at home country) and the healthcare professionals (at health tourism destination) as Hassan (2015) Hassan & Noaman (2017) discusses, in Lebanon for the case before the Pandemic, and before the economic crunch of 2019.

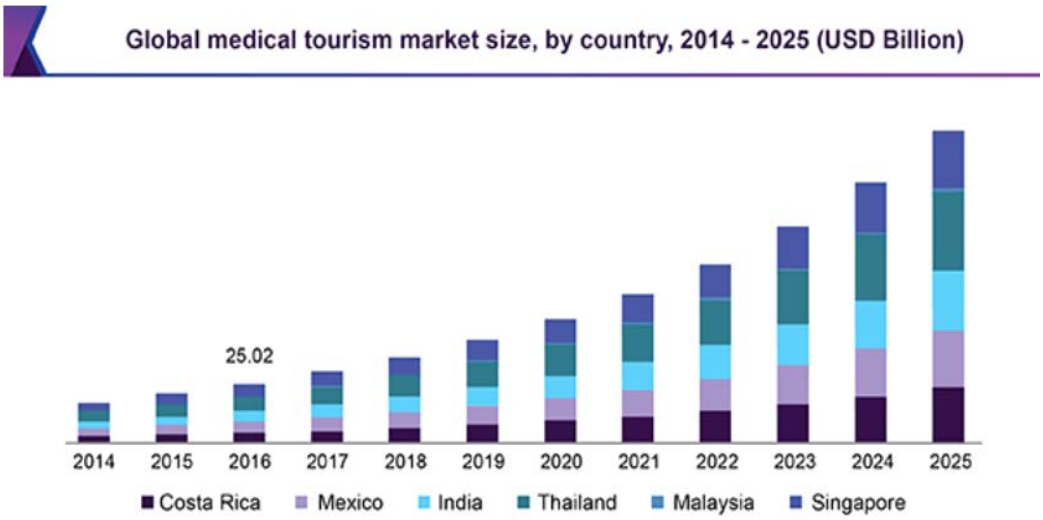
Next, the virtual rehabilitation application will also be benefiting the health tourism industry. It is a system that integrates wearable sensors and records range of motion. The data are analyzed for the therapists to guide the patients in real time via a mobile device (e.g. tablet, smart phone) as Li et al (2013) discuss. The National University of Singapore has launched an IOT-based rehabilitation program for stroke patients in 2016 (UNWTO, 2020a, 2020b). However, there are very few studies on the adoption rate of these innovations among local

communities and health tourists, seeing Singapore as among the top health tourism destinations globally (UNWTO, 2020a, 2020b). In Lebanon, we refer to Hassan & Noaman (2017).

Artificial intelligence (AI) puts consumers in control of health and well-being and also increases the ability for healthcare professionals to better understand the day-to-day patterns and needs of the people they care for, and with that understanding they are able to provide better feedback, guidance and support for staying healthy (cf. Ghassemi et al., 2020, Horne et al., 2020). This is important, as AI seems to be the future of the industry. Yet, other rehabilitation technologies include robotics (e.g. Mann, 2013; Cleveland Clinic Abu Dhabi implemented robotic surgery since 2017 Carlson & Ehrlich, 2005) and assistive technology (AT). In fact, AT plays an intermediary role where it enables disabled individuals (e.g. severe paralysis) to transmit their messages and/or intentions to other devices (e.g. computers) within their surrounding environment (Ghovanloo & Huo, 2014). These technologies further upscale the offerings and competitiveness of health tourism destinations to lure health tourists as seemed to have been discussed in the World Economic Forum (2020a) summit. Figure 1, below, shows the Global 2014 medical tourism market size in billions of USD as discussed by many experts including Hassan (2015).

Despite AI has existed sometimes back, the application of it in the healthcare industry is still at the infant stage (see: Hassan & Noaman, 2017; Liu et al. 2019). The behavioral and mental healthcare fields use AI to learn, understand and reason to make better clinical decisions; diagnostics, testing and patient care management. Besides, AI technologies and techniques also enhance patients' lives via advance self-care tools (Wong & Hazley, 2020). For example, the interactive mobile health applications study the patterns and preferences of users. By doing so, the AI may improve public health through the detection of health risks and recommending interventions. The use of AI enables the interactions between health professionals and care seekers at a distant, providing necessary treatment recommendations (Luxton, 2016), a very useful communication and interaction tool between health tourists and the healthcare professionals overseas. In stepping up Abu Dhabi as a unique health tourism destination, the United Arab Emirates (UAE) has taken AI seriously in regulating the development of its healthcare industry by introducing the first AI policy, tabling out the UAE Artificial Intelligence Strategy and announcing it world's first Minister of State for Artificial Intelligence (see: Luxton, 2016). Governments also play a role in Medical tourism, as seen in the case of Guatemala (Labonté et al., 2018).

Figure 1. *Global Medical Tourism Market Size (in Billion USD)*



Artificial Intelligence, Robotics, and Medical Tourism

IR 4.0 Technologies

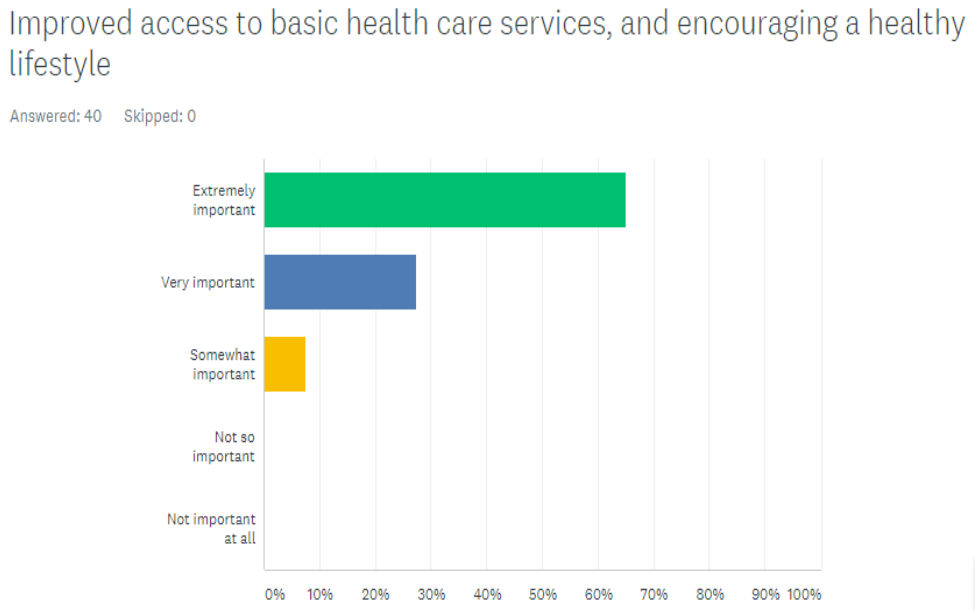
The integration of IR 4.0 technologies in general healthcare industry will benefit health tourism development as it will revolutionize patients' travel options and patterns, particularly for the initial checking and later follow-up stages. Such benefit becomes more significant among the elderlies and those who may have mobility issue to travel. Digitalized and connected health care saw increased investment over the past few years and the widespread use of technology-enabled health care further making the idea of "Smart Hospital" a reality (Frost & Sullivan, 2017). The call for the use of block chain technology to enhance the safety and effective use of health data within the health tourism industry gained attention in the recent years (Iryo.network, 2018). The use of technology may free up face-to-face appointments for health tourists, particularly for follow-up sessions after returning to their home country, and thus generate more convenient and cost-effective experience (Wong & Hazley, 2020).

Healthcare know-how and technologies are available in many parts of the world. The availability of IR 4.0 technologies also enhances expert mobility (e.g. doctors, nurses, professors and care takers) virtually and further enhances the readiness of developing nations to receive its health tourists with an open hand (Wong & Hazley, 2020). Perhaps, with the adoption of IR 4.0 technologies among the health tourism facilities, health tourists may not necessarily require physical movement elsewhere anymore in seeking and receiving health services, such as simple health checks or health advice (see: Seyitoğlub & Ivanov, 2021). So, the recent corona virus pandemic that puts global travelling almost to a halt is a good example of why the future of health tourism should evolve through the technology advancement, specifically the IR 4.0 technologies as available currently. Health care is no longer just about local accessibility but cross-national borders, be it physically or virtually (Wong & Hazley, 2020).

Summary

Before we move to the next section, it is important consider the following points, as Figure 2 shows. Bellos (2021) presets that improved access to healthcare services do encourage a healthy lifestyle and this indeed agrees with the fact that an increasing number of people seek more and more for medical, health, and wellness tourism packages, so indeed the trend is clearly marked toward and increased demand in such tourism packages.

Figure 2. *The Importance of Medical Tourism (Bellos, 2021).*



Methodology

Several questions that were raised from the literature review were adapted as below:

1. What are the reasons behind the growth of medical sectors?
2. Do AI and Robotics play a role in reviving medical tourism during COVID-19?
3. What is the role of AI in transforming the industry and making it more feasible for patients?
4. Does COVID 19 change the future of medical tourism by creating a new niche Market through AI and Robotics?

To respond to the above research questions, the research relies on different sources (articles, papers, reports, statistics for UNWTO, WHO, and so on) together with a complex mixed research methodology (qualitative and quantitative). These comprises of an in-depth interview disseminated to expert Medical Tourism agents, and a qualitative semi structured survey distributed to medical experts from

different fields (Robotics experts, plastic surgeons, dentists, and so on), but more specifically to specialize in Robotic surgery. On the other hand, this research's quantitative component will be based on structured questionnaires to be distributed to a large sample, including, but not limited to tourists, patients, engineers, and medical centers (See: UNWTO 2020a, 2020b). Figure 3 shows the procedure used to build our research design.

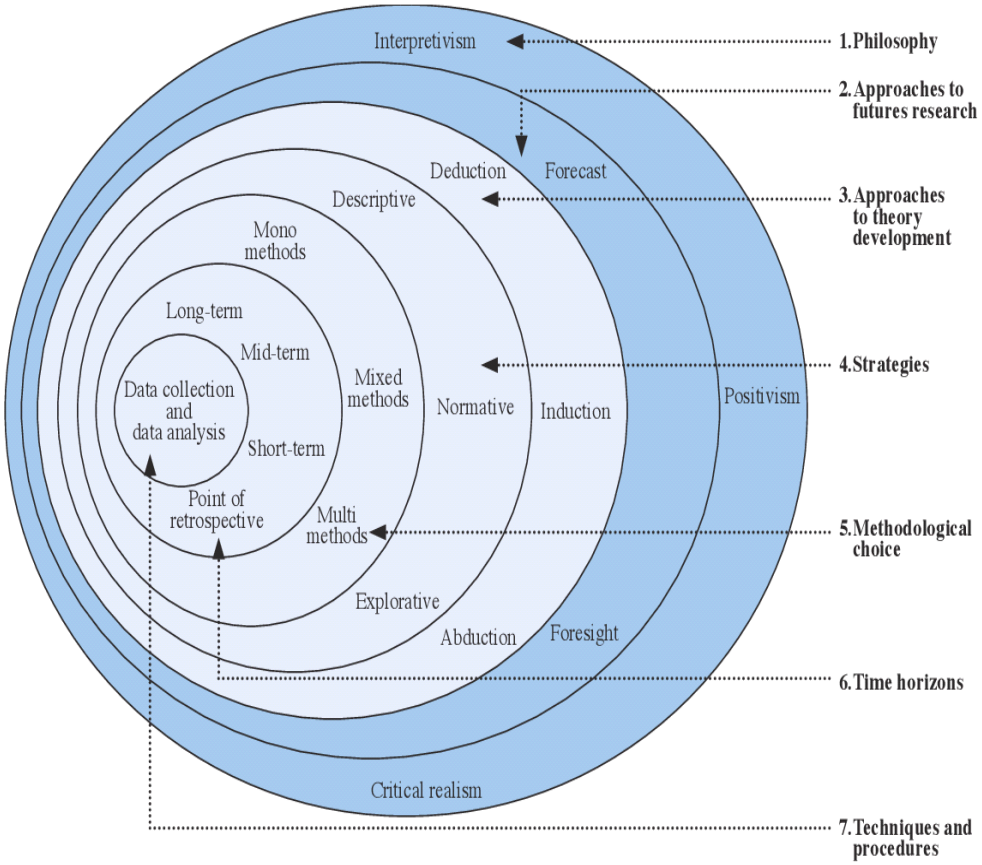
However, the opinion of medical tourism agent directors will enable the researchers to see if AI has helped to revive medical tourism and medical tourists to be followed by their doctors and if the new type of medical tourism such as Robotics and Telehealth will continue growing after COVID 19 (Wong & Hazley, 2020). Additionally, also discussed will be the fact of whether AI applications have been beneficial as well (see: West & Allen, 2018).

Since the research draws on a variety of secondary data sources (publications, scholarly researches, papers, reports, UNWTO, WHO statistics, and so on) it will necessitate a sound research design, which can be summarized in Figure 3. Saunders et al. (2019) helps us review the most suitable research design for our study as both expert interviews and structured surveys will be used for our research strategy. For this purpose, we will be relying on the mixed research approach to answer the aforementioned research questions, necessitating both qualitative and quantitative means (see: UNWTO 2020a, 2020b). We used the complex mixed methods, since we have 2 qualitative surveys (including expert interviews and questionnaire) and a quantitative one (Saunders et al., 2019). We suspect our methods to rely on critical realism, as we want to question the reality we see.

These include in-depth interviews with Medical Tourism agents and physicians from many areas (plastic surgeons, dentists, etc.) that specialize in Robotics surgery. The quantitative component of this study, on the other hand, will be based on surveys and questionnaires that will be provided to tourists, patients, engineers, medical centers, and others. Thus, the UNWTO (2020a, 2020b) statistics will guide us s one of the main sources for secondary data, along with data collected from previous studies to be used as supporting evidence once we triangulate the data together (see: Figure 3).

Thus, we will use *critical realism*, *abductive approaches*, and *surveying* as a way to collect data while using *sequential exploratory mixed methods* as qualitative and quantitative methods are used one after the other, while adopting action research as data collection strategy (Brynman, 2012). Saunders et al (2019) suggest we use this method because it is suitable for researches encompassing in-depth interviews disseminated to experts in the field, and namely those specializing in Robotics surgery.

Figure 3. *Saunders' Research Onion*



Yet, the opinion of medical tourism agent directors will enable the researchers to see *if the AI helped to revive medical tourism* and also *if medical tourists to be followed by their doctors and if the new type of medical tourism such as Robotics and Telehealth will continue growing after COVID 19*. This research method was based on Brynman (2012). On the other hand, this research's quantitative component will be based on both surveys and questionnaires to be distributed to tourists, patients, engineers, medical centers and much more. Furthermore, we will also analyze whether or not *AI applications have been beneficial in these times as well* (Hassan & Noaman, 2017).

During this research an in-depth examination of the role of AI and robotics in reshaping and revitalizing medical tourism during and after COVID-19 will be provided (Orîndaru et al., 2021). Similarly, how this sector will change as a result of placing a high value on AI in order for patients to avoid waiting lists will also be discussed. This will be done in order to help embed a culture of prevention within the community so as for people to stay healthy and reduce their need for doctors, which will be argued (Smith et al., 2013).

COVID19 had a disastrous impact on the medical tourism business, according to the major findings given in recent researches conducted by the UNWTO, due to travel restrictions and visa constraints (see: UNWTO, 2020a,b). Besides *how AI and Robotics are becoming an important part of the healthcare sector globally in not only treating diseases or carrying out intricate procedures but also supporting*

well-being, prevention, and early intervention are part of our research inquiries (Davenport & Kalakota, 2019). This also needs to be considered while responding to our research questions. Therefore, the five research questions are presented below:

RQ1: Does AI reshape the future of Medical Tourism?
RQ2: How does COVID-19 changes the Medical Tourism industry?
RQ3: What are the possible modifications to help the medical tourism sector to revive and continue its growth through AI and Robotics?
RQ4: Will Remote surgeries and Robotics have benefits for medical tourists?
RQ5: Do Robotics and AI play a role in Medical tourism?

These queries necessitate the selection of *mixed methods*, since we used *interviews* and *surveys*. This is why the philosophy and approaches used coincide with the correct selection of data collection methods, best selected to effectively respond to the above research queries. The research design has been well considered since Cronbach Alpha values were estimated at 0.86. This was confirmed in Table 1, as the survey was found to be well correlated, upon completion. Overall, the survey is both reliable and valid, since triangulation with the other data was carried out. The structured survey ran till the end of July 2021, and targeting various people, including but not limited to students, nurses, various medical staff and professionals, which were randomly targeted, giving equal chances for the subjects to appear in the study.

Table 1. *Cronbach Alpha Value*

Cronbach's Alpha	0.861954705
Split-Half (odd-even) Correlation	0.786528583
Split-Half with Spearman-Brown Adjustment	0.880510494
Mean for Test	282.05%
Standard Deviation for Test	1.507852949
KR21 (use only 0 and 1 to enter data for this)	0.224946807
KR20 (use only 0 and 1 to enter data for this)	0.235354538

Findings

The current research paper demonstrated a thorough investigation of *the significance of AI and Robotics in reshaping and reviving the field of medical tourism during and after COVID-19 pandemic*, and *how this sector will change by giving much importance to AI*. Preliminary findings from expert survey where five specialists have been approached worldwide to respond to a qualitative research survey pertaining to the above research aim. Among part of the study objectives were to analyze if the patients will avoid the waiting list, besides, to help embed a culture of prevention within the community for people to stay healthy and reduce

their need for physicians, which in turn reduces capacity and financial burdens on health systems (Hassan, 2015, Hassan & Noaman, 2017).

The main findings presented in the paper have shown that COVID19 had a devastating impact on the medical tourism sector due to the restriction of travel and limitations of giving visas, besides how AI and Robotics are becoming an important part of the healthcare sector globally in not only treating diseases or carrying out intricate procedures but also supporting well-being, prevention, and early intervention is what this study is investigating (Hassan & Noaman, 2017; Huang et al., 2020; Rogoff, 2020).

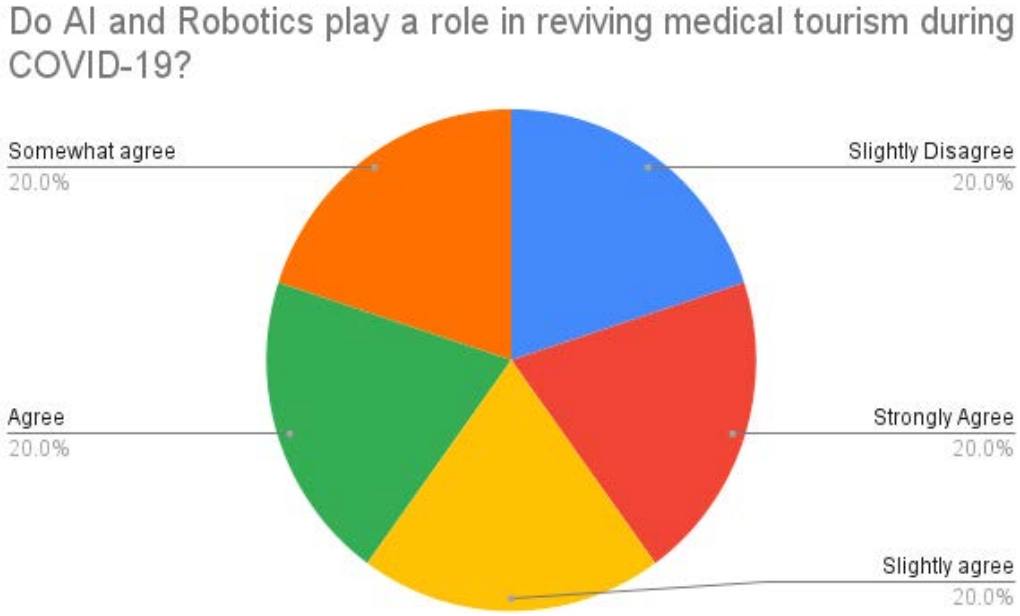
Reviving Medical Tourism through AI and Robotics

Our expert survey demonstrated that all respondents somehow collectively agree to the question with reservations, while in terms of the expert responses, of whom three are robotics experts, among others, an orthopedic specialist and a dentist. In terms of dentistry, it is the dental laboratory component that is considered to be automated with the dental CAD CAM machines, while the profession still remains with contact. Note the 1st expert responded to the qualitative (semi structured) survey on July 1st 2021, whilst the last one responded on July 22nd, so the non-numerical study took three weeks to complete effectively.

Let's discuss the finding in terms of our main research theme, which revolved around investigating whether or not *AI and Robotics play a role in reviving medical tourism during COVID-19* (Van et al., 2020). Thus, from interpreting our findings, we can say that both the first and third experts show neutral arguments pertaining to the above statement, while the second, while the second, fourth and fifth experts agree. The real results are shown in Figure 4, and in we interpret it in a simplified way, 60% of the experts agree, while 40% are neutral. But, if we take the results from the findings per se, it is 60% agreeing, 20% slightly agreeing and 20% slightly disagreeing. Therefore, and to avoid confusion, we go with Figure 4, and could interpret that 80% agree while 20% disagree.

The results of the interview questions pertaining to collecting the opinion of the medical tourism agency directors we sought to reach out to enabled us to see whether or not AI has helped to revive medical tourism and medical tourists to be followed by their doctors, and if the new type of medical tourism such as Robotics and Telehealth will continue growing after COVID 19. The answers of this one expert who did get back to us allowed us to present the following findings. Thus, it was important to contact a medical travel agency in order to understand the role of travel agencies in promoting Medical Tourism, so through the interview we found that the agency is focusing mainly on Cosmetic surgery, as a package which it includes the accommodation, transportation, follow up, consultation. Other than this, the interview, being more of a discussion was summarized in the paragraph below pertaining to the exact roles of travel agencies in promoting medical tourism.

Figure 4. *Detailed Reponses from the Five Experts*



Medical Travel Agency

Adding to it, the travel agency we interviewed promote two main destinations: Turkey (for cosmetic and hair transplant interventions) and Croatia. So basically it covers the Near East and Eastern Europe as preferred destinations for medical tourism. So, in terms of what the interviewee addressed to us, what we noticed while conducting the research that Iran and several destinations in the Maghreb were also attractive as well for medical tourism and for various interventions going from simple medical treatments to complex surgeries, even Lebanon for In Vitro fertilization (see: Johnston et al., 2010; Samadbeik et al., 2017; Béland & Zarzeczny, 2018; Ghassemi et al., 2020; Lunt, et al., 2020).

The business was doing very well until the COVID-19 pandemic struck, as it affected the entire process since they couldn't manage for arranging the visa procedure for its clients. At the same time, with the successive lockdown and the closed borders, things were difficult for regular trips, but it did manage to get permissions for emergency cases. The agency expectation of the industry is that the business will be growing very fast again, after the drop in sales of medical tourism packages during the pandemic.

The reverse was observed after people were getting vaccinated, and most of the agency's customers are currently asking for nature based, wellness and other forms of slow and sustainable tourism, as associated to medical tourism packages, since healing tourism such as yoga, retreats, spas and so on are other packages the agency's clients demanded as well as the cosmetic surgery packages.

For the question if the robotic surgery will replace the traditional medical tourism; the travel agent we asked, believed that though that it will take time as the people prefer the traditional one as they will feel more secure to meet a physical doctor doing a traditional intervention, for sure the future of Medical tourism will

change and the technologies already are showing increasing trends that it will reshape the medical tourism sector.

Pilot Study and Quantitative Survey Results

Whilst still conducting the interviews, on July 14th 2021, a pilot study was carried out as part of the Quantitative data collection strategy for our research. A total of 10 people were approached for testing if the survey was clear and understood: Some minor changes were administered on the survey, based on some of the respondent's feedbacks. The interpretation of this survey follows sequentially that of the expert qualitative surveys and interviews. As the pilot study was fairly well received, the survey turned out to be fairly well correlated as well.

Question 1 (*Where are you based*?) was majority responded by over 85% subjects to be based in the Middle East (yet, as the GCC countries are part of the Middle East, we can consider that the 75% responses come from people based in the Near East, or the Levantine coast, to mean geographically Lebanon, and 8% of the responses to be from the GCC). In terms of responses, 8% of the responses come from Europe, while the remaining responses come from other areas. If we compare with the expert survey, 40% were based in the Middle East, and 40% in the GCC, and the remaining 20% in USA, showing s slightly different sample, as the survey presented a randomly targeted sample of our population unlike the exert survey that was purposive. Question 2 (*What is your average age level*?) tells us that most of our respondents are aged between 20 to 30 years old (70%), meaning that most of our sampled population was composed of youths (Jabbour, 2018; Melkonian, 2019). In equal percentages, we noticed that there are respondents between 40 to 50 years old, and fewer than 20 years old (15% each, or totaling 30% for both age ranges).

Questions 3 to 10 effectively target the questions pertaining to *whether or not Robotics and AI play a role in Medical tourism* (Samala et al., 2021). So, in terms of Question 3 (*Have you made plans for the COVID-19 outbreak*?), 23% of the respondents claimed they had made plans, 31% claimed they were unsure, while, the rest said no, that they had made no plans, which total around 46%. This makes sense, as most people anyways cannot make plans due to the pandemic. While, with Question 4 (*Your practice was affected by COVID-19*?) we see that all of our respondents were affected by Covid 19. Yet, pertaining to Question 5 (*Are you Looking for more guidance and resources from others in the industry*?) 54% of the respondents said yes, while in equal proportions, respondents said they were unsure and that they did not need guidance (totaling 46% for both).

Addressing Question 6 (*Will COVID 19 Change the future of Medical Tourism*?) we realize that 77% of the respondents said yes and the remaining 23% were unsure (Bulatovic & Iankova, 2021). However; with Question 7 (*Does AI and Robotics play a role in reviving medical tourism during COVID-19*?), the results seem inverted in comparison to the previous question; with 38% of the respondents agreeing to the question, and 62% of them not being sure (See: Van et al., 2020). While, Question 8 (*Is the role of AI in transforming the industry and making it more feasible for patients*?), which seems to join both of the former

questions in terms of ranges; shows that 54% of the respondents say yes, and that 46% of them are not sure (see: Hassan, 2015, Hassan & Noaman, 2017).

Whereas, Question 9 (*Will Remote surgeries and Robotics have benefits for medical tourists*?), showing the pretty much exactly the same rate of responses could confirm this tendency. Finally, Question 10 (*Will the AI reshape the future of medical tourism*?), which also yields the same results somehow does show this tendency. Both questions show results showing response rates of 63% of the respondents to agree and 37% to think that they have benefits and reshape medical tourism (Bellos, 2021).

In other words, the last three questions were agreed by 54% of the subjects and, that the remaining 46% of them were not sure (see: Fig. 5). In terms of Cronbach Alpha, our survey is well correlated with a value of 0.86 (Table 1). In terms of responding to our research questions, a pattern is seen whereby indeed, practices, even in the medical and tourism sectors, were affected by the Pandemic. While, overall, the responses agree to the link of Robotics and AI, to be affecting the Medical tourism sector, and confirm a positive relationship, as overall, 59% of the respondents agree, while, 35% of them are unsure, and the remaining 12% disagree (Hwang et al., 2018). So, yes we do see a link in our variables here, and we can safely confirm H1, and reject H0 and H2.

Based on Figure 5 Generally, our preliminary survey results point out to the following, as close to 56% of the survey subjects agree, to the statement that there is a link with AI and robotics and Medical tourism, while 33% are neutral and 11% disagree, based on our bulk survey results.

Discussion

Based on the research findings, 9 research questions were addressed through the surveys and interviews. Bellos (2021) confirmed in his research that the increased demands for improved basic healthcare services and encouraging healthier lifestyles do count for reasons that people may want to consider getting wellness, health or medical tourism packages. The majority of the subjects that were surveyed said that the pandemic has altered the sector, and even consumption behavior at some extent was influenced by the endemic. To date, more people consider investing in such packages, as motivations for seeking increased and improved lifestyles as well as desiring to have better access to health facilities.

As there are increasing demands for such packages, people are basically willing to consider investing in those process and seek better quality services, so the industry ought to consider providing attractive deals, though advertising and communicating these products based on consumer demand. Therefore, and based on our findings, there is a link with Robotics, and AI on Medical Tourism, since most respondents confirmed this.

What are the reasons behind the growth of medical tourism sector? Well as Bellos (2021) pointed out, an increase in demand in health tourism or in lifestyles will motivate more purchases of such tourism packages. This coupled with seeking cheaper medical treatment in a foreign country versus the same treatment back home, which is more expensive even without the same

Do AI and Robotics play a role in reviving medical tourism during COVID-19? Yes they do, since the experts we interviewed and the randomly targeted survey subjects believe that distance surgeries and through AI and robotics could help

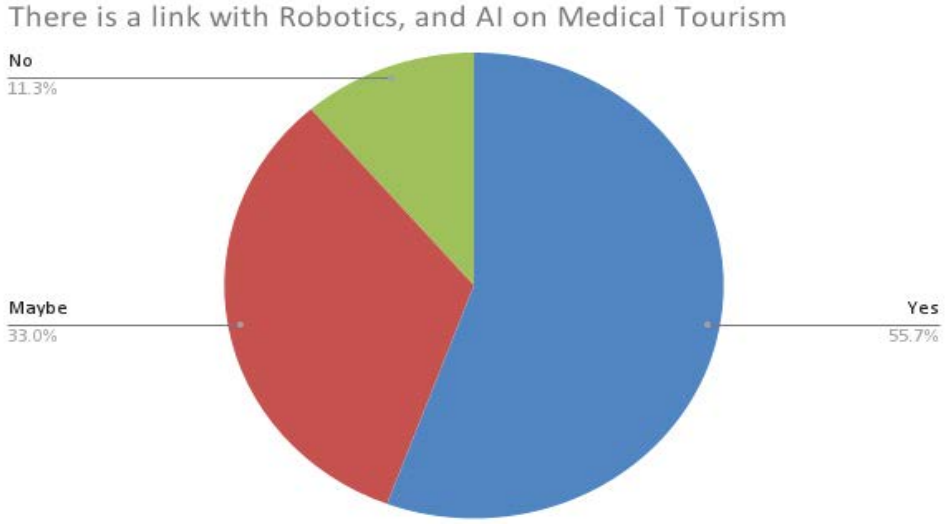
What is the role of AI in transforming the industry and making it more feasible for patients?
Does COVID 19 change the future of medical tourism by creating a new niche Market through AI and Robotics?
Does AI reshape the future of Medical Tourism?
How does COVID-19 change the Medical Tourism industry?
What are the possible modifications to help the medical tourism sector to revive and continue its growth through AI and Robotics?
Will Remote surgeries and Robotics have benefits for medical tourists?
Do Robotics and AI play a role in improving Medical tourism?

Summary

We found out important findings pertaining to the reasons behind the growth of medical tourism sector as more people in Lebanon (locals and visitors) sought to consider purchasing medical tourism packages especially in times of COVID, although the WHO travel restrictions and the UNWTO guidelines controlled the industry through strict regulations with mass tourism as such activities ceased or dramatically decreased during the successive lockdown periods. Experts in the domain indeed demonstrated that AI and Robotics play a role in reviving medical tourism during COVID-19, for many reasons as at times specialists/doctors were not present during interventions but communicated with colleagues or other surgeons using ICT tools. In terms of robotics, many surgeries became less invasive and made easier through such automated techniques.

Among the various roles of AI in transforming the industry, and making it more feasible for patients, is the ease of conducting complex procedures, and decreasing recovery periods at times while being cost beneficial for patients, among other advantages. Indeed, the COVID 19 has changed the future of medical tourism by creating a new niche Market through AI and Robotics, as mainly pre Covid, such systems were already been in use by the sector. While, the industry took advantage of the increased demand for medical tourism packages, tied to wellness and other health tourism needs patients be voiced as a result for the COVID pandemic.

Figure 5. *Bulk Response Results for the Quantitative Survey*



As a result, AI tools have reshaped the future of Medical Tourism partly due to the COVID-19 induced changes on the sector, and partly for other issues as well. This also has compelled changes in consumption behavior, profiling and demand, and whereby new tourism specific marketing strategies need to be considered (Frochot, & Legoherel, 2007; Dechavanne, 2014; Sheth, 2020). Although Remote surgeries and Robotics may have benefits for medical tourists, in some cases, this could be a weakness or a threat, in terms of the loss of market share.

Conclusion

To conclude, our research does hint out that medical tourism will be enhanced in the near future since patients seeking such types of tourism desire to look for treatments at a cheaper cost in countries providing a short stay for them whilst they recover from any surgery or medical intervention (Lunt et al., 2020; Gopalan et al., 2021). This research, now coming to a close, saw a positive link between AI and robotics in reshaping Medical tourism, and thus accepting H1.

In this regard, the authors confirm from research that medical tourism in the Middle East, and especially in Lebanon is an important sector in the tourism activities these countries rely on. if one includes the countries in the entire MENA region, it is noticed that several nations, like Tunisia, Morocco, Turkey and Iran have consequent activities generating from medical Tourism (Ghassemi et al., 2020). Algeria may be considered too (Harouat, 2011-2012).

The below research question responses will provide further evidence to our study.

So "*What are the reasons behind the growth of medical sectors*?" was the first question that was posed in the current research. It was noticed that there were many causes for the boom in this type of tourism, in terms of attracting tourists worldwide for benefitting for cheaper treatments, so countries like Turkey,

Lebanon and Iran appear on the map as tourism in these respective countries (of course pre epidemic) were high sources of GDP income (see: Lunt et al., 2020; Gopalan et al., 2021). Besides, in the case of medical tourism, for Lebanon, there are many types of cosmetic surgery products which highly attract worldwide tourists, as well as in-vitro fertilization (IVF).

Several HORECA experts in Lebanon, including Mr Pierre Achkar ascertain that in countries like Lebanon, tourism activities contribute to 20% of its GDP pre pandemic. There are no state intentions to focus on improving this sector, in spite of the urgent needs to valorize this sector and to enhance the activities revolving around medical or wellness or other related tourism activities.

The second question "*Do AI and Robotics play a role in reviving medical tourism during COVID-19*?" indeed was showing a link as both AI and robotic surgery (among other techniques utilizing ICT tools) did improve during the times of COVID 19. While the expert surgeons in one part of the world would assist other resident surgeons in other parts, and was deemed helpful for dealing with specific cases remotely. In our case, expert robotic surgeons, among other specialist in the medical or dental field had mostly agreed to this. However we notified that in the dental domain, CAD CAM machines (robotics) are used in the dental lab phase and not in dentistry itself (see: Gergely, 2020). ICT tools help in other ways the tourism sector, and not just AI. This is namely in terms of attracting touristic locates to potential customers. The authors consider that any other tool using IT and technology can be beneficial, like augmented reality (AR) or virtual reality (VR).

The third question ‘‘what *is the role of AI in transforming the industry and Making it more feasible for patients*?' was somehow positively responded for the patients' points of view as well. Why? Because, in some cases, during the early stages of the pandemic, we considered the plane loads of incoming Iranian COVID positive patients as medical tourists, even though this was a political move and not something enhancing tourism, as seems that the Lebanese oligarchy wants the pandemic to propagate. But, in terms of this question, indeed the pandemic having caused changes, caused the professionals in the sector to faces issues with mental health and wellbeing which needed immediately to find solutions (Hachache, 2021).

The fourth question "*Does COVID 19 change the future of medical tourism by creating a new niche Market through AI and Robotics*?" addressing the role of the pandemic indeed seems to have triggered a change, and yes, our findings indeed noticed this change (see: Wong & Hazley, 2020). Although, at this stage, we have seen a modification of how the sector plans to generate revenues; bottom line is that we now consider a change in the tourism market from luxury to wellness and nature based tourism (both included in eco and sustainable tourism), two types that could blend in with post op recovery from surgeries, and together with cultural and domestic tourism, could be included as packages under the umbrella of medical tourism.

The part related to AI and Robotics indeed sees a change and is also addressed in the fifth question "*Does AI reshape the future of Medical Tourism*?" to which the answer is yes. Yet, in terms of the sixth question "*How does COVID-19*

changes the Medical Tourism industry?" we obtained a preliminary response from our research to satisfy our research aims, so further research is suggested in this domain, especially in estimating the impact of the coronavirus endemic on the global recovery of the industry, not expected to fully recover until after 2025 (UNWTO, 2020a, b).

Although the last two questions were well covered in our surveying research design, we also suggest further research in these areas. So, the seventh question "*What are the possible modifications to help the medical tourism sector to revive and continue its growth through AI and Robotics*?" could be responded by having hybrid options whereby surgeons in one place meet up with the others in other places, in which the surgeries or treatments occur. Finally, in terms of the eighth question "*Will Remote surgeries and Robotics have benefits for medical tourists*?" it was found out that both remote surgeries and robotics help in certain cases, in terms of the WHO recommendations to avoid too much contact with treating physicians and patients.

Finally in terms of recommendations, mostly we propose further research in these domains and global efforts to correctly and effectively use medical tourism as a way to improve the activities in all countries, especially Lebanon contingent on tourism for economic growth and development, post pandemic.

A more thorough and in depth analysis is needed, such as a thorough analysis if this question targeting larger sample, hereby targeting customer reactivity and overall satisfaction pertaining to the services provided if they had formerly visited Lebanon for treatment. And If not, why or why not. *In case any barriers are considered in customer purchase decisions, what are the constraints they feel are preventing them from purchasing such packages*?

Throughout the pandemic as worldwide tourism activities were altered as per the WHO imposed travel restrictions and the UNWTO statistics pointing to a near 1 trillion USD global loss of revenues during the pandemic lockdown phases, it becomes important to see what re the future trends in tourism activities I terms of the market demand, especially In medical tourism

As a result, here are some potential reasons why the authors suggest future in depth studies to investigate further this issue, stressing on different modes of inquiry, based on what the future research contexts and scopes will be.

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