Development of a dental tourism management system: Rent A Dent

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Abstract—**The popular term that defines the act of traveling abroad to obtain desired dental care is called dental tourism. The following problems that arise with this occurrence are transparency in dental processes, data confidentiality, insurance problems and credibility of dental clinics. With technology getting more advanced every day, it became easier for patients to find appropriate dental care with numerous platforms that connect patients with desired dental care professionals. Rent A Dent represents a platform that allows patients to explore dental clinics abroad, giving them all the information they need. When the desired clinic is chosen by the patient, Rent a Dent platform acts as an intermediary between them to assure that both parties are satisfied and that the agreed dental services have been rendered.**

Keywords—dental tourism, web platform, dental digitalization

I. Introduction (*Heading 1*)

The first recognition and worldwide market adaptation of sharing services through the internet, as a proven business model has arisen straight from the United States by companies like Vrbo, Airbnb, and Uber[1]. The sharing service concept is based on the owner, provider, and user. The owner of the goods, services, or property provides value to the end-user by using the service of the provider. The provider is usually a company that has an application or platform that links the two parties for the goods or services to be shared. A company that provides services takes a one-time fee or monthly subscription from the end-user.

Today, people live longer because of lifestyle improvements, better education and easier access to better health care. In the global trend of digitization, medical services are also being digitized and technology is slowly reshaping the relationship between patients, healthcare providers and health systems[2]. The main focus of today's startups in the health sector is to resolve problems with: hospital workflow, AI and Big Data, medication adherence, sensors and wearables, telemedicine and care management, mental health, VR and AR, 3D printing and chronic disease management. With digitalization, health services are much closer to the patient, especially with wide usage of smartphone devices. Smartphones with appropriate infrastructure will play a crucial role in changing physician-patient communication. By providing access to such personal and sensitive medical data, individual startups were addressing security issues related to the storage of such confidential information. Going forward, these issues will be resolved using blockchain technology.

The transformation of the health sector comes about because society is strongly empowered to use digital tools. People require more professional and personalized service in every industry, and health care is no exception. They are often willing to seek such services outside their own country. Often the main reason is low-cost dental treatment abroad. Dental care can be costly even with insurance.

Dental tourism is defined by the American Dental Association (Resolution 28H-2008) as the act of traveling to another country to obtain dental treatment. The reasons why people travel abroad are lower costs, some procedures are only available abroad, privacy and the opportunity to explore another country, etc. Dental care tourism is widely accepted among cross-border countries such as the US and Mexico or Austria and Hungary[3]. Patients seek dental care abroad, especially due to fordable and timely prosthetic treatments that are not covered by their domestic insurance. The security of dental travel abroad could be improved by better information on available treatment choices, ongoing follow-up care and provider exchanges in different countries.

Price differentiation between well-developed countries and developing countries happens mostly because of the following factors: lower labour cost, insurance cost, government intervention, lower material cost and education tuition fees. However, the difference in price and accessibility is not always the primary criterion for foreign patients: the quality of service in the chosen country must be

at a certain level. Comparing prices between selected countries is one of the key points in deciding where to go abroad for dental care. Most of the users, who travel abroad, look for their medical intervention for a more affordable price, but with quality on a well-matched level. Dental tourists also combine their treatments with vacation and in a way contribute to tourism development. The Table I provides a comparison between dental-care prices in Serbia and some other European countries. Prices in Serbia are much lower, while providing high quality as the others, which makes Serbia more popular for dental tourists[4]. For example, an implant costs more than three times less in Serbia than in the United Kingdom. Additionally, if more treatments are performed, savings can be significant.

TABLE I.　　　DENTAL PRICES COMPARISON BY PROCUTS AND SERVICES

| Country | Dental products and services | | | |
	Ceramic Crowns	Zirocnia Crowns	Implants	Whitening
UK	585 €	850 €	1800 €	590 €
Italy	600 €	750 €	1300 €	430 €
Slovenia	350 €	450 €	1300 €	450 €
Germany	320 €	581 €	1000 €	348 €
Serbia	140 €	300 €	550 €	150 €

Medical tourism in general is a new phenomenon that has acquired global characteristics as a result of the increase in tourism mobility. The countries, already recognised in the medical travel industry are Mexico, Turkey, India, Hungary, South Korea and Costa Rica. Those countries also have a high percentage of travel receipts relative to GDP, mostly because of the capability to increase patient satisfaction.

Another common situation is that less developed countries, with good micro-location and borders with more developed countries, have evolved by offering different accommodation services, such as dental care and hair transplantation. The villages along the border between Germany and Poland, Hungary and Austria, as well as Croatia and Italy are good examples.

TABLE II.　　　PERCENTAGE OF FOREIGN PATIENTS IN BUDAPEST AND WESTERN HUNGARY

| Country | % of total foreign patients | | |
	Budapest	Western Hungary	Total
Austria	17.4%	83.6%	67.7%
Switzerland	11.8%	8.7%	9.4%
Germany	11.8%	6.2%	7.5%
UK	20.2%	0.2%	5.0%
Romania	11.3%	0.1%	2.7%
USA	5.3%	0.3%	1.5%

As shown in Table II, the highest percentage of foreign patients, requesting dental services in Hungary, comes from Austria, a neighbouring country sharing the same border.

The most critical points in seeking dental treatments abroad are different dental standards based on a country. In addition, there are language barriers, continuity of care, the ability to find trusted and reputable dentists, communication, travel planning and organization, and post-appointment care planning. One of the problems that arises, when it comes to dental care abroad, is the ability to prosecute interventions that have gone wrong for the patient.

There are many differences between the off-line comparison and the on-line approach to dental travel. Also, a lot of key aspects that can help each user decide where to go according to their preferences. The need to travel for medical care starts with the patient's need for an intervention which may be more or less urgent. Travel abroad for "old-fashioned" dental care has advantages and disadvantages. All of these issues can be addressed through adequate online platforms that gather data from dental clinics and present only verified data. The options, offered on the platforms, are primarily aimed at improving the user experience and enabling patients to have numerous options when choosing their dental professional.

In an offline approach, users encounter a number of factors that may determine their experience. For instance: how to find credible medical specialists and how to ensure that their choice is safe and secure in all aspects. First, issues related to finding a medical specialist without prior background checks are focused on price and security. Also, how to be sure that the intervention will be made properly, or whether the prices are consistent with the service. But, thanks to platforms, users control a lot more of what they need. This includes information about their chosen dental professional, based on recommendations of other patients. Additional information relates to legal licences and required documentation. Moreover, depending on the patient's budget and preferences, which country should be chosen?

Rent A Dent is a platform that links people who seek dental services abroad to professional dental clinics. By using web and mobile technologies, the platform resolves numerous problems mentioned above for both parties: patients and dental clinics.

II.　LITERATURE OVERVIEW

Today, dental services are inseparable from other digital processes related to the care of people and their health. According to paper[5], the most commonly used technologies and tactics are:

- Live video featuring real-time video communication between healthcare providers and the patient.

- Reserve and forward health information (e.g., digital patient impressions, x-rays, photographs, etc.) to the health care provider using a reliable communication system.

- Remote monitoring of patients and ambulatory health, where public health and educational providers use mobile communication. Devices, such as smartphones and tablets, are used to help patients outside of medical institutions.

The introduction of new technologies in travel and tourism introduces new consumer-centred tools and the impact of

digitization on dental care. There are a number of benefits in areas such as significant savings, knowledge sharing, personalized patient data, and better outcomes[6].

One of the key aspects of the success of digital platforms with dental services is marketing. There are two approaches to dental travel marketing, both offline and online. In online marketing, we have two kinds of patients or target groups: customers who have already taken a health intervention abroad, and customers who know nothing about medical tourism.

Marketing campaigns and final conversion are more cost-effective for the first group. These clients have more knowledge and are not afraid to seek dental treatment abroad. The second group first needs to be educated through a variety of news videos and blogs. An offline approach can be used to attract older populations who like to travel. Advertisements in travel magazines or a similar section in newspapers are a good alternative. The problem with the off-line approach is the lack of feedback. Problems in medical and dental tourism include data protection, transparency, digitization and interoperability. According to paper[6], blockchain has become a promising technology to address these problems.

Digitization in medical tourism is not such a frequent phenomenon, or something that may be called commonplace in everyday life, at least not yet. But there are indications that support the fact that going online, when seeking medical treatment, will be more frequent. Often, clinics that offer their services to international patients are supported by their own mobile applications. There, the patient can learn about the service, its dental professional and its range of prices. The downside of these biased applications is the fact that users can be exposed to altered and unverified information. To solve these problems, platforms are created to introduce all clinics together in a single location.

These platforms provide users with free access to all clinics and medical procedures they may need (such as laser eye, facelift, chiropractic, and more). Among the most visited platforms in the world is What Clinic. It provides patients with choice and comprehensive information about each service and clinic. The main difference between What Clinic and Rent A Dent can be split into two categories: what kind of service the user can get and in which country. While the What Clinic provides services to any medical condition and offers clinics in a number of countries, the Rent A Dent is specialized for dental problems and is located in Serbia. Rent a Dent acts as an aggregator that collects dental clinics in one location and provides the user with necessary information.

III. Model of dental tourism management system

In this research, web platform and mobile application for dental tourism were developed. The web platform consists of four key elements: 1) Presentation area, 2) Client portal, 3) Clinic portal, 4) Dentist portal.

The presentation area provides valuable information to end-users. Once the end-user registers and chooses the clinic and procedure, he becomes a client and has access to the client portal. This enables users to contact and chat directly with the clinic and then with a designated dentist. To help clients describe the problem, a 3-D view of the jaw is enabled. This makes it possible to select the teeth and describe the procedures, required for each of them. Using the client portal, users can upload ortophan and other important documents, get information on clinical offers, get 24/7 support and a live chat with a designated dentist.

The clinic portal allows clinics to manage all their employees, which includes personal information and professional documentation, as well as assign clients to specified dentists. Dentists on their own portal have options for chatting with users in real time, checking their downloaded ortophan and other important documents. All elements of the system have implemented a real-time notification system, both on the platform and via email. This makes it possible for all participants in the system to be up-to-date.

The infrastructure of the web platform consists of four different applications that communicate with RESTful API and through API, with Database as shown in Fig. 1. Each of the four applications was created using JavaScript and React framework. RESTful API was developed using PHP and Symfony framework that communicate with the MySQL database.
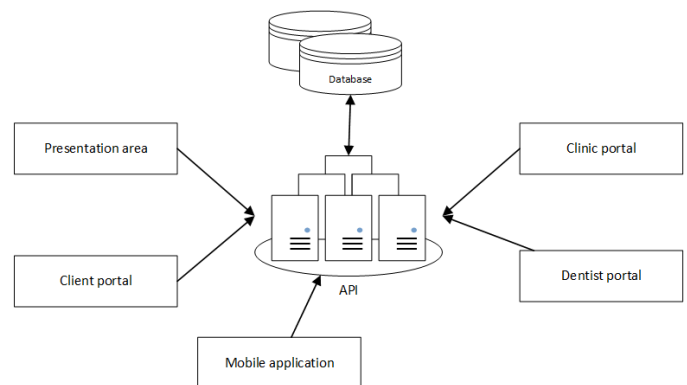

Fig. 1. Model of dental tourism management system

A mobile application for the client portal has been developed to facilitate end-user access to the system and to receive real-time notifications. The mobile application uses the API to store and receive data, as shown in Figure 1. The application was developed using the React Native framework that provides both iOS and Android access to the client portal on their smartphones.
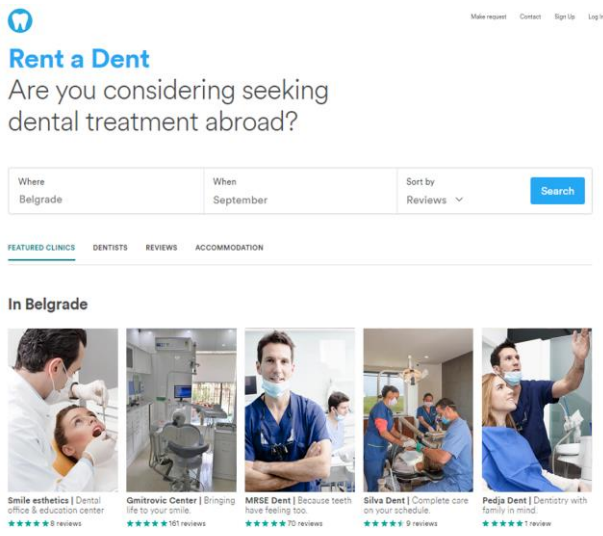
Fig. 2.   Web platform

Figure 2 shows a landing page where end-users can search for clinics by location, time and sort them by reviews or pricing as well as featured clinics.
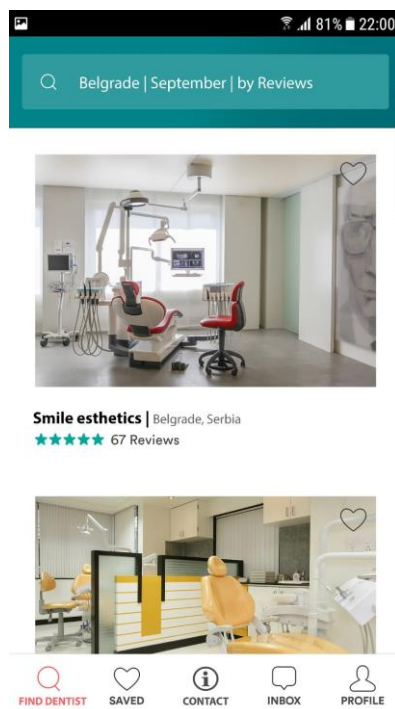

Fig. 3.   Mobile application platform

Figure 3 shows a search page for mobile applications, where users can see clinics filtered based on specified parameters.

IV. CONCLUSION

In this paper we discuss the fact that dental tourism has become an important part of the healthcare sector in Europe and around the world. Many patients, from distant regions, travel to neighbouring countries.

Price differences are a key factor in patients' decision to travel abroad to receive dental services. Therefore, Serbia has considerable market share potential. The demand for dental services, as well as the increased capacity of Serbian clinics and focusing on the needs of foreign patients, have led to an increase in dental tourism in Serbia[7].

The main problems that arise in dental tourism are the adjustment with GDPR, the storage of medical data and the lack of information about clinics and dentists. In addition, the manner in which procedures will be proceeded is one of the biggest issues that can arise. The Rent A Dent platform has overcome potential challenges by offering easier and more accessible communication, with verified and certified dental clinics in Serbia. To do so, dental clinics must be approved for viewing on the platform to determine if they have established standards and procedures. This includes fully operational staff with surgeons in-house, sufficient number of staff members and dental chairs, accessible accommodation, etc. Distance communication and pre-examination problems were reduced by having a form of anamnesis. It was mandatory to be completed by the patient just prior to the application being sent to the desired number of dentists .

The success of application usage only motivates authors to keep up the work and to expand the number of users while, in the meantime, having continuity with improvements .

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