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Telemedicine for international travelers through a Smartphone-based monitoring platform (Trip Doctor®)

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ABSTRACT

Background: Overall, more than 50% of international travelers develop symptoms while traveling and 55% of them seek medical assistance during the trip. We conducted a study to evaluate the usefulness of a Smartphone app called TRIP Doctor® to provide telemedicine to international travelers.

Methods: Participants over 18 years old attending our travel clinic at Hospital Clinic in Barcelona were invited to participate during 2017–2019. After downloading the app, the health status of the traveler was monitored on a daily basis, providing specific medical advice and offering remote contact with specialized physicians through an integrated chat, if needed.

Results: From 449 users, 59 (13%) contacted for medical assistance through the app during the trip. Main reasons for telemedicine were diarrhea (25.7%), skin conditions (19.7%) and fever (12.1%). Among patients who contacted, 90% of the travelers did not require to be referred to a local doctor. Symptomatic treatment was the main treatment prescribed (38%). In a 14.7% of the cases a follow-up was not required, a 63.2% recovered and 22.1% were loss of follow-up. After a multivariate analysis, duration of trip >14 days was found to be the only factor associated with the use of telemedicine (OR 2.2, CI 95% 1.1–4.5, p = 0.03).

Conclusion: In conclusion, travelers using telemedicine travelled for longer periods of time and mostly contacted for mild symptoms which could be solved successfully by remote assistance with our specialized doctors.

1. Background

Until the beginning of 2020 the progressive growth of tourism [1], the globalization of trade and the increase of professionals working for international and non-governmental organizations contributed to a great number of Europeans visiting and working at tropical and subtropical destinations.

According to some cohorts [2,3] international travelers, up to 51% of travelers experience symptoms while traveling and around and 55% of them seek medical assistance during travel. Moreover, hospitalization rate can be as high as 1% during travel [3]. Consequently, 21% of those international travelers who experienced symptoms stop their initial planned itineraries [2,3]' because of a medical problem. Besides health consequences, these events could cause elevated monetary and time loss costs for some travelers, especially for those who travel without insurance.

E-health and especially mobile health through telemedicine apps could help assisting travelers in need for a specialized doctor during the travel, but the impact of this tool has to be fully evaluated. It is a concern whether travelers will be able to contact through a mobile app if they are in a rural or remote area.

To shed some light on previous questions: according to the International Telecommunication Union [4], 93% of the world population have access to a mobile-broadband network. In most regions, more than 90% of the population has access to a mobile-broadband network (3G or above). The least covered areas are Africa and Commonwealth of Independent States where up to 23% of the population has no access to a mobile network. Only 17% of rural areas worldwide are not covered at

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all, even in low-income countries. However, these figures are likely to improve in the following years.

Likewise, travelers' willingness to use and pay for telemedicine could also be a barrier. A survey to determine whether travelers may be interested to use telemedicine s was performed among Swiss population in 2018. Around 59% of the travelers interviewed were interested in telemedicine and, among them, immunosuppressed and older travelers were more inclined to found telemedicine a useful tool. In this survey 99% of travelers were willing to pay for the service [5].

In our experience as a national reference center for travel medicine and tropical imported diseases, over the past years, an increasing number of travelers contact our team by phone or mail seeking for medical care during travel.

We conducted a study to evaluate the usefulness of a Smartphone app called TRIP Doctor® from Hospital Clinic Barcelona to provide telemedicine to international travelers.

The aim of the present study is to describe the reasons for consultation and the outcomes of the international travelers using telemedicine compared to a total cohort of travelers using a Smartphone app for health monitoring.

2. Methods

2.1. Study setting and study population

The study was conducted between 2017 and 2019 at the Hospital Clinic Barcelona Travel Clinic (Spain). Adult international travelers who attended our clinic before their trip were invited to participate in the study.

2.2. The smartphone-based system

The Trip Doctor® platform includes a Smartphone app to be installed on travelers' mobile phones. A web-back-end interface allowed capturing the health data automatically on a cloud server from a web secure browser. Physicians from our department were able to monitor patients in real-time and to interact remotely with them through the interface. The information recorded was uploaded to the system at any internet connection point during the travel.

The app was free of charge (downloaded through PlayStore® and Apple Store®), and it was activated by a code that each participant received after the inclusion in the study. The system monitored the health status of the traveler on a daily basis through a push message regardless to the symptoms or the need of a physician, providing specific medical advice and offering remote contact with specialized physicians through an integrated chat, if needed.

The app was routinely updated.

2.3. Statistical analysis

STATA 16 was used to summarize continuous variables as median and interquartile range [IQR] and categorical variables as frequency and percentage.

Univariate analyses were performed using the chi-square test or Fisher's exact test for categorical variables (and the Mann–Whitney *U* test for continuous variables). A multivariate logistic regression analysis which included statistically significant and clinically relevant variables in the univariate analysis was performed to determine independent predictive factors for telemedicine use. A p value of <0.05 was considered to be statistically significant. Results were given as odds ratios (OR) and 95% confidence intervals (95% CI).

2.4. Ethics

This study was approved by the Ethics Committee of Hospital Clinic Barcelona (reference HCB/2015/0995) and the clinical investigation was conducted according to the principles expressed in the Declaration of Helsinki. The participants signed a digital informed consent and privacy and legal disclaimers before using Trip Doctor®. The system was not designed to respond to emergencies and travelers were aware of that by the disclaimers and at recruitment.

Table 1
Univariate and multivariate analysis of predisposing factor for telemedicine use amog 458 travelers.

Predisposing factors to use telemedicine	Telemedicine users n = 59	Non-telemedicine users n = 399	Unadjusted Model OR 95% CI p	Adjusted Model OR 95% CI p
Age				
18–35 years	36 (62.1%)	208 (52.6%)	1.4 (0.8–2.6) 0.17	1
36–60 years	20 (34.5%)	154 (38.9%)	0.8 (0.4–1.4) 0.5	0.9 (0.5–1.8) 0.9
>60 years	2 (3.4%)	33 (8.3%)	0.4 (0.09–1.7) 0.2	0.5 (0.1–2.1) 0.10
Sex (Women)	37 (63.8%)	213 (53.9%)	1.5 (0.8–2.6) 0.1	1.5 (0.8–2,8) 0.16
Chronic condition	14 (24%)Ω	79 (20%)π	1.3 (0.6–2.4) 0.5	–
Purpose of travel				
Tourism	48 (82.7%)	289 (73%)	1.7 (0.8–3.6) 0.11	–
Bussines	2 (3.45%)	50 (12.6%)	0.24 (0.05–1.05) 0.04	0.4 (0.08–1.6) 0.18
Aid workers	8 (13.8%)	49 (12.4%)	1.1 (0.5–2.5) 0.76	–
VFR[#]	0	7 (1.7%)	–	–
Destination				
Africa	6 (10.9%)	110 (27.8%)	0.31 (0.13–0.76) <0.01	0.4 (0.2–1.1) 0.10
Americas	16 (29.1%)	94 (23.8%)	1.3 (0.7–2.4) 0.39	–
Asia	32 (58.2%)	181 (45.8%)	1.6 (0.9–2.9) 0.08	–
Rest of the world[*]	1 (1.82%)	10 (2.5%)	0.7 (0.08–5.7) 0.74	–
Duration of travel>14 days	45 (80.36%)	230 (58.3%)	2.9 (1.4–5.9) <0.01	2.2 (1.06–4.5) 0.03
Malaria prophylaxis	12 (21.05%)	110 (27.8%)	0.7 (0.3–1.3) 0.28	–
Use of the app <50% of the travel	30 (81%)	207 (75.3%)	0.7 (0.3–1.7) 0.43	–

[#] Visiting friends and family.
[*] Including Europe and Middle East Ωverified by a physician πself-reported.

3. Results

Among a total of 449 participants that used the Smartphone app, 59 (13%) contacted our medical team through Trip Doctor® during the travel. Traveler demographics comparing users and non-users of telemedicine are summarized in Table 1.

3.1. Telemedicine users

A total of 59 patients contacted through the app and 7 of them contacted twice for a different reason during the same travel.

Among travelers who used telemedicine, 7 patients (11.8%) reported comorbidities: 3 hypertension, 1 asthma, 1 hiatal hernia, 1 bone marrow transplant, 1 depression, and 1 anemia.

They contacted after an average of 14 days [IQR 6.5–25] of travel and soon after the symptoms started (0 days, [IQR 0–1]).

Fig. 1. Skin lesions reported by the travelers during the period of the study. From left to right, up and down: phytodermatosis-Vietnam; sea urchin lesion-Indonesia; atovaquone-proguanil folliculilits-Senegal; arthropod bites-Peru.

The reasons for contacting were: 17 patients (25.7% diarrhea, 13 (19.7%) skin problems (Fig. 1), 8 (12.1%) fever, 3 (4.5%) abdominal pain, 3 (4.5%) ear related symptoms, 3 (4.5%) respiratory symptoms and other reasons 19 (28.7%) (3 questions about how to take malaria prophylaxis, 1 case of lower limb deep vein thrombosis, 1 scorpion sting, 1 malaise, 1 leg pain, 1 altitude sickness-like symptoms, 1 case of dizziness, 1 nail prick, 1 urinary symptom, 1 thoracic trauma).

According to the symptoms described through the app, travel medicine doctors suggested to take medicines in 29 (49%) cases: symptomatic treatment mostly painkillers (16), antihistamines (7), antibiotics (5 cases, mostly the advice was finishing the prescription suggested at destination), and to take malaria standby treatment (1).

A 90% of the patients did not need to be referred to a local physician: only 6 (10%) were referred to a local doctor, mainly for fever or severe diarrhea, and eight (13.5%) to our own travel clinic after the travel.

Two hospitalized patients were remotely followed (one for a diagnosis of dengue, one for deep vein thrombosis) during all the admission and until they returned home.

In 14.7% of the cases a follow-up was not required, a 63.2% recovered and 22.1% were loss of follow-up.

3.2. Factors predisposing telemedicine use

We performed an uni and multivariate analysis in order to determine predisposing factors for telemedicine use (Table 1). After a multivariate analysis, travel duration >14 days was the only predisposing factor for contacting through telemedicine with an OR 2.2 (95%CI 1.06–4.5, p = 0.03).

4. Discussion

Our travelers successfully used the app for telemedicine. Telemedicine has proven useful as it can solve 90% of situations without the need to visit local health facilities in the country of destination.

Consistently with other European and North American cohorts of travelers, main symptoms were diarrhea, skin problems and fever [6]. Moreover, the most prescribed treatments (38%) were antihistamines and symptomatic treatments, posing low complex consultations.

The only factor that was significantly associated to the use of telemedicine was the length of the travel. Patients who used telemedicine made longer trips, 80% of them travel for more than 14 days compared to the travelers not using telemedicine that were only 58%. Travelers using telemedicine consulted after 2 weeks of travel since the beginning of the trip and soon after the symptoms started, mostly due to mild symptoms. That could mean that shorter trips have less risk of travel illnesses and do not need remote assistance than longer trips as it is seen in other cohorts [7].

Surprisingly, those who travelled to Africa or for business did not contact the most. It could be partly explained by the number of days of travel.Travelers who travelled to Africa made shorter trips (60% of them travelled less than two weeks). In the case of business travelers there were only two patients in the Telemedicine group, but still they made shorter trips (60% of business travelers made less than 2-week trips). Regarding to the amount of use of the app, underlying conditions or those who took malaria prophylaxis did not use telemedicine more than the others. In our cohort, young people used more telemedicine although this tendency was not statistically significant. Factors related to health problems in other cohorts [7] such as sex or destination were not associated with the use of telemedicine.

Although the follow-up loss was up to 22%, more than 50% of the patients either recovered or they did not need further assistance.

Overuse of the telemedicine service by the participants of the study has not been demonstrated, as only 13% of them contacted though the app for assistance.

Baseline characteristics of our study population match with people attending our travel clinic. As a consequence, the main limitation of our study is the lack of representation of some groups of travelers such as: (i) children, which were not included in the study, and (ii) VFRs, that present socioeconomic differences with our cohort and no easy access to mobile phones or internet.

To conclude, in our cohort patients who used telemedicine were those who travelled for longer periods of time and consulted for mild symptoms which could be successfully solved by remote assistance with our specialized doctors. Telemedicine could save money and time for travelers. Alongside it fills the gap between pre travel consultation and post travel medicine, covering the travel health status of the traveler during all the steps of the trip.

Declarations

This study was performed with the aim of the AGAUR Research Project Award 2018 PROD 00157.

CRediT authorship contribution statement

N. Rodriguez-Valero: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Visualization, Roles/, Writing – original draft, Writing – review & editing. **MJ Ledesma Carbayo:** Investigation, Resources, Validation, Writing – review & editing. **D. Camprubí-Ferrer:** Investigation, Methodology, Resources, Writing – review & editing. **H. Martí-Soler:** Data curation, Formal analysis, Investigation, Resources, Writing – review & editing. **D. Cuadrado Sanchez:** Investigation, Resources, Writing – review & editing. **A. Vladimirov:** Investigation, Resources, Writing – review & editing. **M.J. Pinazo:** Investigation, Resources, Writing – review & editing. **A. Almuedo-Riera:** Investigation, Resources, Writing – review & editing. **A. Roman:** Funding acquisition, Investigation, Project administration, Resources, Writing – review & editing. **I. Vera:** Investigation, Resources, Writing – review & editing. **M. Roldan:** Investigation, Resources, Writing – review & editing. **T. de Alba:** Investigation, Resources, Writing – review & editing. **A. Jimenez:** Funding acquisition, Investigation, Project administration, Resources, Writing – review & editing. **Juan J. Gómez-Valverde:** Investigation, Resources, Writing – review & editing. **M Luengo Oroz:** Investigation, Resources, Validation, Writing – review & editing. **J. Muñoz:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – review & editing.

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