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ORIGINAL ARTICLE

Positive environmental impact of remote teleconsultation in urology during the COVID-19 pandemic in a highly populated area

Évaluation de l'impact carbone de la téléconsultation en urologie durant le premier confinement en France lié au COVID-19

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KEYWORDS
Remote consultation;
Greenhouse gases;
Carbon footprint;
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Summary
Introduction. — Greenhouse gas (GHG) emissions are a serious environmental issue. The healthcare sector is an important emitter of GHGs. Our aim was to assess the environmental cost of teleconsultations in urology compared to face-to-face consultations.
Materials and methods. — Prospective study of all patients who had a remote teleconsultation over a 2-week period during COVID-19 pandemic. Main outcome was the reduction in CO_2e emissions related to teleconsultation compared to face-to-face consultation and was calculated as: total teleconsultation CO_2e emissions—total face-to-face consultation CO_2e emissions. Secondary outcome measures were the reduction in travel distance and travel time related to teleconsultation.
Results. — Eighty patients were included. Face-to-face consultations would have resulted in 6699 km (4162 miles) of travel (83.7 km (52 miles) per patient). Cars were the usual means of transport. CO_2e avoided due to lack of travel was calculated at 1.1 tonnes. Teleconsultation was responsible for 1.1 kg CO_2e while face-to-face consultation emitted 0.5 kg of CO_2e. Overall, the

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total reduction in GHGs with teleconsultation was 1141 kg CO_2e, representing a 99% decrease in emissions. Total savings on transport were 974 € and savings on travel time were 112 h (1.4 h/patient).
Conclusions. — Teleconsultation reduces the environmental impact of face-to-face consultations. The use of teleconsultation in our urology departments resulted in the avoidance of more than 6000 km of travel, equivalent to a reduction of 1.1 tonnes of CO_2e. Teleconsultation should be considered for specific indications as the healthcare system attempts to become greener.
Level of evidence. — 3.

MOTS CLÉS
Téléconsultation ;
Gaz à effets de serre ;
Empreinte carbone ;
Urologie ;
Environnement

Résumé
Introduction. — Les émissions de gaz à effet de serre (GES) constituent un grave problème environnemental dont le secteur de santé est un important émetteur. L'objectif était d'évaluer l'impact environnemental des téléconsultations instaurées en urologie pendant le premier confinement.
Matériel et méthodes. — Tous les patients qui ont eu une téléconsultation sur une période de 2 semaines pendant la pandémie COVID-19 au sein de deux centres universitaires ont été prospectivement inclus. Les émissions d'équivalents CO_2 (eCO_{2e}) relatives à la téléconsultation ont été minutieusement calculées et comparées à celles émises si la consultation avait eu lieu en face-à-face. Dans un second temps étaient évalués le temps et les coûts liés aux déplacements d'une consultation en présentiel.
Résultats. — Au total, 80 patients ont été inclus. La téléconsultation a permis d'éviter 6699 km de déplacement (83,7 km/patient). La voiture était le moyen de transport le plus utilisé. La téléconsultation a permis une réduction d'1,1 tonne d'eCO_{2e} liée aux déplacements. La téléconsultation en soi émettait 1,1 kg de CO_2e tandis que la consultation en face-à-face émettait 0,5 kg de CO_2e. Globalement, la réduction totale des GES grâce à la téléconsultation a été de 1141 kg CO2e, soit 99 % des émissions. Les économies totales étaient de 974 € et 112 h (1,4 h/patient) passées dans les transports ont été évitées.
Conclusion. — La téléconsultation permet de réduire l'impact environnemental par rapport aux consultations en face à face. La téléconsultation devrait être envisagée pour des indications spécifiques dans le cadre des efforts déployés par le système de santé pour devenir plus écologique.
Niveau de preuve.— 3.

Introduction

Current healthcare systems are faced with many challenges that are likely to increase in the future. Due to the constant population increase worldwide, the anthropogenic emission of greenhouse gases (GHGs) is an environmental issue that many countries have decided to prioritise. The healthcare sector is an important emitter of anthropogenic GHGs and is estimated to be responsible for 4.4% of total emissions worldwide with various discrepancies between countries (10% of total emissions in the USA and 20% of public sector emissions in the UK) [1—3]. Equivalent access to healthcare for every patient is a priority, but the accessibility of healthcare facilities and the cost of care are two major obstacles to this. Additionally, providing a facilitated healthcare access with our current tools may be inconsistent with a greener healthcare industry.

Teleconsultation and telehealth medicine were first introduced in the late 1970s but has recently been used more widely due to the COVID-19 pandemic [4—7]. Teleconsultation has a positive environmental impact because it reduces the number of motorised journeys while maintaining optimal healthcare access. Moreover, the efficiency and overall satisfaction of this new tool have already been demonstrated [8,9].

Although the environmental benefits of teleconsultation have already been described, previous studies have several limitations [10—12]. In the majority of studies, the different modes of transport used by the patients, such as the car, public transport or train, were not taken into consideration in the analysis of GHG emissions. Most studies also failed to evaluate the energy costs of devices used for teleconsultation (computers, internet connections). Finally, most studies were undertaken in sparsely populated areas and not in urban areas where many trips can be made by public transport, electric vehicles, bike or on foot.

The aim of this study was to assess the reduction in carbon footprint related to the replacement of in-person consultations with teleconsultations in two urology departments in a dense city (Paris) during the COVID-19 pandemic.

Material and methods

Study population and data collection

Every patient who had a remote teleconsultation in two academic urology departments over 14 consecutive days in May 2020 were included in this study. The teleconsultations were led by five senior urologists and had been introduced in these departments for the first time 1 month previously as a response to the COVID-19 lockdown in France. Teleconsultation was performed using the website doctolib© (www.doctolib.fr). Patients who lived in another country were excluded from the study in order to have better fare distance homogeneity.

The following demographic data were collected for each patient: age, sex, reason for consultation, place of residence, mode of transport. The local ethic board approved this study and each patient gave their consent to participate.

Environmental outcome analysis

The main outcome measure was the environmental cost of teleconsultation compared to in-person consultation. For each patient, we calculated the carbon footprint generated by the teleconsultation compared to that of a regular consultation.

For the teleconsultation, we took into account the energy consumed by two computers (patient and urologist) for a 20 min live video connection using either optic fibre or digital subscriber line (DSL). We assumed that 15 minutes of the connexion were for the consultation itself and that the 5 remaining minutes were used for website registration and for appointment scheduling. The energy consumed was then converted to CO_2 equivalent (CO_2e) using the French National Environmental calculator conversion factor (1 kWh = 0.1 kg CO_2e) [13]. We considered that both patients and consultants used teleconference equipment based on a computer, a webcam and a loudspeaker equivalent to 200 Wh for 1 h of use. Overall, one set of teleconsultation equipment for a 20 min connection was estimated to have consumed 67 Wh, equivalent to 0.0067 kg of CO_2e.

The estimated energy consumed for a regular in-person consultation included the mode of travel declared by the patient (car, walking or public transport) and the distance travelled to the hospital and the return journey home. For car journeys, we selected the type of car most frequently used in France in 2019 according to the ministry of transport (diesel engine car) [14]. The travel and time distances were evaluated using Google Maps from the patient's address to our institution on a morning weekday. The amount of GHGs (CO_2, methane, nitrous oxide and other air contaminants) was then calculated as CO_2e following the conversion factors used by international organisations to report on 2020 GHG emissions [15]. We chose this tool because it emanates from a government, has already been used in previous studies and the full conversion methodology is public and available. Car emissions were estimated using the category ''Average car'' using ''diesel fuel'' (1 km = 0.175 kg CO_2e). For carbon and equivalent costs of public transport, the national French railway company (SNCF) carbon emission was used to evaluate CO_2e emission (1 km on the metro = 0.0034 kg CO_2e). Patients who went to their consultation on foot were considered to be GHG emission free.

Finally, the overall reduction in GHG emissions was calculated as the difference in CO_2e emission between teleconsultation and a hypothetical in-person consultation if teleconsultation had not been available.

Cost outcome analysis

The overall reduction in cost of teleconsultation compared to in-person consultation was calculated. The consultation cost was not included as it did not differ between remote and in-person consultations. The calculation included the diesel cost for the average French car (0.07 l/km at a rate of 1.47 €/l equal to 0.1 €/km) [14]. For public transport, a one-way ticket without reduction in costs (1.90 €) and was used as standard. For teleconsultation, we did not calculate any internet or computer costs considering that most patients now possess a computer with internet access in our country.

Patients and physicians satisfaction analysis

As a secondary outcome, patient and physician's satisfaction regarding their remote consultation was assessed using the Telemedicine Satisfaction Questionnaire (TSQ) [16]. The TSQ is a validated 14-item questionnaire that evaluate patient satisfaction with telemedicine. This questionnaire uses a 5-point Likert scale ranging from ''Strongly disagree'' (1) to ''Strongly agree'' (5). TSQ score varies from 14 to 70, and a TSQ score > 56 was considered a good experience for the patient.

Statistical analysis

Quantitative variables are described as median and interquartile range [IQR] and qualitative variables as number and percentage. The reduction in GHG emissions was calculated as: total teleconsultation CO_2e emissions—total in-person consultation CO_2e emissions. All analyses were carried out using R version 3.6.2. (2009-2019 RStudio, Inc.).

Results

Patient demographics

Overall, 80 patients were included in this study. Median age [IQR] was 66 years [56—71], 10 patients were female (13%) and 20 (25%) were new patients. The main reasons for consultation were oncological (*n* = 49; 61%), functional urology (*n* = 14; 18%) and benign prostatic hyperplasia (*n* = 13; 16%). Two patients were excluded who lived in Cameroun and Senegal. Most of the patients usually drove to attend their consultations (*n* = 60; 75%).

Table 1 Distance and cost related to a round trip according to mode of transport.

Mode of transport	Cohort ($n = 80$)
Walking, *n* (%)	8 (10)
Distance (km), median [IQR]	3.8 [3.8–4.2]
Total distance (km)	20.4
Duration (min), median [IQR]	20 [20–25]
Total duration (min)	115
Public transport, *n* (%)	12 (15)
Distance (km), median [IQR]	12.7 [7.5–14.7]
Total distance (km)	156.8
Total cost (€)	45.6
Duration (min), median [IQR]	61 [43–80]
Total duration (min)	688
Car, *n* (%)	60 (75)
Distance (km), median [IQR]	40.2 [24.2–86.2]
Total distance (km)	6522
Cost (€), median [IQR]	4 [2.4–8.6]
Total cost (€)	928.4
Duration (min), median [IQR]	72 [52–112]
Total duration (min)	5934

Reduction in GHG emissions

Overall, 6699 km (4162 miles) would have been covered by the patients if the consultation had been face-to-face during the study period. The distance per person was estimated at 83.7 km (52 miles). Car journeys were the usual means of transport and patients drove 6522 km (97.3%) (Table 1).

The estimated CO_2e emissions avoided due to lack of travel was calculated as 1.1 tonnes during the 1-month study period (Table 2). Teleconsultations (two computers connected) were responsible for 1.1 kg CO_2e emissions while in-person consultations (only one computer used by the consultant) emitted 0.5 kg of CO_2e.

The total reduction in GHGs was 1141 kg CO_2e, representing a 99% decrease in emissions.

Secondary outcomes

Overall, the patients would have spent 974 € on transport if they had attended *in-person* consultations. This was distributed as follows: fuel (645 €), tolls (283 €) and metro tickets (46 €) (Table 1).

Avoiding in-person consultations saved the patients a total of 112 h of travel time which corresponded to 1.4 h saved per patient.

Of the 80 included patients, 69 (86.3%) judged the teleconsultation as a ''good experience'' according to their TSQ. Median TSQ was 66 (IQR = [58–67]). Of the 5 five urologists who performed the teleconsultation, 4 (80%) judged the teleconsultation as ''good teleconsultation''.

Discussion

The results of our study show that the use of teleconsultation resulted in a 99% reduction in GHG emissions, mostly due to reduced travel.

This study provides complementary information to that in the literature with a comprehensive assessment of the environmental and cost impact of teleconsultation in a highly populated area. Miah et al. were the first authors to carry out a prospective evaluation of the environmental and cost impact of a virtual urology clinic [12]. They estimated that the reduction in carbon footprint due to lack of travel ranged from 0.35 to 1.45 metric tonnes of CO_2e depending on the mode of transport (car or train). However, the authors did not include the carbon footprint related to the energy consumption of the virtual urology clinic and they did not take into consideration each patient's mode of transport.

Interestingly, a Canadian study stated that over a 6-month study period of 840 patients, teleconsultation resulted in a GHG saving of 185,159 kg of CO_2e while teleconsultation had an energy consumption of 42 kg CO_2e [17]. Another study by Holmner et al. showed, through a life-cycle inventory, that teleconsultation was associated with a 40-70% reduction in GHG emissions [18]. More recently, a Spanish study calculated that teleconsultation for 1 year, accounting for 12,322 procedures, resulted in a saving of more than 3 tonnes of CO_2 [10].

It is noteworthy that public transport was responsible for 0.5 kg of CO_2e emissions in our study. Although we calculated a major decrease in GHG emissions due to the avoidance of vehicle journeys, attending a in-person consultation by public transport should already be enough to reduce a patient's carbon footprint. Obviously, this concern is only applicable to patients living in a highly populated area with an efficient and broad public transport policy.

In 2015, during COP21 in Paris, 196 countries decided to reduce their GHG emissions in order to avoid a global temperature increase > 2 °C by 2050. In order to comply with the COP21 agreement, for example, French people need to reduce their GHG emissions 5-fold [19]. Carbon 4, an independent consulting firm specialising in low carbon strategies and adaptation to climate change, estimated that individual behaviour could lead to reduced GHG emissions of 2.8 tonnes

Table 2 CO_2e emissions and reduction in GHGs.

GHG producer	Teleconsultation	In-person consultation	Overall GHG reduction
Electricity consumption (kg CO_2e)			
Computer	1.1	0.53	+0.57
Transport consumption (kg CO_2e)			
Car	–	1141.3	−1141.3
Public transport	–	0.5	−0.5
Total	1.1	1142.3	−1.141.2

CO_2e per person per year, of which 30% is associated with mobility. We believe that an increase in teleconsultation could help in the individual reduction of GHG emissions.

This study is not a plea for the only use of teleconsultation. Although we evidenced that greening our healthcare system could be performed via teleconsultation and reduction of patients motorized transportation, the motive of teleconsultation should be carefully selected in order to avoid extra in-person consultation. Post-operative, stones or BPH follow-up could be, for example, good candidates for teleconsultation, whereas functional urology requiring physical examination should be in-person consultation. Also, there is a lack of literature with hindsight validating teleconsultation in replacement of in-person consultation.

Additionally, at the light of our results, there seems to be best ways to reduce more GHG emission. Indeed, a patient going to a teleconsultation walking emits less CO_2e when compared to a patient undergoing teleconsultation. However, not all patients live near their hospital and not all of them have a full mobility. Increasing the development of public transportation, expanding health care centre for consultation or a better repartition of the provision of care are solutions that could promote low GHG emissions in-person consultations.

We also found that teleconsultation resulted in a saving of 974 € (12 € per patient) divided between car fuel, tolls and public transport tickets. This small difference is not consistent with the literature. Masino et al. evaluated that patients saved 67,015 Canadian dollars over 840 teleconsultations equivalent to 80 Canadian dollars per patient [17]. The difference is explained by the demography of France. Our two academic centres are located in highly populated city and the network of hospitals is very close preventing long-distance travel. In the study of Masino et al., almost 400,000 km of travel were avoided for 840 teleconsultations, while our 80 patients only avoided 6522 km of travel. Additionally, depending on the country and its national health coverage, the cost for journeys will be different from one study to another.

Our study has a number of limitations. First, the energy consumption of teleconsultations could be miscalculated because we did not know the type of connection used by each patient (optic fibre or DSL). Also, The GHG emissions resulting from roads construction or maintenance and from car parking was not considered in our total. Moreover, we considered that each patient used a computer for the teleconsultation and did not take into account the use of smartphone that consume less energy. Consequently, our calculated carbon footprint could vary. Second, our study period was short with a limited number of patients. We also did not include in this study the onset of an in-person consultation after teleconsultation which would have an impact on the final results. Finally, we did not include the loss of salary caused by in-person consultations in the economic analysis and this figure could therefore be underestimated.

Conclusion

This cross-sectional study of a consecutive series of patients confirms that teleconsultation reduces the environmental impact of vehicle journeys required for in-person consultations. The use of teleconsultation in our urology departments during the COVID-19 pandemic resulted in the avoidance of more than 6000 km of travel, equivalent to a reduction of 1.1 tonnes of CO_2e. For specific indications, teleconsultation should be considered as a means of transformation to a greener healthcare system.

Disclosure of interest

The authors declare that they have no competing interest.

References

[1] Eckelman MJ, Sherman J. Environmental Impacts of the U.S. health care system and effects on public health. PLoS One 2016;11(6):e0157014.

[2] NHS carbon footprint | Measuring carbon footprint | NHS Requirements | Sustainable Development Unit [Internet]. [cité 26 oct 2020]. Disponible sur : https://www.sduhealth.org.uk/policy-strategy/reporting/nhs-carbon-footprint.aspx.

[3] Lenzen M, Malik A, Li M, Fry J, Weisz H, Pichler P-P, et al. The environmental footprint of health care: a global assessment. Lancet Planetary Health 2020;4(7):e271—9.

[4] Car J, Koh GC-H, Foong PS, Wang CJ. Video consultations in primary and specialist care during the covid-19 pandemic and beyond. BMJ 2020;371:m3945.

[5] Benschoter RA, Eaton MT, Smith P. Use of videotape to provide individual instruction in techniques of psychotherapy. J Med Educ 1965;40(12):1159—61.

[6] Gadzinski AJ, Ellimoottil C, Odisho AY, Watts KL, Gore JL. Implementing telemedicine in response to the 2020 COVID-19 pandemic. J Urol 2020;204(1):14—6, http://dx.doi.org/10.1097/JU.0000000000001033.

[7] Méjean A, Rouprêt M, Rozet F, Bensalah K, Murez T, Game X, et al. [Recommendations CCAFU on the management of cancers of the urogenital system during an epidemic with Coronavirus COVID-19]. Prog Urol 2020;30(5):221—31.

[8] Viers BR, Lightner DJ, Rivera ME, Tollefson MK, Boorjian SA, Karnes RJ, et al. Efficiency, satisfaction, and costs for remote video visits following radical prostatectomy: a randomized controlled trial. Eur Urol 2015;68(4):729—35.

[9] Pinar U, Anract J, Perrot O, Tabourin T, Chartier-Kastler E, Parra J, et al. Preliminary assessment of patient and physician satisfaction with the use of teleconsultation in urology during the COVID-19 pandemic. World J Urol 2021;39(6):1991—6.

[10] Vidal-Alaball J, Franch-Parella J, Lopez Seguí F, Garcia Cuyàs F, Mendioroz Peña J. Impact of a telemedicine program on the reduction in the emission of atmospheric pollutants and journeys by road. Int J Environ Res Public Health 2019;16(22).

[11] Oliveira TC, Barlow J, Gonçalves L, Bayer S. Teleconsultations reduce greenhouse gas emissions. J Health Serv Res Policy 2013;18(4):209—14.

[12] Miah S, Dunford C, Edison M, Eldred-Evans D, Gan C, Shah TT, et al. A prospective clinical, cost and environmental analysis of a clinician-led virtual urology clinic. Ann R Coll Surg Engl 2019;101(1):30—4.

[13] ADEME — Site Bilans GES [Internet]. [cité 1 nov 2020]. Disponible sur : https://www.bilans-ges.ademe.fr/.

[14] Véhicules en service | Insee [Internet]. [cité 27 oct 2020]. Disponible sur : https://www.insee.fr/fr/statistiques/2045167#tableau-figure1_radio1.

[15] Greenhouse gas reporting: conversion factors 2020 [Internet]. GOV.UK. [cité 31 oct 2020]. Disponible sur : https://www.gov.

uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020.
[16] Yip MP, Chang AM, Chan J, MacKenzie AE. Development of the Telemedicine Satisfaction Questionnaire to evaluate patient satisfaction with telemedicine: a preliminary study. J Telemed Telecare 2003;9(1):46—50.
[17] Masino C, Rubinstein E, Lem L, Purdy B, Rossos PG. The impact of telemedicine on greenhouse gas emissions at an academic health science center in Canada. Telemed J E Health 2010;16(9):973—6.
[18] Holmner A, Ebi KL, Lazuardi L, Nilsson M. Carbon footprint of telemedicine solutions-unexplored opportunity for reducing carbon emissions in the health sector. PLoS One 2014;9(9):e105040.
[19] Dugast C, Soyeux A. Pouvoir et responsabilité des individus, des entreprises et de l'état face à l'urgence climatique.: 21, https://www.carbone4.com/publication-faire-sa-part.