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RESEARCH COMMUNICATION

Zooming to Net Zero: Using Virtual Visits to Decrease Carbon Emissions and Costs from Surgery

Jenny H. Chang[1] · **Sara M. Maskal**[1] · **Ryan C. Ellis**[1] · **Ajita S. Prabhu**[1] · **Michael J. Rosen**[1] · **R. Matthew Walsh**[1] · **Benjamin T. Miller**[1]

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Introduction

Minimizing healthcare-associated travel may reduce the healthcare sector's greenhouse gas (GHG) emissions and patient costs, as travel is estimated to contribute 10% of healthcare sector carbon emissions.[1,2] The COVID-19 pandemic was a catalyst for telemedicine as the healthcare industry had to rethink clinical care while social distancing. We aimed to examine the patient cost burden and the environmental impact associated with travel versus telehealth before and during COVID-19.

Methods

Following IRB approval, the EMR was queried for General Surgery (GS) outpatient visits in the HPB, ACS, hernia, and breast divisions at our institution. Virtual visits (VVs) were defined as synchronous surgeon-to-patient video conferencing. Nineteen-month periods prior to (June 2017–December 2019) and during (January 2020–July 2022) COVID-19 were compared.

Table 1 demonstrates the outcome calculations based on the following assumptions: (1) Transportation from home (based on zip code) was by an average gasoline-powered passenger vehicle. (2) Average fuel economy = 24.2 miles/gallon (US Department of Energy). (3) CO_2 emissions are 95–99% of the total GHG emissions from a vehicle, emitting approximately 404 g of CO_2/mile (EPA). The environmental impact of computers was considered negligible.

Descriptive statistics were performed using Microsoft Excel (2013, Washington).

Results

A total of 56,248 office and virtual visits were identified. Before COVID-19, 26,208/26,515(98.8%) visits were in-office; 307/26,515(1.2%) were virtual. During COVID-19, 26,477/29,733(89.0%) were in-office; 3,256/29,733(10.9%) were virtual.

Patients participating in VV during the pre-COVID-19 period saved an estimated aggregate of $23,942, 8,345 gallons of gasoline, and 81,590 kg of CO_2 for a median travel distance saved of 378 (IQR 157–785) miles (Table 2). During the COVID-19 period, VV patients saved an estimated aggregate of $147,438, 49,233 gallons of gasoline, and 481,341 kg of CO_2 for a median travel distance saved of 182 (IQR 52–404) miles (Table 2). The difference equated 40,888 gallons of gasoline and 399,751 kg of CO_2 saved through utilization of telemedicine between the two periods.

During this study period, if a randomly selected half of the 52,685 office visits completed VVs, potential patient travel burden saved would be 4,502,916 miles and $613,008. The potential environmental impact would be 186,070 gallons of gas and 1,819,178 kg of CO_2 saved.

Discussion

During COVID-19, VV utilization increased from 1 to 11%. Saving nearly 40,000 gallons of gas and 400,000 kg of CO_2 emissions, telemedicine successfully maintained clinical

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✉ Jenny H. Chang
Changj7@ccf.org

1 Department of General Surgery, Digestive Disease and Surgery Institute, Cleveland Clinic, 9500 Euclid Ave A100, Cleveland, OH 44195, USA

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Table 1 Definition and formulation of outcome measurements

	Variable	Definition	Calculation
Patient travel burden	Travel distance	Round trip distance between patient zip code and service site of surgeon	Distance traveled $\times$ 2
	Travel costs	Cost of patient travel including cost of fuel and parking	$\left(\frac{\text{Distance traveled} \times 2}{24.2 \text{ miles per gallon}} \times \text{Average US retail gasoline price per year}\right) + \$4$ Based on the US Department of Energy average passenger vehicle fuel economy
Environmental Impact	Fuel consumption	Amount of standard gasoline consumed per round trip	$\frac{\text{Distance traveled} \times 2}{24.2 \text{ miles per gallon}}$ Based on the US Department of Energy average passenger vehicle fuel economy
	Carbon emissions	Vehicle emission of carbon dioxide	Distance traveled $\times$ 2 $\times$ 404g CO2 per mile Based on the Environmental Protection Agency's average passenger vehicle emissions per mile

Table 2 Estimated travel burden and environmental impact saved through utilization of virtual visits, median (IQR)

		2017–2019 virtual visits (N = 307)		2020–2022 virtual visits (N = 3256)	
		Median (IQR)	Total	Median (IQR)	Total
Patient travel burden	Saved travel distance (miles)	378 (157–785)	201,956	182 (52–404)	1,191,440
	Saved travel costs ($)	48 (22–92)	23,942	23 (9–49)	147,438
Environmental impact	Saved fuel consumption (gallons)	16 (7–32)	8345	8 (2–17)	49,233
	Saved carbon emissions (kg of CO2)	153 (63–317)	81,590	74 (21–163)	481,341

volume while reducing patient travel burden. If half of all GS clinic visits in this study were virtual, the potential environmental impact saved would be equivalent to the CO_2 emissions from 354 homes' electricity use for 1 year or carbon sequestered by a forest size of 1% of New York City. This is only representative of a portion of the GS department at one quaternary institution which sees 10 million patients annually.

VVs are feasible in GS; however, adoption has been limited. Barriers to increased integration of telemedicine include workflow disruption, security concerns, technology infrastructure and technology literacy of patients and clinicians, limited ability to examine patients leading to clinical uncertainty, and perceived lack of personal connection, as well as regulatory and reimbursement restraints.[3,4] As the USA declared a public health emergency during COVID-19, payers expanded previously limited coverage for telemedicine services, and the policy and payment landscape continues to evolve.[5,6]

Limitations include calculations that are based on theoretical assumptions and an inherent selection bias in those who choose/decline to utilize telehealth. Differentiation between encounter type (preoperative versus postoperative), visit duration, and technology failure rate was not acquired.

Conclusion

The impact of VVs extends beyond the cost of care not only in dollars, but on the environment. As the healthcare sector is a major contributor to climate change, telehealth is one way surgeons can make a positive environmental impact.

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Critical revision: Jenny H. Chang, Sara M. Maskal, Ryan C. Ellis, Ajita Prabhu, Michael Rosen, R. Matthew Walsh, Benjamin Miller.

All authors have read and approved the manuscript.

Data Availability The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data, such as patient zip codes, are not available.

Declarations

Conflict of Interest The authors have the following disclosures to report:
Jenny H. Chang MD has no financial disclosures.
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