



Center for  
**Connected  
Health Policy**  
The National Telehealth Policy Resource Center

## Environmental Impacts Research Catalogue

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To increase and organize the evidence for the use of telehealth, the Center for Connected Health Policy (CCHP) has been examining published studies that have been designed to measure the use of telehealth in achieving one or more of the goals of the Triple Aim. CCHP has been cataloguing studies published in peer reviewed journals that meet certain criteria. This catalogue of studies on the Environmental Impacts of Telehealth is one result.

CCHP employed several search parameters when selecting studies on the environmental impact of telehealth. All studies selected were published post 2010, have a sample size of no less than 50 (for studies with control groups, there needs to be a minimum of at least 30 subjects per group), a study period of no less than 6 months and a primary focus on the environmental impacts of a selected telehealth modality. Due to the lack of U.S. based studies, international studies have been included at the end of this catalogue. The absence of relevant prospective controlled studies also led to the inclusion of retrospective studies to make this catalogue possible.

Pub Med, Google Scholar, Science Direct, SAGE, Ebsco, ProQuest, WorldCat and JSTOR were used in the peer-reviewed articles search. Search terms included, but were not limited to: telehealth environmental impact, telehealth and emissions, telehealth and carbon, telehealth and pollution, telehealth and climate change, and telehealth and environmental cost. Each search was duplicated using both telehealth and telemedicine.

The original catalogue was prepared by McKenna Thompson and the work supervised by Mei Wa Kwong and Christine Calouro.

**U.S. based Summaries:**

**Dullet, N. W., Geraghty, E. M., Kaufman, T., Kisse, J. L., King, J., Dharmar, M., Smith, A. C., Marcin, J. P. (2017). Impact of a University-Based Outpatient Telemedicine Program on Time Savings, Travel Costs, and Environmental Pollutants. *Value in Health: the Journal of the International Society for Pharmacoeconomics and Outcomes***

Study Length	State	Sample Size	Telehealth Modality Type	Method	Outcome	Quality	Cost
17 years, 6 months	CA	19,246	Live videoconferencing	Retrospective analysis		x	x

**Summary**

**Objective:** The objective of this study was to estimate travel-related and environmental savings resulting from the use of telemedicine for outpatient specialty consultations with a university telemedicine program.

**Methods:** The study was designed to retrospectively analyze the telemedicine consultation database at the University of California Davis Health System (UCDHS) between July 1996 and December 2013. Travel distances and travel times were calculated between the patient home, the telemedicine clinic, and the UCDHS in-person clinic. Travel cost savings and environmental impact were calculated by determining differences in mileage reimbursement rate and emissions between those incurred in attending telemedicine appointments and those that would have been incurred if a visit to the hub site had been necessary.

**Results:** There were 19,246 consultations identified among 11,281 unique patients. Telemedicine visits resulted in a total travel distance savings of 5,345,602 miles, a total travel time savings of 4,708,891 minutes or 8.96 years, and a total direct travel cost savings of \$2,882,056. The mean per-consultation round-trip distance savings were 278miles, average travel time savings were 245 minutes, and average cost savings were \$156. Telemedicine consultations resulted in a total emissions savings of 1969 metric tons of CO<sub>2</sub>, 50 metric tons of CO, 3.7 metric tons of NO<sub>x</sub>, and 5.5 metric tons of volatile organic compounds.

**Conclusions:** This study demonstrates the positive impact of a health system's outpatient telemedicine program on patient travel time, patient travel costs, and environmental pollutants.

**Access:** <https://www.ncbi.nlm.nih.gov/pubmed/28407995>

**International Summaries:**

Holmner, Åsa, Ebi, Kristie L, Lazuardi, Lutfan, & Nilsson, Maria. (2014). *Carbon footprint of telemedicine solutions - unexplored opportunity for reducing carbon emissions in the health sector*. Umeå universitet, Institutionen för strålningsvetenskaper.

Study Length	Location	Sample Size	Telehealth Modality Type	Method	Outcome	Quality	Cost
1 year	Sweden	719	Live videoconferencing	Retrospective Life Cycle Assessment Comparison			x

**Summary**

**Background:** The healthcare sector is a significant contributor to global carbon emissions, in part due to extensive travelling by patients and health workers.

**Objectives:** To evaluate the potential of telemedicine services based on videoconferencing technology to reduce travelling and thus carbon emissions in the healthcare sector.

**Methods:** A life cycle inventory was performed to evaluate the carbon reduction potential of telemedicine activities beyond a reduction in travel related emissions. The study included two rehabilitation units at Umeå University Hospital in Sweden. Carbon emissions generated during telemedicine appointments were compared with care-as-usual scenarios. Upper and lower bound emissions scenarios were created based on different teleconferencing solutions and thresholds for when telemedicine becomes favorable were estimated. Sensitivity analyses were performed to pinpoint the most important contributors to emissions for different set-ups and use cases.

**Results:** Replacing physical visits with telemedicine appointments resulted in a significant 40-70 times decrease in carbon emissions. Factors such as meeting duration, bandwidth and use rates influence emissions to various extents. According to the lower bound scenario, telemedicine becomes a greener choice at a distance of a few kilometers when the alternative is transport by car.

**Conclusions:** Telemedicine is a potent carbon reduction strategy in the health sector. But to contribute significantly to climate change mitigation, a paradigm shift might be required where telemedicine is regarded as an essential component of ordinary health care activities and not only considered to be a service to the few who lack access to care due to geography, isolation or other constraints.

**Access:** <https://www.ncbi.nlm.nih.gov/pubmed/25188322>

**Steffen, B., Luís, G., James, B., & Tiago, C. O. (2013). Teleconsultations reduce greenhouse gas emissions. *Journal of Health Services Research & Policy, 18, 4, 209-214.***

Study Length	Location	Sample Size	Telehealth Modality Type	Method	Outcome	Quality	Cost
8 years	Alentejo, Portugal	20,824	Live videoconferencing	Retrospective analysis; Survey Research			x

#### Summary

**Objectives:** Health services contribute significantly to greenhouse gas emissions. New models of delivering care closer to patients have the potential to reduce travelling and associated emissions. We aimed to compare the emissions of patients attending a teleconsultation – an outpatient appointment using video-conferencing equipment – with those of patients attending a face-to-face appointment.

**Methods:** We estimated the total distances travelled and the direct and indirect greenhouse gas emissions for 20,824 teleconsultations performed between 2004 and 2011 in Alentejo, a Portuguese region. These were compared to the distances and emissions that would have resulted if teleconsultations were not available and patients had to attend face-to-face outpatient appointments. Estimates were calculated using survey data on mode of transport, and national aggregate data for car engine size and fuel. A sensitivity analysis using the lower and upper quartiles for survey distances was performed.

**Results:** Teleconsultations led to reductions in distances and emissions of 95%. 2,313,819 km of travelling and 455 tonnes of greenhouse gas emissions were avoided (22 kg of carbon dioxide equivalent per patient). The incorporation of modes of transport and car engine size and fuel in the analysis led to emission estimates which were 12% smaller than those assuming all patients used an average car.

**Conclusions:** The availability of remote care services can significantly reduce road travel and associated emissions. At a time when many countries are committed to reducing their carbon footprint, it is desirable to explore how these reductions could be incorporated into technology assessments and economic evaluations.

**Access:** <https://www.ncbi.nlm.nih.gov/pubmed/23945677>

Masino, C., Rubinstein, E., Lem, L., Purdy, B., & Rossos, P. G. (2010). The impact of telemedicine on greenhouse gas emissions at an academic health science center in Canada. *Telemedicine Journal and E-Health: the Official Journal of the American Telemedicine Association*, 16, 9, 973-6.

Study Length	Location	Sample Size	Telehealth Modality Type	Method	Outcome	Quality	Cost
6 months	Ontario, Canada	840	Live videoconferencing	Retrospective analysis			x

#### Summary

**Objective:** This study estimates the reduction in greenhouse gas (GHG) emissions resulting from 840 telemedicine consultations completed in a 6-month time period. Our model considers GHG emissions for both vehicle and videoconferencing unit energy use. Cost avoidance factors are also discussed.

**Materials and Methods:** Travel distances in kilometers were calculated for each appointment using postal code data and Google Maps

Web-based map calculator tools.

**Results:** Including return travel, an estimated 757,234 km were avoided, resulting in a GHG emissions savings of 185,159 kg (185 metric tons) of carbon dioxide equivalents in vehicle emissions. Approximately 360,444 g of other air pollutant emissions was also avoided. The GHG emissions produced by energy consumption for videoconference units were estimated to be 42 kg of carbon dioxide equivalents emitted for this sample.

**Conclusions:** The overall GHG emissions associated with videoconferencing unit energy is minor when compared with those avoided from vehicle use. In addition to improved patient-centered care and cost savings, environmental benefits provide additional incentives for the adoption of telemedicine services.

**Access:** <https://www.ncbi.nlm.nih.gov/pubmed/20958198>