Environmental impact of a tele-screening program for diabetic retinopathy in rural argentina

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Abstract

Background: Tele-screening programs for diabetic retinopathy are implemented worldwide, but the environmental impact has not been studied yet. The aim of this study was to evaluate the emission reduction achieved by a tele-screening program for diabetic retinopathy in La Pampa (Argentina).
Methods: A descriptive study was performed comparing the emissions generated with and without the program. A retinal camera was transported to 60 rural cities, and the images were classified asynchronously as “referable” and “non-referable”. An ophthalmologist then traveled to each location to assess the identified “referable” cases. The $eqCO_2$ emissions generated by the program were compared with those that patients would have generated if they had traveled from their location to the nearest ophthalmology center in the conventional manner.
Results: Emissions generated per patient without the program were equivalent to 63 kg, whereas with program implementation they ranged from 4 kg to 18 kg. The reduction in emissions per patient for 2019, 2020, and 2021 was 45 kg, 41 kg, and 62 kg, respectively. The absolute reduction in $eqCO_2$ emissions by the program for 2019, 2020, and 2021 was 166Tn, 28Tn, and 161Tn, respectively.
Conclusion: CO_2 emissions were significantly reduced by the tele-screening program for diabetic

retinopathy prevention in La Pampa. Ophthalmologists should consider the environmental impact when implementing their practice.
Keywords: diabetic retinopathy, telemedicine, environmental pollution, carbon footprint, global warming.

Impacto ambiental de un programa de *telescreening* de retinopatía diabética en argentina.

Resumen

Objetivo: La expansión mundial de programas de *tele-screening* para la retinopatía diabética ha demostrado su eficacia en diversas regiones; sin embargo, su impacto ambiental permanece insuficientemente examinado. Este estudio se propuso cuantificar la disminución en las emisiones de carbono atribuible a la implementación de un programa de *tele-screening* para la retinopatía diabética en La Pampa, Argentina.
Materiales y métodos: Mediante un diseño descriptivo comparativo, este estudio evaluó las emisiones de equivalentes de dióxido de carbono ($eqCO_2$) generadas por el desplazamiento de pacientes con y sin la operación del programa. Se utilizó una cámara retinal móvil para examinar a pacientes en 60 localidades rurales, clasificando las imágenes obtenidas en “referibles” y “no referibles” para posterior evaluación oftalmológica presencial en casos seleccionados. Las emisiones se estimaron comparando el $eqCO_2$ producido por el programa frente al que hubieran emitido los pacientes al trasladarse al centro oftalmológico más cercano por medios convencionales.
Resultados: Sin la intervención del programa, las emisiones por paciente se estimaron en 63 kg de $eqCO_2$, mientras que su implementación redujo este valor a un rango entre 4 y 18 kg por paciente. Durante los años 2019, 2020 y 2021 se logró una reducción de emisiones por paciente de 45 kg, 41 kg y 62 kg, respectivamente, lo que resultó en una disminución absoluta de emisiones de 166 toneladas, 28 toneladas y 161 toneladas de $eqCO_2$ por año, respectivamente.
Conclusión: La implementación del programa de *tele-screening* para la retinopatía diabética en La Pampa ha demostrado una significativa reducción en las emisiones de $eqCO_2$, subrayando la importancia de considerar el impacto ambiental en la práctica oftalmológica. Este estudio destaca el potencial de las intervenciones de telemedicina para contribuir a la sostenibilidad ambiental en el sector salud.
Palabras clave: retinopatía diabética, telemedicina contaminación ambiental, huella de carbono, calentamiento global.

Impacto ambiental de um programa de teletriagem de retinopatia diabética na Argentina

Resumo

Objetivo: A expansão global dos programas de teletriagem da retinopatia diabética demonstrou a sua eficácia em diversas regiões; no entanto, o seu impacto ambiental continua insuficientemente examinado. Este estudo teve como objetivo quantificar a diminuição das emissões de carbono atribuíveis à implementação de um programa de teletriagem para retinopatia diabética em La Pampa, Argentina.
Materiais e métodos: Utilizando um desenho descritivo comparativo, este estudo avaliou as emissões de equivalentes de dióxido de carbono ($eqCO_2$) geradas pela movimentação de pacientes com e sem operação do programa. Uma câmera retinal móvel foi utilizada para examinar pacientes em 60 localidades rurais, classificando as imagens obtidas em “refernciáveis” e “não referenciáveis” para posterior avaliação oftalmológica presencial em casos selecionados. As emissões foram estimadas comparando o $eqCO_2$ produzido pelo programa *versus* aquele emitido pelos pacientes quando se deslocam até o centro oftalmológico mais próximo por meios convencionais.
Resultados: Sem a intervenção do programa, as emissões por paciente foram estimadas em 63 kg de $eqCO_2$, enquanto a sua implementação reduziu esse valor para um intervalo entre 4 e 18 kg por paciente. Durante os anos de 2019, 2020 e 2021, foi alcançada uma redução nas emissões por paciente de 45 kg, 41 kg e 62 kg, respetivamente, resultando numa diminuição absoluta das emissões de 166 toneladas, 28 toneladas e 161 toneladas de $eqCO_2$ por ano, respectivamente.

Conclusão: A implementação do programa de teletriagem para retinopatia diabética em La Pampa demonstrou uma redução significativa nas emissões de $eqCO_2$, ressaltando a importância de considerar o impacto ambiental na prática oftalmológica. Este estudo destaca o potencial das intervenções de telemedicina para contribuir para a sustentabilidade ambiental no setor da saúde.

Palavras-chave: retinopatia diabética, telemedicina, poluição ambiental, pegada de carbono, aquecimento global.

Introduction

In recent decades, the world has experienced an enormous number of environmental disasters, largely due to increasing global warming. The consequences, such as polar ice retreat, heat waves, wildfires, droughts, and floods are some of the events that threaten not only human health, but also the future of the next generations[1]. In response to these challenges, the United Nations forged the Paris Agreement in 2016, aiming to mitigate the rise in global temperature and address climate change concerns[2].

While efforts to combat climate change primarily focus on reducing industrial emissions, it is essential to recognize the role of various sectors, including healthcare, in minimizing their carbon footprint. The healthcare sector is responsible for approximately 5% of global greenhouse gas emissions[3]. The United States healthcare system alone is responsible for an 8% increase in carbon footprint[4]. One of the measures that has a negative impact is the alarming increase in hazardous waste generated by healthcare systems[5]. Additionally, the necessity of medical visits often entails long-distance travel, resulting in harmful emissions that negatively impact the environment[6].

Nevertheless, some environmentally friendly measures have already been implemented to address these concerns. Telemedicine programs have emerged as a promising solution, not only improving access to medical care but also, in many cases, offering potential environmental benefits by reducing patient transportation[7-8]. The advent of the COVID-19 pandemic further accelerated the adoption of these types of services, and the number of teleconsultations increased tremendously, providing indirect environmental health benefits[9-10].

In the province of La Pampa, Argentina, the Ojo Pampa tele-screening program was introduced in 2019 to facilitate early detection of diabetic retinopathy. This program successfully enhanced access to eye examinations by 39%[11]. However, the environmental impact associated with the implementation of this program remains largely unexplored.

The primary objective of this study was to evaluate the carbon footprint of the tele-screening program for diabetic retinopathy in La Pampa. By assessing the environmental implications of this program, valuable insights can be gained to inform sustainable healthcare practices and contribute to the growing body of knowledge at the intersection of environmental sustainability and public health.

Materials and methods

The Ojo Pampa program was launched in 2019. A retinal camera was transported to 60 rural communities in La Pampa where there were no ophthalmology specialists. Color retinal photographs were taken to diabetic patients and classified asynchronously as "referable" or "non-referable"[12]. Referable cases were referred for face-to-face consultation. In 2020, the program underwent a change that continues to these days: an ophthalmologist travels to assess "referable" cases. A retrospective and descriptive study was conducted quantifying emissions in two scenarios: with the hypothetical situation without the program (HS) and with program (WP) functioning.

In the hypothetical HS scenario spanning 2019 to 2021, the study calculates emissions as if every "referable" patient treated had traveled from their locality to the corresponding Ophthalmology Department according to health zones[13]. General Pico corresponds to Health Zone 2, while other localities, including Santa Rosa, align with Health Zones 1, 3, 4, and 5.

Table 1. Number of visited localities and patients treated within the Ojo Pampa Program.

	2019	2020	2021
Total patients	3660	672	2604
Positive patients	912	154	513
Total localities	63	13	54
Localities with positive cases	59	13	49

In the case of scenario WP, which incorporates tele-screening improvements over the years, in the initial year of the Program (2019), emissions included a one-time assessment of the official vehicle's mobility from Santa Rosa to each locality. Patients with positive results traveled 30 days later to the nearest ophthalmology center, adding to the initial emissions. In subsequent years (2020 and 2021), the Program evolved, and the ophthalmologist traveled to each locality for the 30-day review of positive cases, reducing patient mobility. WP emissions in these years considered both the official vehicle and the ophthalmologist's travels to localities with positive cases. The reduction in emissions resulting from the WP scenario was determined by subtracting WP emissions from HS emissions, indicating the environmental impact reduction.

Utilizing this approach, we estimated the distance traveled from each rural community to the respective Ophthalmology Department (in cases where patients were mobilized) and from Santa Rosa to each rural community (in scenarios involving the mobilization of an ophthalmologist). These distance measurements served as crucial inputs for calculating transportation emissions across different situations. Supplementary Information 1 shows data on distances traveled by the official vehicle and the ophthalmologist from Santa Rosa to each locality, as well as distances from each locality to the corresponding ophthalmology center.

Table 1 presents the total number of localities visited and patients treated within the Ojo Pampa Program for each year. The table also provides a breakdown of localities and patients with positive diagnoses requiring a 30-day follow-up.

The emission estimation methodology employed to calculate transport emissions was a top-down approach of the Intergovernmental Panel on Climate Change (IPCC) Level 1 approach, calculating greenhouse gas emissions by multiplying estimated fuel consumption by predetermined emission factors. For the analysis, basic information on emission factors was taken from the methodological guidelines of the IPCC[14]. The approach is shown in the equation for greenhouse gas (GHG) emissions from transportation (Equation 1)

$$\mathbf{E = FC * EF}$$

Where

E = emissions [kg]

FC = fuel consumption [TJ]

EF = emission factor [kg/TJ].

The CO_2 emission factor accounts for all carbon from fuel, including carbon emitted as CO, volatile organic compounds, and particulate matter. These emission factors vary widely depending on the type of fuel used (gasoline, diesel, or gas). For CO_2 emissions, values were extracted from Table 3.2.1[15]. However, emission rates for CH_4 and N_2O are highly dependent on the combustion technology and emission control present in vehicles. Consequently, emission factors based on fuel alone, without specifying vehicle technology, are considerably uncertain. Therefore, as a precautionary measure, it is encouraged to use higher emission factors derived from Table 3.2.2[15]. Additionally, global warming potentials of 1, 21, and 310 are considered for CO_2, CH_4, and N_2O, respectively[16]. Table 2 offers a summary of emission factors for gasoline and diesel vehicles.

Various assumptions were made for the analysis, including vehicle types, catalytic converters, average fuel consumption, individual patient travel, and the destination of patient travel: 1) an average fuel consumption value of 9.1L/100km was estimated based on the highway consumption at 120 km/h of the 70 best-selling gasoline vehicles in Argentina[17]; 2) the official vehicle is a diesel pickup truck with a consumption of 12 liters per 100 km; 3) the ophthalmologist drove a gasoline vehicle with oxidation catalyst in each city, with and an average consumption of 8.5 L/100km.

As a secondary analysis, emissions per La Pampa resident caused by surface transportation were compared to the emissions reduction per treated patient achieved by the Program. For this purpose, total provincial emissions from surface transportation, without distinction by type, were divided by the estimated population of La Pampa according to the 2022 census[18].

To compare the amount of emission reduction per patient in each year, a Mann-Whitney U test was performed. STATA 16.0 software was used for statistical calculation, and a p-value <0.05 was considered statistically significant.

This study was conducted in full compliance with the Declaration of Helsinki.

Table 2. Emission factors by fuel type and emitted gas.

	EF (Kg/TJ)		
	CO_2	CH_4	N_2O
Gasoline	73.000	86	24
Diesel	74.800	9,5	12

EF: emission factors. CO_2: carbon dioxide. CH_4: methane. N_2O: nitrous oxide.

Results

Absolute emissions

In 2019, the program screened 3,660 patients, with 912 qualifying for referral. In 2020, 672 patients were screened, and 154 were eligible for referral. In 2021, 2,604 patients were screened, and 513 were found to be eligible for referral.

Table 3 presents all emissions in the hypothetical HS scenario and those effectively generated in the WP scenario. CO_2 is the predominant GHG, constituting 89% of total emissions. In both situations, it is evident that total emissions with the Program in operation were lower (Fig. 1). As absolute values, the greater differences between years within the same situation are attributed to variations in the number of patients treated and localities visited. Nonetheless, between the HS and WP scenarios, total emissions decreased by 72%, 95%, and 94% for the years 2019, 2020, and 2021, respectively. This underscores the substantial impact of the improvements implemented in the Program over the last two analyzed years.

Emissions per treated patient

This section delves into a detailed analysis of emissions per treated patient, measured in kilograms per capita, and categorizes these emissions by gas type for the years 2019-2021. The comparison between the hypothetical HS and actual WP scenarios provides insights into the program's impact on individual-level emissions.

Table 4 and figure 2 present a comprehensive breakdown of emissions per treated patient in both scenarios. The data underscores the effi-

Table 3. Absolute emissions (Tn) and by gas type for the period 2019-2021.

	HS			WP		
AE (Tn)	2019	2020	2021	2019	2020	2021
CO_2	205,16	26,02	151,33	58,01	1,41	9,17
CH_4	0,24	0,03	0,18	0,0618	0,0008	0,0048
N_2O	0,07	0,01	0,05	0,0180	0,0003	0,0021
Total emissions	231,15	29,32	170,49	64,89	1,52	9,91

Tn: tons. AE: absolute emissions. HS: hypothetical situation. WP: with program.

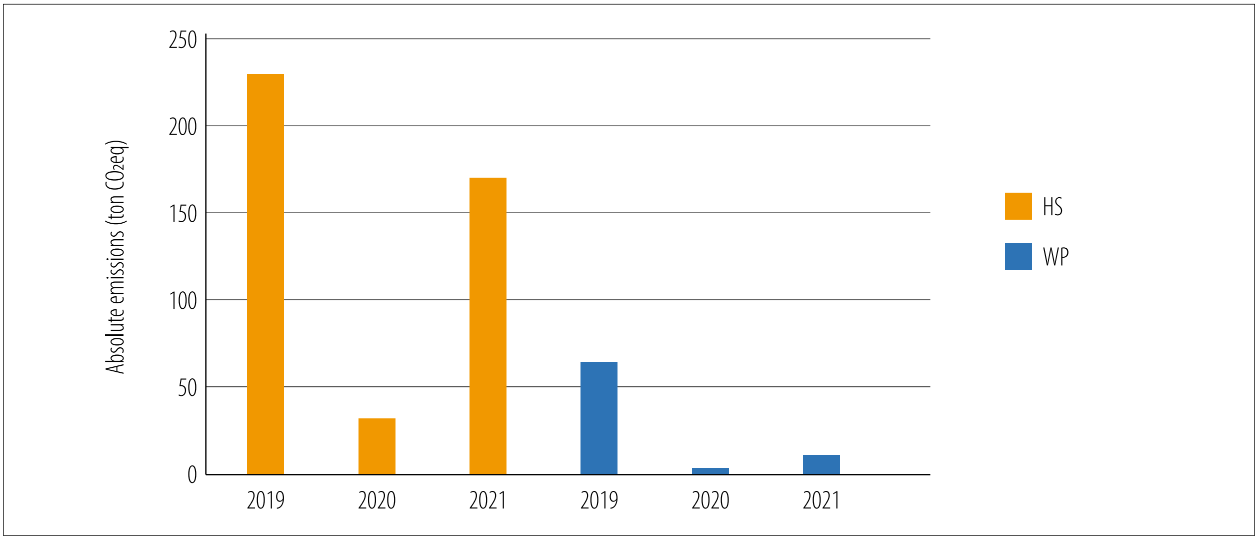

Figure 1. Absolute emissions for the period 2019-2021.

Table 4. Emissions per treated patient and by gas type for the period 2019-2021 in HS and WP scenarios.

	HS			WP		
EpTP (Kg/cap)	**2019**	**2020**	**2021**	**2019**	**2020**	**2021**
CO_2	56,055	38,725	58,113	15,849	2,098	3,523
CH_4	0,066	0,046	0,068	0,017	0,001	0,002
N_2O	0,018	0,013	0,019	0,005	0,000	0,001
Total emissions	63,155	43,629	65,474	17,730	2,269	3,806

HS: hypothetical situation. WP: with program. EpTP: emissions per treated patient. CO_2: carbon dioxide. CH_4: methane. N_2O: nitrous oxide.

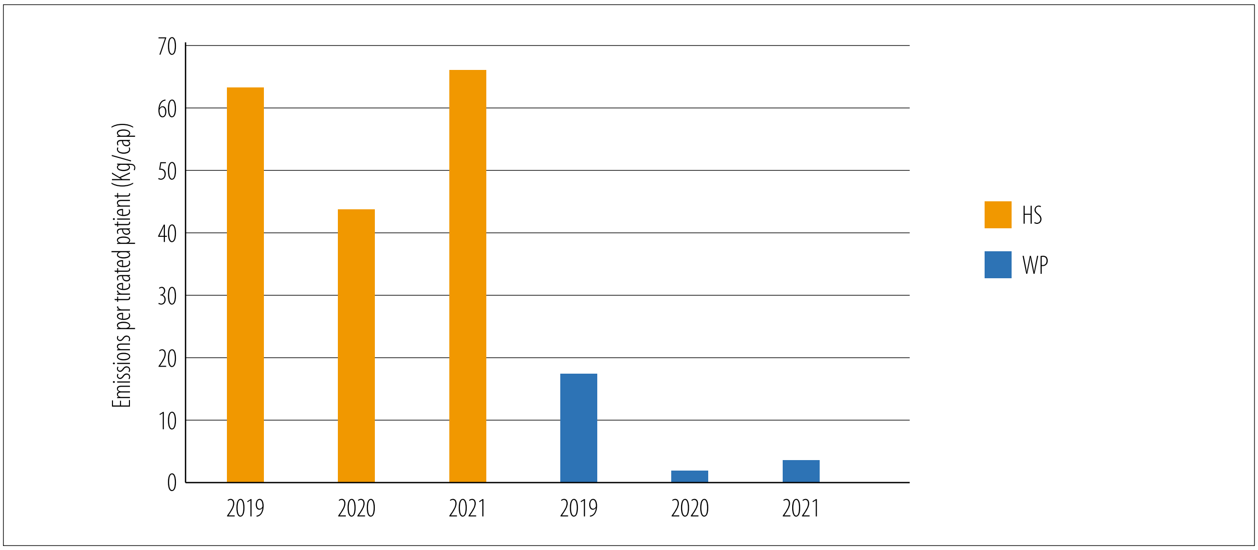

Figure 2. Emissions per treated patient for the period 2019-2021 in HS and WP scenarios.

Table 5. Absolute reductions and reductions per patient.

	Absolute emissions (Tn)			Emissions per patient (Kg)		
	2019	**2020**	**2021**	**2019**	**2020**	**2021**
CO_2	147,15	24,61	142,15	40,20	36,62	54,59
CH_4	0,18	0,03	0,17	0,04	0,04	0,06
N_2O	0,05	0,01	0,05	0,01	0,01	0,01
Total eq CO_2	166,25	27,79	169,58	45,42	41,36	61,66

Tn: tons. Kg: kilograms. CO2: carbon dioxide. CH4: methane. N2O: nitrous oxide. eq CO2: carbon dioxide equivalent.

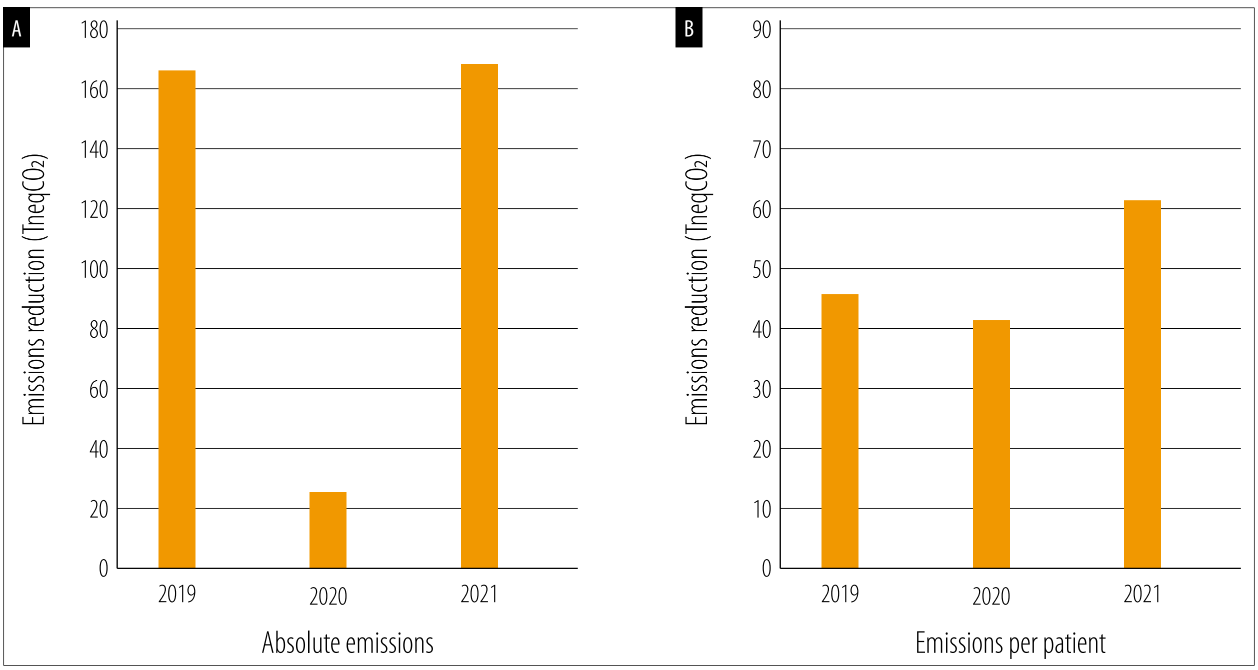

Figure 3. Absolute emission reduction (a) and per treated patient (b) achieved for the period 2019-2021.

ciency of the Ojo Pampa Program in minimizing the carbon footprint associated with each patient. Additionally, the categorization by gas type sheds light on the specific gases affected by the program's implementation. The differences are less pronounced compared to the analysis of absolute emissions. These differences are more closely tied to the efficiency of the WP scenario—specifically, the number of individuals treated per locality visited—and the HS scenario, reflecting the distance of various localities from the corresponding ophthalmology center.

Emission reduction by the Ojo Pampa program

Emissions per patient were 63 kg without the program, 18 kg with the program, and 4 kg with the program changes. The reduction in emissions per patient was 45 kg, 41 kg, and 62 kg for 2019, 2020, and 2021, respectively ($p=0.001$). The absolute reduction in eqCO_2 emissions for the entire program in 2019, 2020, and 2021 was 166Tn, 28Tn, and 161Tn, respectively. Table 5 and figure 3 show the absolute reductions and reductions per patient achieved during the development of the Ojo Pampa program. The largest absolute savings were achieved in the years when a larger number of patients were served, and a larger number of cities were visited.

Each resident of La Pampa emits 5 kg/day. The program reduced emissions by an average of 49.5 kg over the three years. The emissions avoided by the program are equivalent to 3.6% of the emissions from land transport of La Pampa inhabitants per year, with reference to the data of this category from the subnational disaggregation for La Pampa of the National Inventory of greenhouse gases, reported in the fourth Biennial Update Report (BUR4) of Argentina[19]. With the program improvements in 2021, the emissions generated by an average La Pampa resident per day in this emissions category were reduced by a factor of six.

Discussion

The emissions reduction achieved are of paramount importance in terms of sustainable policies. Such actions are in line with the suggestions made in the editorials of scientific journals after the United Nations expressed its concern about the 1.5°C increase in global warming in September 2021[20]. Therefore, health systems must take action to limit global warming, restore biodiversity, and protect health[20].

With the implementation of the Ojo Pampa program, we observed significant reductions in emission per patient: 45 kg in 2019, 41 kg in 2020, and 62 kg in 2021. The notable increase in emission reduction in 2021 can be attributed to key program enhancements, including the introduction of in-person assessments by ophthalmologists in various localities. This strategic change was implemented to ensure that patients requiring direct ophthalmological examination could receive care without the need to travel long distances. By bringing specialized care closer to the patients, we not only improved access to essential eye care, especially for those who faced difficulties in traveling, but also further mitigated overall emissions. The estimated emissions from a La Pampa resident traveling for an eye examination typically amount to 63 kg, considering vehicle emissions alone.

During the pandemic, the program had to adapt to biosafety requirements, leading to a temporary reduction in the frequency of visits. Despite these challenges, the program successfully continued to provide patient care, demonstrating resilience and adaptability in the face of unprecedented global health challenges. These adaptations ensured continued patient care while maintaining a focus on reducing environmental impact, highlighting the program's commitment to both healthcare excellence and sustainability.

Our study aligns with the growing body of research examining the environmental impact of telemedicine and healthcare activities. Several studies have explored the carbon footprint associated with telemedicine screening programs, providing valuable context for our findings. As in Ojo Pampa, various actions are being taken in the health sector worldwide to reduce pollution. Teleconsultations can be effective in improving environmental sustainability in health care by enabling remote communication and collaboration between sustainability experts and health care professionals[10]. The use of telemedicine has been found to reduce 0.70 to 372 kg eqCO_2 per consultation[21]. Rodler *et al.* found that a total of 48 studies met the inclusion criteria, covering 68,465,481 telemedicine consultations and savings of 691,825 tons of CO_2 emissions and 3 318,464,047 km of travel distance[22]. On the other hand, Ravindrane and Patel found that all studies consistently show that telemedicine offers environmental benefits by reducing greenhouse gas emissions associated with travel for medical consultations[23]. Moreover, three of the studies consider the overall environmental impact, including emissions from telemedicine equipment, and still find telemedicine to be a more environmentally friendly option than traditional face-to-face consultations. A study at Stanford Health Care found a 36% decrease in greenhouse gas emissions from clinic visits between 2019 and 2021, attributed to the increased use of telemedicine services, which helped avoid around 17,000 metric tons of GHGs in 2021[24].

Additionally, exploring the realm of ophthalmic surgery and carbon-saving activities contributes depth to our discussion. The carbon footprint of a single patient undergoing first cataract surgery is estimated to be 181.8 kg $eqCO_2$[25]. However, reported results vary considerably by center or technique used[26-29]. To reduce the carbon footprint per surgery, surgical kits could be reused and redesigned, disposable equipment could be reprocessed, two adjacent operating rooms could be used simultaneously, and the nonoperative tasks of the physician could be minimized. It has even been suggested that both eyes could be operated on the same day[26, 29]. While our focus is on telemedicine screening, understanding the broader healthcare landscape's environmental impact provides a comprehensive perspective.

The limitations of this study were that we do not have accurate data on CO_2 generation in the situation without the program. Therefore, we had to assume that all vehicles were gasoline-powered and had oxidation catalysts; each diagnosed patient, when required to travel to the city for the study, did so individually and in his or her private vehicle (not using public transportation); the patient's final destination was the health center where the study was conducted; and in 2019, all referral-eligible patients traveled to the eye care center on which they depended (Santa Rosa or General Pico) within 30 days for their examination.

This study evaluated the carbon footprint of the Ojo Pampa tele-screening program for diabetic retinopathy in the province of La Pampa, Argentina. The findings provide valuable insights into the environmental implications of implementing such a program and highlight the potential for sustainable healthcare practices at the intersection of environmental sustainability and public health. The results demonstrated significant reductions in emissions per patient associated with the program compared to the hypothetical scenario of patients traveling to the corresponding Ophthalmology Department. The total emissions reduction for the entire program was substantial, contributing to the provincial efforts to mitigate climate change.

Furthermore, the findings also underscored the role of the healthcare sector in minimizing its carbon footprint. By implementing environmentally friendly measures, such as telemedicine, healthcare systems can contribute to global efforts to reduce greenhouse gas emissions. It is essential for health systems to recognize the significance of sustainable policies in addressing the challenges posed by global warming and protecting public health. Actions that limit global warming and reduce pollution are crucial for the well-being of current and future generations. The Ojo Pampa program serves as an example of the positive impact that can be achieved through sustainable healthcare practices, and it provides a foundation for further research and initiatives in this field.

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Supplementary information 1. Kilometers traveled from each rural community to the corresponding Ophthalmology Department.

Locality / City / Rural community	Corresponding Sanitary Zone	Distances to Santa Rosa (Km)	Distance to the corresponding Ophthalmological Department (Km)	Treated patient in 2019	Treated patient in 2020	Treated patient in 2021
25 de Mayo	Santa Rosa	411	411	140	0	127
Abramo	Santa Rosa	162	162	12	0	15
Algarrobo del Aguila	Santa Rosa	317	317	19	0	21
Alpachiri	Santa Rosa	135	135	46	0	28
Alta Italia	General Pico	161	64	33	0	30
Anguil	Santa Rosa	29	29	42	84	64
Arata	General Pico	117	58	34	0	29
Ataliva Roca	Santa Rosa	47	47	16	0	22
Bernardo Larroude	General Pico	222	83	78	0	43
Bernasconi	Santa Rosa	167	167	57	0	56
Colonia Santa María	Santa Rosa	111	111	10	0	16
Caleufu	General Pico	139	80	25	0	39
Casa de Piedra	Santa Rosa	370	370	0	0	2
Carro Quemado	Santa Rosa	132	132	7	9	0
Catrilo	Santa Rosa	85	85	128	0	71
Ceballos	General Pico	197	67	16	0	0
Chacharramendi	Santa Rosa	203	203	11	0	8
Coronel Hilario Lagos	General Pico	210	80	11	0	0
Colonia Baron	General Pico	84	78	98	88	0
Conhello	General Pico	215	90	45	0	51
Doblas	Santa Rosa	83	83	58	0	56
Dorila	General Pico	148	15	6	0	27
Eduardo Castex	General Pico	82	59	171	0	126
Embajador Martini	General Pico	140	82	1	0	26

Locality / City / Rural community	Corresponding Sanitary Zone	Distances to Santa Rosa (Km)	Distance to the corresponding Ophthalmological Department (Km)	Treated patient in 2019	Treated patient in 2020	Treated patient in 2021
Gobernador Duval	Santa Rosa	352	352	10	0	8
General Acha	Santa Rosa	106	106	158	0	218
General Campos	Santa Rosa	158	158	25	0	12
General San Martin	Santa Rosa	182	182	88	0	80
Guatrache	Santa Rosa	184	184	124	0	79
Ingeniero Luiggi	General Pico	156	98	134	0	69
Intendente Alvear	General Pico	198	58	295	0	98
Jacinto Arauz	Santa Rosa	201	201	133	0	77
La Adela	Santa Rosa	276	276	61	0	49
La Gloria	Santa Rosa	53	53	38	0	0
La Humada	Santa Rosa	396	396	40	0	39
La Maruja	General Pico	174	115	28	0	35
La Reforma	Santa Rosa	259	259	6	0	8
Lonquimay	Santa Rosa	66	66	81	89	79
Loventue	Santa Rosa	144	144	3	0	0
Luan Toro	Santa Rosa	125	125	32	34	0
Macachín	Santa Rosa	110	110	87	0	108
Mauricio Mayer	General Pico	77	80	18	15	1
Metileo	General Pico	115	22	26	0	24
Miguel Cane	General Pico	114	63	18	33	0
Miguel Riglos	Santa Rosa	79	79	63	53	0
Monte Nievas	General Pico	93	44	30	0	31
Parera	General Pico	183	123	58	0	42
Pichi Huinca	General Pico	156	97	0	0	11
Puelches	Santa Rosa	262	262	18	0	14
Puelen	Santa Rosa	432	432	22	0	20
Quehue	Santa Rosa	77	77	11	0	10
Quemu Quemu	General Pico	129	49	127	80	90
Rancul	General Pico	211	134	140	0	78
Realico	General Pico	179	91	172	0	85
Rolon	Santa Rosa	138	138	17	0	17
Santa Isabel	Santa Rosa	190	190	62	0	76
Santa Teresa	Santa Rosa	183	183	0	0	15
Speluzzi	General Pico	154	15	8	0	11
Telen	Santa Rosa	158	158	52	43	0
Toay	Santa Rosa	11	11	84	0	105
Trenel	General Pico	122	35	74	0	42
Uriburu	Santa Rosa	45	45	44	19	47

Locality / City / Rural community	Corresponding Sanitary Zone	Distances to Santa Rosa (Km)	Distance to the corresponding Ophthalmological Department (Km)	Treated patient in 2019	Treated patient in 2020	Treated patient in 2021
Vertiz	General Pico	171	31	21	0	26
Victorica	Santa Rosa	151	151	128	100	0
Villa Mirasol	General Pico	90	61	23	25	0
Winifreda	General Pico	49	96	37	0	43