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**Aims:** Cost-minimization analysis (CMA) comparing the tele dermatology service of the State of Santa Catarina, Brazil with the provision of conventional care, from the societal perspective. **Patients & methods:** All costs related to direct patient care were considered in calculation of outpatient costs. The evaluation was performed using the parameters avoided referrals and profile of hospitalizations. The economic analysis was developed through a decision tree. **Results:** Totally, 40% of 79,411 tests performed could be managed in primary care, avoiding commuting and expanding the patients' access. The CMA showed the tele dermatology service had a cost per patient of US\$196.04, and the conventional care of US\$245.66. **Conclusion:** In this scenario, tele dermatology proved to be a cost-saving alternative to conventional care, reducing commuting costs.

**Lay abstract:** Diagnosis and treatment of skin diseases through tele dermatology avoid patient referrals, improves accessibility to specialized care, as well as the skin care provided by physicians. This study compared the costs of the tele dermatology service of the State of Santa Catarina, Brazil with the costs of the provision of conventional care, to check which of them was more efficient. All costs related to direct patient care were considered in the calculation of costs. Totally, 40% of 79,411 dermatological tests performed could be locally managed in primary care, avoiding commuting, and expanding the patients' access to care. The tele dermatology service had a cost per patient of US\$196.04, compared with the cost of conventional care of US\$245.66. In this evaluation, tele dermatology proved to be cheaper than conventional care, reducing commuting costs.

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**Keywords:** cost-minimization analysis • dermatology • health economics • health services research • telehealth

## Background

Tele dermatology has been constantly expanding in global health systems. The development of technological advances combined with the increased demand for dermatological care have led to the implementation and growth of this area. Tele dermatology services have become a reliable and cost-effective access alternative for populations in need of dermatological care [1]. A literature review focusing on diagnosis and treatment of skin diseases through

teledermatology confirmed the effectiveness of this alternative to improve accessibility to specialized care, as well as in diagnostic and therapeutic agreement, and in skin care provided by physicians, while reducing costs [2,3]. What makes it attractive is the optimization of care processes, resulting in more efficient use of resources, both financial and human [4]. The exchange of information about a patient between a nondermatologist and a dermatologist found good diagnostic efficiency and accuracy, with reduced costs and improved quality of life for patients [5]. On the other hand, a systematic review of economic evaluations focusing on telemedicine confirmed that it is cost-effective for applying in major medical fields, but in dermatology, studies could not confirm the positive capability of telemedicine. The authors pointed out that the evidence they analyzed was inconsistent, across a wide range of fields [6]. Nevertheless, the limited literature evaluating the economic consequences of teledermatology suggests that teledermatology may be cost-effective [7].

Brazil is a country of continental dimensions, and telehealth is a necessity and a solution for the integration of assistance networks, as well as for the coordination among the levels of care in the Brazilian National Health System (known by its acronym SUS). An integrated health system shows better results in terms of quality and efficiency [8]. The Telehealth Center of the State of Santa Catarina (TCSC) is one of the centers of the Brazilian Telehealth Program, an initiative of the Ministry of Health. Developed by the Federal University of Santa Catarina, in partnership with local government secretariat and municipalities, the TCSC telemedicine service aims to offer citizens better access to medical examinations, including dermatological, through a technological infrastructure that supports the performance of these examinations in the municipalities and their subsequent submission to the TCSC, meeting the needs of local professionals and strengthening primary care and the SUS [9]. A cost-minimization analysis (CMA) was conducted with 79,411 patients referred to the TCSC teledermatology service, in Santa Catarina State, Brazil, between January 1<sup>st</sup>, 2016 and December 31<sup>st</sup>, 2018. A decision tree model was performed to compare the cost of managing patients' care in this teledermatology service versus the cost for the provision of conventional care. The economic analysis was carried out from the societal perspective.

## Methods

### The TCSC system

The system adopted by the teledermatology service is store-and-forward (asynchronous). Images are captured by dermatoscopes and digital cameras at the primary care level, stored and sent to dermatologists for analysis and diagnostic report. The exams received are classified using a color system, according to severity and need for intervention [9]. White is the least severe and does not require intervention by the primary care physician. Blue means low risk and no need for referral, amenable to treatment at primary care and the dermatologist suggests the management to the attending physician. Exams classified as green require referral to secondary care, and yellow, more severe cases, are referred to tertiary care.

### Data collection

The CMA compared the teledermatology service with the provision of conventional care, for the period January 2016 to December 2018. The analysis was carried out from the societal perspective. To this end, an unidentified database was used containing the following information for each patient: date of the report, sex, date of birth, municipality of origin, municipality of reference in SUS, diagnosis of the report and risk classification. Additionally, hospital admissions in Santa Catarina were identified, whose dermatological diagnoses were similar to those reported as a yellow classification. Hospitalizations and days of stay were collected in the hospital information system (SIH, acronym in Portuguese) of SUS, from 2013 to 2018.

Ethical aspects and confidentiality were strictly safeguarded, insofar as the data from a secondary source were not identified, access to them remained restricted to researchers, and results were presented exclusively in an aggregated manner. The principles outlined in the Declaration of Helsinki have been followed.

### Estimation of costs

The measurement of outpatient costs included all costs related to direct patient care (primary and secondary care), in addition to the cost of commuting to the reference municipality, and the opportunity cost of the patient and companion. Maintenance costs of the teledermatology service (equipment, infrastructure, imaging storage, dermatologists, secretary, patient support and communication) were also considered.

To calculate the number of hours spent by the patient (and companion, when appropriate) for outpatient treatment outside the city of residence, the following were considered:

**Table 1. Description of costs related to patient care, in primary and secondary care.**

Category	Parameter	Description	Source	Value (US\$)
Primary care medical consultation	Value of consultation	1/3 of payment for medical services in the public sector per hour	RAIS/MTE	15.19
Dermatology medical consultation	Dermatology consultation fee	1/3 of payment for medical services in the public sector per hour	RAIS/MTE	19.93
Per diem without overnight stay for the patient (or companion)	Food expenses	Daily remuneration value without overnight stay	SIGTAP – codes 08.03.01.002.8 or 08.03.01.005.2	4.11
Per diem with overnight stay for the patient (or companion)	Food and accommodation expenses	Daily remuneration value with overnight stay	SIGTAP – codes 08.03.01.001.0 or 08.03.01.004.4	12.11
Patient opportunity cost	Patient hours	Number of hours spent by the patient to undergo the procedure	Estimated from the patient's place of residence	N/A
Patient opportunity cost	Hourly wage	Hourly income based on per capita nominal monthly family income in Santa Catarina	IBGE 2018	5.08 [812.13/month]
Companion opportunity cost	Companion hours	Number of hours spent by companion of patient undergoing a procedure	Estimated from the patient's place of residence	N/A
Companion opportunity cost	Hourly wage	Hourly income based on per capita nominal monthly family income in Santa Catarina	IBGE 2018	5.08 [812.13/month]
Salary – an hour of the driver	Hourly wage amount	Usual average real income from the main job of persons aged 14 years and over, employed in the week of reference in formal jobs in Santa Catarina	IBGE 2018	7.43 [1189.33/month]
Driver working hours	Driver hours per patient	1/3 of the number of hours spent by the driver to make a trip (considering three people transported on average, per trip)	Estimated from the total travel period	N/A
Remuneration unit for the patient and/or companion travel by land transport	Spending on the patient and/or companion travel	Mileage compensation amount between cities (per km driven)	CREA/SC	0.46

CREA/SC: Conselho Regional de Engenharia e Agronomia/Santa Catarina (Regional Council of Engineering and Agronomy of Santa Catarina; <https://portal.crea-sc.org.br>); IBGE: Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics; <https://cidades.ibge.gov.br/brasil/sc/panorama>); N/A: Not applicable; PPP: Purchasing power parity, expressed in US dollars – 1 PPP dollar = R\$2.044 (2018); RAIS/MTE: Relação Anual de Informações Sociais/Ministério do Trabalho e Emprego (Annual List of Social Information/Ministry for Labor and Employment; <http://trabalho.gov.br/rais>); SIGTAP/SUS: Sistema de Gerenciamento da Tabela Unificada de Procedimentos/Sistema Único de Saúde (SUS's System of Management of the Table of Procedures, Medications, Orthotics, Prosthetics and Special Materials; <http://sigtap.datasus.gov.br>).

- i. The average speed of 60 km/h, to calculate travel time between cities.
- ii. Four-hour stay in the city where the service is available.
- iii. One overnight stay when the commuting time added to the length of stay was  $\geq 9$  h.
- iv. Percentage of patients with a companion (27%).

The costs related to the patient's outpatient care are described in [Table 1](#).

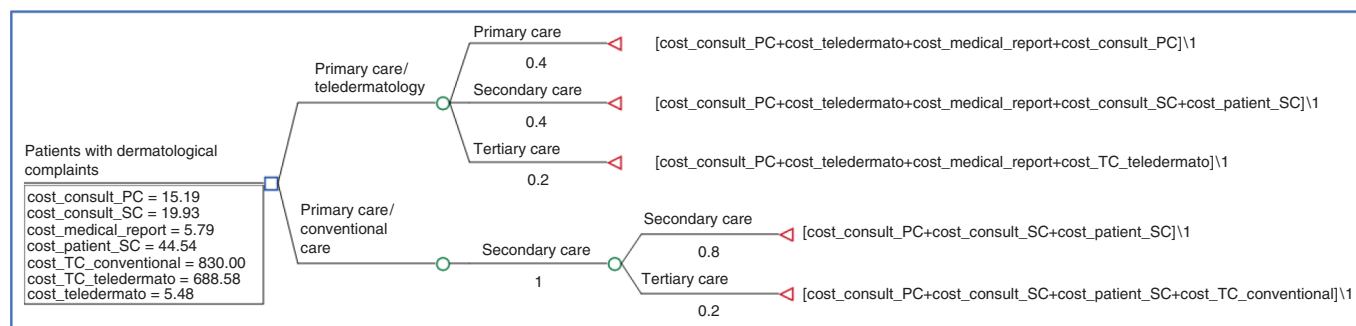
Hospital costs were obtained from SIH/SUS, and the recorded values during the hospitalization period were collected. In addition to hospitalization costs, the following were considered:

- i. Travel costs with a calculation similar to that of outpatient care.
- ii. Two nights with an overnight stay for a companion, if the hospital stay exceeded 24 h.
- iii. The opportunity cost of the patient, corresponding to the number of days of hospitalization.
- iv. Companion's opportunity cost, when their stay in the hospital was registered at the SIH. Patients admitted to the municipality where they lived did not add travel costs.

All costs were adjusted to December 2018 based on the Extended National Consumer Price Index (IPCA-IBGE) and converted to the US dollar adjusted by purchasing power parities (PPP) for the 2018 calendar year. It is worth pointing out that many of the estimated costs were extrapolated from government databases and may not fully match the real costs.

## Effectiveness

There is evidence that the effectiveness of the alternatives teledermatology or conventional care is similar [10] and corresponds to the patient seen at any level of care.



**Figure 1. Decision tree with the parameters used for cost-minimization analysis.** Consult: Medical consultation; PC: Primary care; SC: Secondary care; TC: Tertiary care.

The following assumptions were adopted in the model:

- Secondary care dermatologists have the same clinical management capacity as teleradiology experts [10–13].
- The costs of maintaining care network are similar in both alternatives. However, the maintenance costs of the tele dermatology service were added to this alternative.

Tele dermatology service was considered fully implemented as of 2016. Thus, hospitalizations in the 2013–2015 triennium corresponded to the conventional alternative and those in the 2016–2018 triennium to the tele dermatology alternative. For modeling, the proportional distribution of diagnoses in the two trienniums was considered.

### Model development

The CMA was developed through a decision tree model, considering the transition possibilities for the alternatives tele dermatology or conventional care (Figure 1). Tele dermatology care can result in the resolution of cases with no need for referral. When a referral is required, it can be to secondary or tertiary care, depending on the complexity of the case. In conventional care, patients are always referred to secondary care, where they are seen or referred to tertiary care. For modeling, the proportional distribution of diagnoses of hospitalization in the two trienniums was considered.

### Data analysis

We calculated the frequency distributions for the categorical variables; and means, standard deviation and medians for the continuous variables. Trends over time in hospitalization with the selected diagnoses were examined. The difference in costs between trienniums was calculated using the Mann–Whitney test, as the data were not normally distributed, according to the Kolmogorov–Smirnov test. The decision-tree model consists of a hypothetical cohort of individuals who seek primary care with a complaint of dermatological problems. When patients are seen in a service with tele dermatology, clinicians may consult this service. Based on the data available, the model predicts that, of the patients seen in primary care, 20% are referred to tertiary care, 40% to secondary care and 40% remain in primary care. When treated in a conventional service, 100% of patients are referred to secondary care and, after being seen by a specialist, 20% are referred to tertiary care and the rest remain in secondary care. Figure 1 shows the decision tree with the parameters used for CMA, comparing the alternative tele dermatology with conventional care. The mean value of hospitalization, including travel and opportunity costs, was the parameter used in the decision tree for tertiary care in each period. All analyses were conducted using TreeAge® Pro Healthcare software version 2020R1.2 (MA, USA).

### Sensitivity analysis

A univariate deterministic sensitivity analysis assessed the model’s uncertainties and identified which variables most impacted the results obtained in terms of incremental costs. The sensitivity analysis by the Tornado diagram was performed varying the estimates of costs. The values related to medical consultation, medical report and tele dermatology cost were varied by 20% more and less. We used the minimum and maximum values of patient’s outpatient care and the costs of tertiary care were varying according to the lower and upper CIs of costs.

**Table 2.** Mean value of the variables referring to the patient’s commuting, in purchasing power parities expressed in US dollars, considering the set of tests performed (N = 79,411) by the teledermatology service, Santa Catarina, 2016–2018.

Variables	Mean	Standard deviation	Minimum	Maximum
Travel and stay time (days)	2.58	0.80	1.96	5.45
Cost of patient travel (PPP US\$) (a)	14.81	19.00	0.00	83.21
Patient opportunity cost (PPP US\$) (b)	26.76	8.27	20.31	56.54
Daily cost (PPP US\$) (c)	2.47	2.79	0.00	12.11
Companion cost (PPP US\$) (d)	11.89	7.80	0.00	41.00
Total cost (a + b + c + d) <sup>†</sup>	44.54	29.97	20.31	156.33

<sup>†</sup> Total cost in PPP expressed in US dollars Exchange rate: 1 PPP dollar = R\$ 2.044 (2018).  
PPP: Purchasing Power Parity.

**Table 3.** Mean and median values of hospitalization, in purchasing power parities<sup>†</sup> expressed in US dollars, for the set of selected dermatological diseases, according to the hospitalization period, Santa Catarina, 2013–2018.

Period	n	Mean	Standard deviation	95% CI		Median <sup>‡</sup>	Minimum	Maximum
				Lower limit	Upper limit			
2013–15	7597	830.00	886.36	810.07	849.93	469.76	32.32	20,802.27
2016–18	10751	688.58	910.85	671.36	705.80	364.33	30.46	31,335.14
Total	18348	747.14	903.45	734.06	760.83	408.08	30.46	31,335.14

<sup>†</sup> Purchasing Power Parities Exchange rate: 1 purchasing power parity dollar = R\$ 2.044 (2018).  
<sup>‡</sup> p < 0.001 (test U of Mann–Whitney).

We performed an additional sensitivity analysis in order to assess the impact of the cost of hospitalizations on the total cost, in the teledermatology period (2016–2018). The objective was to evaluate whether the reduction in the cost of hospitalizations for this period is driving the findings of an overall cost reduction for the teledermatology. Thus, we perform this sensitivity analysis using a 20% increase in the cost of hospitalization in the teledermatology arm.

### Results

During the period, 79,411 exams were performed at the teledermatology service; in that, 29.2% in 2016, 28.9% in 2017 and 42.0% in 2018. Most patients were female (63.7%), with a mean age of 50.4 (±20) years.

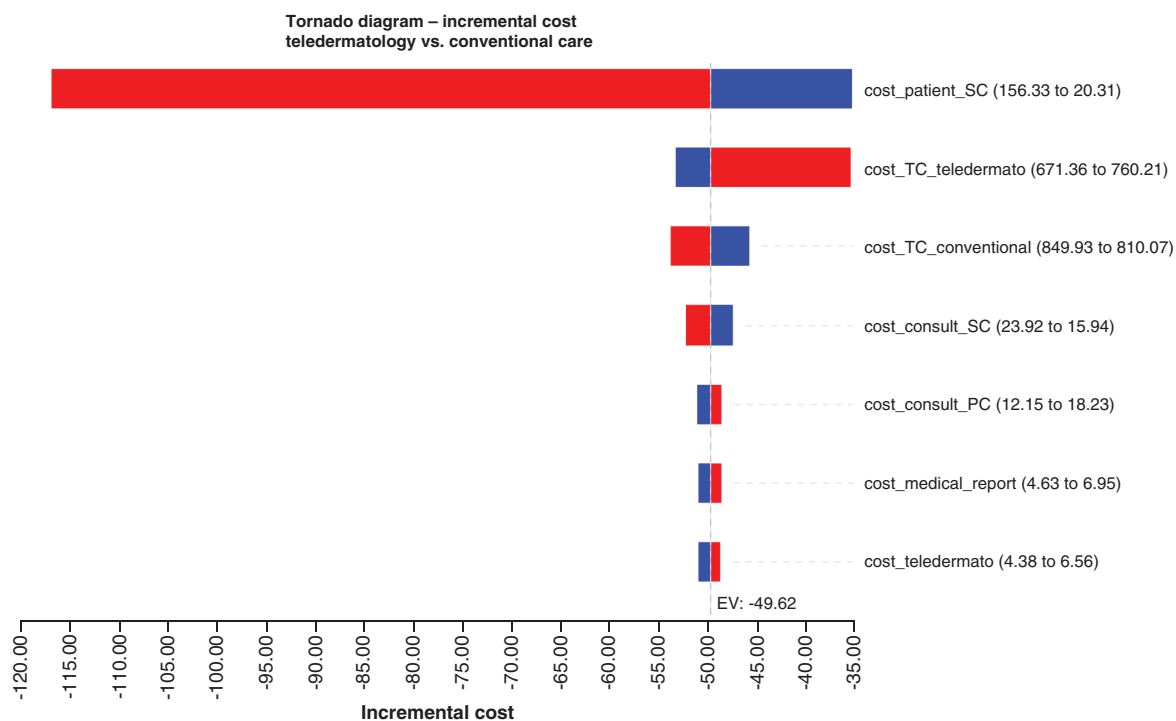
There was an increase of 43.8% in the examinations performed by the teledermatology service, from 2016 to 2018. In 2016, 9737 patients were classified in the categories white and blue, and this number increased to 13,179 in 2018. Between the years 2016 and 2018, 40.2% of exams were classified as a white or blue risk category, 40.0% as green and 19.8% as yellow. There were no significant differences in the distribution of categories between the years observed. Of the 15,693 exams classified as yellow and referred to tertiary care, 75.2% were suspected of having nonmelanoma skin cancer, 8.6% moderate-to-severe psoriasis, and 6.6% melanoma skin cancers.

In the 2013–2015 triennium, there were 7597 hospitalizations due to any of the selected dermatological diagnoses. In the 2016–2018 triennium, this figure rose to 10,751 hospitalizations. There was a decrease in the mean number of days spent at the hospital, which fell from 3.71 days in the first 3 years to 1.92 days in the second triennium (p < 0.001).

### Cost measurement

Table 2 presents the values of patients commuting to outpatient care, considering 79,411 exams performed by the teledermatology service, between January 2016 and December 2018.

Table 3 shows the mean and median values, in PPP expressed in US dollars, of hospitalizations that occurred in the 2013–2015 and 2016–2018 3-year periods, including travel and opportunity costs. The mean values of hospitalization, in PPP expressed in US dollars, decreased in the second triennium (688.58 ± 910.85) when compared with the first triennium (830.00 ± 886.36). Accordingly, the median values also decreased from the first to the second triennium (p < 0.001).



**Figure 2. Tornado analysis of the incremental cost relation between tele dermatology and conventional care.** Consult: Medical consultation; PC: Primary care; SC: Secondary care; TC: Tertiary care.

The monthly estimate of total maintenance costs for the TCSC is US\$135,083.60. Considering an average monthly production of 24,625 activities in the period, each activity produced generated a maintenance cost of US\$5.48.

### Cost-minimization analysis

The CMA shows the service using the tele dermatology strategy has a cost per patient of US\$196.04, whereas the use of conventional services has a cost of US\$245.66. Based on the assumption that the services have an equal capacity for patient care, there are only differences in costs, resulting in an additional US\$49.62 for conventional patient care, which makes tele dermatology the alternative cost-saving compared with the conventional patient care. A sensitivity analysis assessed the model’s uncertainties and verified whether changes in the values used could alter the incremental cost found. The sensitivity analysis confirmed the robustness of the main results. Figure 2, of the tornado analysis, shows the values that most impact the results are the total cost of the patient in secondary care, followed by the total cost in tele dermatology tertiary care.

In the additional sensitivity analysis, the cost of hospitalization in the tele dermatology arm was increased by 20% (US\$826.30). In this setting, the result showed an additional cost of US\$22.08 for conventional patient care, which means that the cost of hospitalization had an important contribution to the overall cost. Despite this, the cost difference between the alternatives is maintained.

### Discussion

An important aspect to be emphasized in this evaluation refers to the innovation caused by tele dermatology in the organization of health actions and services in the state of Santa Catarina. This organization proposal aimed to reduce unnecessary referrals and reduce the waiting time for consultation with specialists. In addition, it sought to provide support to the primary care professional in patient management [8,9,14].

A reduction of unnecessary referrals was observed in the 2016–2018 3-year period, and more patients could have been managed in primary care, avoiding commuting and expanding the access of more severe patients to the specialist. After the implementation of the tele dermatology service in 2015, there was a significant drop in the number of patients on the waiting list, from 4080 to 98 patients, as well as in the average waiting time, from more

than 1000 to 20 days, when comparing 2013 with 2017 [15]. Reductions in waiting list time after implementing tele dermatology were also seen in Spain and the USA [16,17]. Moreover, it was found that tele dermatology increased access to face-to-face dermatological care [17], and the mean rate of dermatological consultations avoided ranged from 45.5% to 57.0% when adopting the asynchronous system (store and forward), which reinforces its feasibility and importance, helping the general physicians to manage such conditions and optimizing medical hours and costs, especially in the public system [18,19]. A systematic review estimated the use of asynchronous tele dermatology was associated with 43% of avoided trips [20]. These proportions reported in the literature are very close to those observed in the tele dermatology service in Santa Catarina, which also adopts the asynchronous model.

The highest number of patients with their dermatological problems solved in primary care may be related to a higher qualification of care at this level. The educational benefit derived from the content of the tele dermatology consultation is mentioned in the literature as a useful resource, with feedback many times faster than through traditional consultation processes [18], observing better knowledge of dermatology among primary care physicians who used this referral system [21,22].

Another aspect that deserves to be highlighted is the growth in the number of hospitalizations due to selected dermatological conditions, during the period 2016–2018, which occurred simultaneously with a significant decrease in the mean number of days spent at the hospital. A possible explanation for this, although not exhaustive, refers to the reduction of barriers to access to care. However, we have assumed that patients with the same diagnosis of hospitalization in different periods are matching cases, which is a limitation of this study. In addition, any change in the dermatological practice between the time periods could have contributed to differences seen in model parameters, although the tele dermatology service team had not reported significant changes in this practice. A prospective study in university hospitals found tele dermatology reduces the time required for a dermatologist to respond and the time required for a primary care team to receive an answer for a consultation to define the need for hospitalization. These findings suggest tele dermatology as a tool to improve access to tertiary-level dermatological care [23]. In addition, tele dermatology is a valuable mechanism for dermatologists to screen appointments and increase efficiency, thus expanding access to specialized care for hospitalized patients [24].

Tele dermatology increases access to care without increasing cost [25]. A cost-minimization analysis was conducted to compare the organization-wide cost of managing referred dermatology patients within a tele dermatology triage system versus a conventional dermatology care model at a general hospital. The study suggests that using tele dermatology to triage and manage dermatology patients within a capitated healthcare system may be associated with significant cost savings [26]. Telemedicine usually avoids the overhead costs in the healthcare system that are associated with conventional in-person care. However, we also must consider societal costs [27].

The economic evaluation developed in this study adopted the societal perspective and included the use of direct medical resources in the production of procedures, in addition to commuting costs from the municipality of residence to the service, per diem and opportunity costs for the patient and companion, when applicable. In the scenario assessed here, tele dermatology proved to be a cost-saving alternative to conventional care. The sensitivity analysis shows that incremental costs could vary according to the amounts spent on patients in secondary care. This finding reinforces the importance of tele dermatology in reducing commuting costs and productivity loss for patients since it avoids unnecessary expenses [3,28]. In a country of continental dimensions such as Brazil, where distances separating rural and urban areas can be very large, the use of tele dermatology has the potential to generate substantial savings in resources, as well as greater patients satisfaction.

Given that asynchronous tele dermatology has the potential to reduce commuting and offers greater convenience to the patient, these gains can be addressed more holistically from a societal perspective [29,30].

The available current economic evidence is sparse, but suggested the asynchronous store-and-forward tele dermatology may be cost-effective, especially when used as a screening mechanism to reduce the demand for face-to-face consultations and when considering the costs associated with productivity loss [7,29,31–33]. In this sense, our results are in line with the literature. However, because of country-specific variations in the health systems, it is problematic to generalize economic evaluations of telemedicine interventions from one country to another [6].

According to Landow *et al.* [32], by maximizing the time of a scarce resource, such as dermatologists, tele dermatology provides improved access by increasing the number of patients evaluated and treated, and avoiding unnecessary and time-consuming face-to-face consultations. In this way, it fulfills three promises it makes about dermatological care: to be better, cheaper and faster. It is ‘better’ because, although it cannot offer the patient as much as a traditional visit, it extends the dermatologist’s reach to places and in ways that were previously not possible due to time and place limitations. It is ‘cheaper and faster’ for having the potential to reduce costs and

increase the efficiency of patients and providers, by resulting in less time away from work and faster service. The results obtained by the present economic evaluation, focusing on the teledermatology service in Santa Catarina, are consonant with the fulfillment of these promises

## Conclusion

A cost-minimization analysis was performed comparing the teledermatology service of the State of Santa Catarina, Brazil with the provision of conventional care. This economic evaluation adopted the societal perspective and included the use of direct medical resources in the production of procedures, in addition to commuting costs from the municipality of residence to the service, per diem and opportunity costs for the patient and companion, when applicable. In the scenario assessed here, teledermatology proved to be a cost-saving alternative to conventional care. This finding reinforces the importance of teledermatology in reducing commuting costs and productivity loss for patients since it avoids unnecessary expenses.

### Summary points

- The limited literature evaluating the economic consequences of teledermatology suggests that teledermatology may be cost-effective.
- There is evidence that the effectiveness of the alternatives teledermatology or conventional care is similar and corresponds to the patient seen at any level of care.
- This article presents a cost-minimization analysis comparing the teledermatology service of the State of Santa Catarina, Brazil with the provision of conventional care.
- The economic evaluation adopted the societal perspective and included the use of direct medical resources in the production of procedures, in addition to commuting costs from the municipality of residence to the service, per diem and opportunity costs for the patient and companion, when applicable.
- During the period 2016–2018, 79,411 exams were performed at the teledermatology service. Most patients were female (63.7%), with a mean age of 50.4 ( $\pm 20$ ) years.
- The cost-minimization analysis shows the service using the teledermatology strategy has a cost per patient of US\$196.04, whereas the use of conventional services has a cost of US\$245.66, resulting in an additional US\$49.62 for conventional patient care.
- The sensitivity analysis confirmed the robustness of the main results.
- In the scenario assessed here, teledermatology proved to be a cost-saving alternative to conventional care. This finding reinforces the importance of teledermatology in reducing commuting costs and productivity loss for patients since it avoids unnecessary expenses.
- In a country of continental dimensions such as Brazil, where distances separating rural and urban areas can be very large, the use of teledermatology has the potential to generate substantial savings in resources, as well as greater patients satisfaction.

### Author contributions

FA Acurcio, AA Guerra Junior and JA Teodoro designed the study, collected and analyzed the data and wrote the manuscript. MM Garcia and RG Pereira collected data, contributed with the discussion and reviewed the manuscript. M Akerman, LF Spinel, IC Borysow, RR Silva, PS Azevedo and PCIC Gomes contributed with the discussion and reviewed the manuscript. MCM Calvo and DH Nunes designed the study, contributed with the discussion and reviewed the manuscript. All authors approved the final version of the manuscript.

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### Financial & competing interests disclosure

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No writing assistance was utilized in the production of this manuscript.

### Ethical conduct of research

Ethical aspects and confidentiality were strictly safeguarded, insofar as the data from a secondary source were not identified, access to them remained restricted to researchers, and results were presented exclusively in an aggregated manner. The principles outlined in the Declaration of Helsinki have been followed.

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Papers of special note have been highlighted as: ● of interest; ●● of considerable interest

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- **A cost-minimization study design (a model-based approach) was applied to compare teledermatology and conventional process costs per dermatology patient care episode, from the societal perspective. The results showed that savings by teledermatology can be achieved if the distance to a dermatologist is larger ( $\geq 75$  km) or when more consultations ( $\geq 37\%$ ) can be prevented due to teledermatology.**
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