

Analysis of Health Data and Forecasts From a Telemedicine and Telehealth Center

Análise de Dados e Previsões em Saúde de um Núcleo de Telemedicina e Telessaúde

Análisis de Datos y Previsiones Sanitarias de un Centro de Telemedicina y Telesalud

RESUMO

Objetivo: Avaliar a contribuição do Telessaúde Goiás na redução de encaminhamentos da Atenção Primária para unidades de referência e estimar a demanda futura pelo programa. **Métodos:** Estudo observacional, retrospectivo, com dados de 30.167 teleconsultas (2015-2022). Empregou-se análise descritiva e modelo ARIMA para projeções até 2030. **Resultados:** Observou-se crescimento progressivo das teleconsultas, com predomínio de medicina, enfermagem e odontologia. Os principais diagnósticos incluíram infecção por coronavírus, hipertensão e supervisão gestacional. Houve redução dos encaminhamentos de 17,41% (2015) para 1,24% (2022). Mais de 75% dos profissionais relataram satisfação com o serviço. As projeções indicaram crescimento até 2030. **Conclusão:** O Telessaúde Goiás ampliou a resolutividade na Atenção Primária, reduzindo encaminhamentos e qualificando a assistência no SUS.

DESCRIPTORES: Monitoramento Remoto de Pacientes; Telemedicina, Encaminhamento e Consulta, Centros de Saúde, Atenção Primária à Saúde.

ABSTRACT

Objective: To evaluate the contribution of Telehealth Goiás in reducing referrals from Primary Care to reference units and to estimate future demand for the program. **Methods:** Observational, retrospective study with data from 30,167 teleconsultations (2015-2022). Descriptive analysis and ARIMA model were employed for projections until 2030. **Results:** Progressive growth of teleconsultations was observed, with predominance of medicine, nursing, and dentistry. The main diagnoses included coronavirus infection, hypertension, and pregnancy supervision. There was a reduction in referrals from 17.41% (2015) to 1.24% (2022). More than 75% of professionals reported satisfaction with the service. Projections indicated growth until 2030. **Conclusion:** Telehealth Goiás expanded resoluteness in Primary Care, reducing referrals and improving healthcare quality in the SUS.

DESCRIPTORS: Remote Patient Monitoring, Telemedicine, Referral and Consultation, Health Centers, Primary Health Care.

RESUMEN

Objetivo: Evaluar la contribución de Telesalud Goiás en la reducción de derivaciones de la Atención Primaria para unidades de referencia y estimar la demanda futura del programa. **Métodos:** Estudio observacional, retrospectivo, con datos de 30.167 teleconsultas (2015-2022). Se empleó análisis descriptivo y modelo ARIMA para proyecciones hasta 2030. **Resultados:** Se observó crecimiento progresivo de las teleconsultas, con predominio de medicina, enfermería y odontología. Los principales diagnósticos incluyeron infección por coronavirus, hipertensión y supervisión gestacional. Hubo reducción de las derivaciones de 17,41% (2015) para 1,24% (2022). Más de 75% de los profesionales relataron satisfacción con el servicio. Las proyecciones indicaron crecimiento hasta 2030. **Conclusión:** Telesalud Goiás amplió la resolutividad en la Atención Primaria, reduciendo derivaciones y calificando la asistencia en el SUS.

DESCRIPTORES: Monitorización Remota de Pacientes, Telemedicina, Derivación y Consulta, Centros de Salud, Atención Primaria de Salud.

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INTRODUCTION

Telehealth involves the use of information and communication technologies (ICT) to enable the remote delivery of healthcare services, representing a strategic resource for expanding access and improving the quality of care provided to patients¹. In Brazil, it was officially regulated by Law No. 14,510/2022, which established legal parameters for its implementation². Since then, its adoption has intensified in different areas of the healthcare system, especially in Primary Care, and is used to provide remote consultations, monitor chronic diseases, and optimize referrals to specialized services¹. The implementation of telehealth is aligned with the principles of the Unified Health System (SUS), particularly regarding the universality, equity, and comprehensiveness of care.

Telemedicine and telehealth have been recognized as relevant strategies for reducing regional inequalities in access to health services by enabling qualified clinical guidance for populations living in remote areas or areas with a shortage of specialists, without the need for travel.³ Furthermore, the use of digital technologies in healthcare can help optimize healthcare resources, strengthen care coordination across levels of care, and reduce operational costs, including those related

to transportation.⁴

In recent decades, telehealth has expanded from isolated initiatives to integrated systems for clinical support and monitoring⁵, defined as the application of digital technologies and electronic media to expand access, improve the quality of care, and enable remote clinical monitoring³⁻⁵. Although its adoption has remained limited, both in high-income countries and in middle- and low-income countries⁷, the COVID-19 pandemic has driven its incorporation in the face of contact restriction measures to contain SARS-CoV-2⁶⁻⁸, accelerating its implementation globally. This shift, however, highlighted structural challenges related to resource constraints, insufficient operational experience, and infrastructure weaknesses, especially in contexts that required rapid expansion or consolidation of services⁹.

In this scenario, telehealth began to encompass remote consultations via video or telephone between patients and physicians, as well as interactions among healthcare professionals, with the aim of monitoring the patient's clinical condition and facilitating the transmission of medical information⁹. Evidence indicates that telehealth may be as effective as standard care, with benefits such as greater accessibility, reduced waiting

times, and lower costs⁵. However, available studies focus on specific health conditions, such as COVID-19, cardiovascular diseases, and diabetes, and do not detail the factors associated with the choice between remote and in-person consultations, leaving their contribution to reducing referrals and to the satisfaction of the professionals involved uncertain⁵.

Given the need to use telehealth as a strategy to expand access to health services, this study evaluates the contribution of Telessaúde Goiás to reducing referrals of primary care patients to referral units located in the state's urban centers from 2015 to 2022. Additionally, it conducts a predictive analysis to estimate future demand for the program, supporting the planning and improvement of telehealth initiatives within the SUS.

METHODS

Study Design

This is an observational, retrospective study based on secondary data, with descriptive and temporal analysis components, which utilized data collected by the Telessaúde Goiás Program, coordinated by the Center for Telemedicine and Telehealth at the Federal University of Goiás School of Medicine (NUTTs / UFG), from 2015 to 2022.

Data Collection

The study was conducted using the Telessaúde Goiás database, covering the period from 2015 to 2022, based on teleconsultations recorded in an electronic system. The analyses included the distribution of teleconsultations by year, specialty, and diagnosis (ICD-10), as well as referral requests, call classifications, and the generation of predictions. Regarding referral requests, two variables were evaluated: intention to refer the patient and actual patient referral.

The Goiás Telehealth Program promotes health, diagnosis, and follow-up for the state's population through teleassistance and continuing education in 225 municipalities. The service supports Basic Health Units with standardized protocols for requesting consultations and guidance, conducted exclusively by registered professionals, with data stored in NUTTs/UFG.

Ethical considerations

Since this involves secondary data from the Telessaúde Goiás database, authorized through an Institutional Consent Form and made available in an anonymized form, without any individual identification of users or professionals, there was no need for submission and/or approval by the Research Ethics Committee, in accordance with CNS Resolution No. 510/2016 and Law No. 13,709/2018 (General Personal Data Protection Law). It should be noted that the analyzed information ensures the confidentiality and privacy of those involved, in accordance with the ethical principles governing research using secondary data.

Variables Analyzed

The variables explored in the study are: date of registration; date of completion; specialty; ICD-10 diagnosis; referral intention (yes/no); referral (yes/no); call classification; profes-

sional satisfaction; patient's question answered (yes/no).

Statistical analysis

The data, owned by NUTTs/UFG and restricted to authorized access, were made available in a spreadsheet. Two approaches were used: descriptive analysis and predictive analysis.

In the descriptive analysis, the data were grouped according to categorical variables to calculate absolute and relative frequencies. In the predictive analysis, the data were analyzed using a time series methodology with the Autoregressive Integrated Moving Averages (ARIMA) model, adjusting the autoregressive parameters ($p = 2$), moving averages ($q = 1$), and the number of differentiations required for the series to become stationary ($d = 2$).

To validate the ARIMA model, stationarity (Dickey-Fuller test), trend (Mann-Kendall test), seasonality (Kruskal-Wallis test), and residual autocorrelation (Box-Pierce test) were assessed. Additionally, for the diagnosis of the ARIMA model, the Akaike Information Criterion (AIC), both corrected and uncorrected, and the Bayesian Information Criterion (BIC) were used. For predictive analysis, the *forecast* package was used to calculate point and interval estimates. It should be noted that all hypothesis tests considered a significance level of 5% ($\alpha=0.05$). The analyses were performed in Microsoft Excel 2020 and R software version 4.2.1.

RESULTS

Between 2015 and 2022, Telessaúde Goiás recorded 30,167 teleconsultations (Table 1), covering municipalities in different regions of the state. During this period, a progressive increase in teleconsultations was observed, with a sharp rise beginning in 2020, showing no stationarity or seasonality, coinciding with the onset

of the COVID-19 pandemic in Brazil. Regarding the specialty variable, it was found that, during the analyzed period, the fields of medicine, nursing, and dentistry accounted for the largest share.

Table 1. Total teleconsultations recorded in Telessaúde Goiás from 2015 to 2022

Year	N	%
2015	579	1,92%
2016	438	1,45%
2017	1.001	3,32%
2018	1.879	6,23%
2019	3.222	10,68%
2020	4.298	14,25%
2021	8.121	26,92%
2022	10.629	35,23%
Total	30.167	100%

n: absolute number of teleconsultations; %: percentage

Source: NUTTs, 2025.

Among the main diagnoses from Telessaúde Goiás teleconsultations (2015–2022), classified by ICD-10, codes related to preventive examinations and follow-up predominated — Z008 (general examination - 4.24%), Z719 (unspecified counseling - 2.57%), and Z00 (general medical examination - 1.21%) — as well as conditions such as A010 (typhoid fever - 1.08%), B342 (coronavirus infection—1.01%), I10 (primary essential hypertension—0.96%), Z34 (normal pregnancy care—0.85%), A90 (classic dengue—0.82%), R070 (sore throat—0.80%), and F411 (generalized anxiety disorder—0.74%), highlighting demands related to chronic diseases and acute conditions of regional epidemiological relevance.

The frequency of coronavirus infection (ICD B342) in teleconsultations was expected, given the 1,824,524 cases of COVID-19 recorded in the Midwest between 2020

and 2022. This scenario increased the demand for teleconsultations at Telessaúde Goiás, reinforcing its role in supporting clinical decision-making during health emergencies. Although the WHO declared the end of the public health emergency in 2023, the pandemic drove advances in telehealth, the use of which tends to im-

prove the quality of care.

Between 2015 and 2022, a significant reduction was observed in the intention to refer patients to urban center facilities, as well as in the number of referrals made. In 2015, 53.83% of healthcare professionals reported an intention to refer patients, but 17.41% of patients were actually re-

ferred; in 2016, 30.25% and 10.49%; and in 2017, 6.38% and 1.62%, with a referral, respectively. This pattern persisted between 2018 and 2022, with intentions of 10.40%, 14.92%, 13.18%, 8.10%, and 4.70%, and referrals of 2.86%, 3.81%, 3.20%, 1.69%, and 1.24%. The frequencies are described in Table 2.

Table 2. Call frequencies regarding referral intentions and actual referrals, according to Telessaúde Goiás records (2015–2022)

Intention to Refer	Year	n	%	Patients Referred	Year	n	%
No	2015	289	46.16	No	2015	517	82.59
Yes	2015	337	53.83	Yes	2015	109	17.41
No	2016	339	69.75	No	2016	435	89.51
Yes	2016	147	30.25	Yes	2016	51	10.49
No	2017	925	93.62	No	2017	972	98.38
Yes	2017	63	6.38	Yes	2017	16	1.62
No	2018	1,663	89.60	No	2018	1,803	97.14
Yes	2018	193	10.40	Yes	2018	53	2.86
No	2019	2,726	85.08	No	2019	3,082	96.19
Yes	2019	478	14.92	Yes	2019	122	3.81
No	2020	3,723	86.82	No	2020	4,151	96.81
Yes	2020	565	13.18	Yes	2020	137	3.20
No	2021	7,497	91.90	No	2021	8,020	98.31
Yes	2021	661	8.10	Yes	2021	138	1.69
No	2022	10,111	95.30	No	2022	10,478	98.76
Yes	2022	499	4.70	Yes	2022	132	1.24

n: absolute number of calls; %: percentage

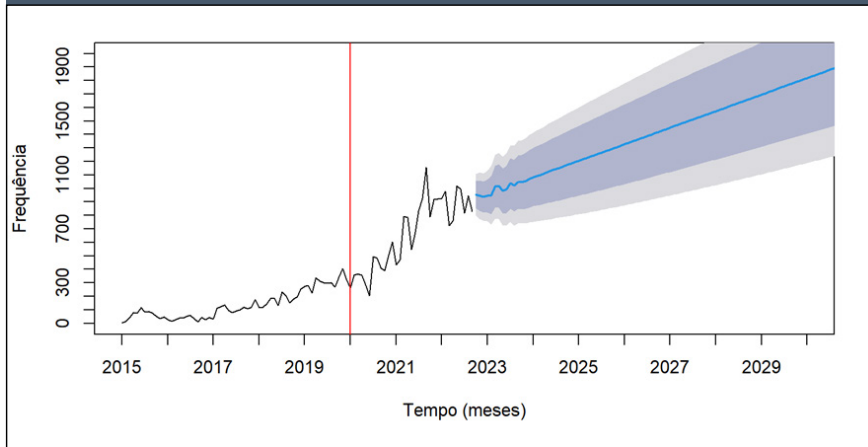
Source: NUTTs, 2025.

Between 2015 and 2022, more than 75% of professionals who requested calls through Telessaúde Goiás reported that their questions that prompted the teleconsultations were fully addressed, while approximately 25% reported partial clarification, no clarification, or were unable to provide information.

Additionally, an average of 72.06%

of professionals requesting calls through Telessaúde Goiás (2015–2022) reported being fully satisfied with the information provided for their calls. The average proportion of professionals who reported being satisfied was 21.39% during the analyzed period. Among those who self-reported being completely dissatisfied, dissatisfied, or indifferent, the averages were 3.26%, 0.91%, and 2.37%, respectively.

The tests applied to the model constructed to assess the temporal pattern of the frequency of calls at Telessaúde Goiás (2015–2022) did not indicate stationarity ($p = 0.788$) or seasonality ($p = 0.999$), but revealed a temporal trend ($p < 0.001$). The prediction of the number of calls for 2023, 2024, and 2030, using the ARIMA model, suggests a significant increase in the frequency of teleconsultations over time.

Figure 1. Prediction of Calls at Telessaúde Goiás for the period 2023–2030.

Source: NUTTs, 2025.

DISCUSSION

Telehealth has been recognized as a strategy to expand healthcare capacity in public and private systems¹⁰. In Telessaúde Goiás, an increase in calls was observed between 2015 and 2022, in line with the global incorporation of digital technologies in healthcare¹¹, accompanied by a reduction in referrals to urban centers, indicating greater problem-solving capacity. Projections through 2030 point to a growing trend in demand, suggesting the consolidation of the service as a strategic component of care coordination.

In this context, the results highlight the relevance of Telessaúde Goiás in supporting Primary Care. Created in 2007 and affiliated with the Center for Telemedicine and Telehealth at the Federal University of Goiás (NUTTs/UFG), the program is the result of a partnership between the UFG School of Medicine and the Goiás State Department of Health (SES-GO), currently serving 225 of the 246 municipalities, with prospects for expansion given its relevance and free access¹¹.

The service offers teleconsultation, teliagnosis, and tele-education; in this study, we analyzed asynchronous

teleconsultation, in which primary care professionals refer cases via the internet to specialists, with a response within 72 hours. The model supports clinical decision-making, enabling local resolution or timely referral¹². Medicine, nursing, and dentistry accounted for the highest demand, a finding consistent with their central role in Primary Care and one that reinforces the role of Telehealth as a clinical support tool and instrument for coordinating care.

The fact that medicine ranks among the top areas of demand on the Telessaúde Goiás platform is consistent with its focus on clinical care and the historical consolidation of remote healthcare. Since the 1920s, there have been records of medical consultations transmitted via radio^{3,13}. Beginning in the 1990s, with advances in information and communication technologies, telemedicine expanded, incorporating multiple care modalities and clinical fields. This movement broadened its conceptual scope, leading the World Health Organization (WHO) to no longer distinguish between “telemedicine” and “telehealth”¹³, encompassing a concept that includes, in addition to monitoring and diagnosis, continuing education (e-learning) and teleconsultation or telecounseling for spe-

cialized second opinions¹³.

The significant participation of nursing among the areas with the highest demand in Telessaúde Goiás is consistent with its strategic role in Primary Care, especially given the incorporation of digital technologies that have been transforming the planning, recording, and analysis of care. Recent evidence shows that nursing teleconsultation requires specific clinical and communication skills, although it still faces structural barriers and training gaps, particularly in the post-pandemic context^{13,14}.

Similarly, dentistry stands out among the most in-demand fields, in line with the expansion of teledentistry, which encompasses teleconsultation, teliagnosis, and telemonitoring, contributing to higher quality and more effective oral health care. Studies indicate that these modalities positively influence the conduct of teams in Primary Care, improving clinical decision-making and reducing unnecessary referrals^{15–17}. Despite this progress, there is still resistance among some professionals, possibly related to the need to develop new skills¹⁸. However, it is expected that this barrier will be progressively overcome, expanding access to dental care, especially for populations in rural or socially vulnerable areas¹⁸.

In the calls made to Telessaúde Goiás, a wide variety of ICD-10 codes were identified. Among the most frequent were typhoid fever, coronavirus infection, hypertension, prenatal care, dengue, sore throat, and anxiety. The high number of calls related to hypertension, fever, and sore throat may reflect the impact of COVID-19 in the Midwest region, as these symptoms are common in the infection¹⁹. From another perspective, it was observed that the prevalence of hypertension among individuals with COVID-19 was similar to that of the general population; however, this condition is associated with a higher

risk of severe forms of the disease²⁰. In this context, the increase in calls related to hypertension likely reflects concern for more vulnerable patients, highlighting the importance of Telessaúde Goiás in providing clinical support during the pandemic.

The onset of the COVID-19 pandemic, characterized by the rapid spread of SARS-CoV-2, social isolation, and high mortality, had far-reaching repercussions on the population's health and placed pressure on healthcare systems²⁰. Although the prevalence of hypertension among individuals with COVID-19 is similar to that of the general population, this condition was associated with a higher risk of severe disease, which may have contributed to the increase in teleconsultations related to hypertension at Telessaúde Goiás^{20,21}. Furthermore, evidence suggests that anxiety disorders associated with the pandemic may compromise blood pressure control in hypertensive individuals, a hypothesis consistent with the simultaneous increase in calls related to anxiety and hypertension²².

During the same period, pregnant women exhibited greater psychosocial vulnerability in the face of uncertainties about the disease and its potential maternal-fetal effects, with increased anxiety and demand for healthcare support²³. Concurrently, the reorganization of access during the pandemic drove the adoption of telehealth to ensure continuity of care during the pregnancy and postpartum period²⁴. Thus, the higher frequency of calls for prenatal follow-up on Telessaúde Goiás may reflect its role in reducing access barriers and supporting clinical decision-making in a context of contact restrictions^{4,6,8}. Furthermore, dengue being among the main reasons for teleconsultations, especially in 2022, may be related to the regional epidemiological profile, highlighting the coexistence of demands for acute infectious conditions and chronic

diseases during the analyzed period.

In Primary Health Care in Goiás, preventive actions and the resolution of health issues are prioritized, with complex cases referred to urban centers. In this context, Telessaúde Goiás (2015–2022) increased the ability to resolve issues within the units themselves, reducing referrals. This finding is consistent with evidence that telemedicine reduces waiting times, optimizes access to specialists, lowers travel costs, and strengthens support for professionals in remote areas²⁵. Furthermore, the high proportion of professionals who reported having their questions answered and expressed satisfaction with the service reinforces its role in improving the quality of care and clinical decision-making.

A growing trend in requests to Telessaúde was observed through 2030; however, the predictive model is specific to this population and has limitations in long-term projections²⁵. Thus, estimates for 2023–2024 are more accurate than those for 2030, due to the greater variability of the confidence intervals. Furthermore, the prediction may have been influenced by the high proportion of calls related to COVID-19, which was declared a public health emergency in 2023²⁵. Nevertheless, the pandemic drove the adoption of telehealth, and the predictive analysis reinforces its potential to inform planning, service expansion, and public policies aimed at reducing barriers to access within the SUS.

Among the study's strengths is the analysis from the perspective of primary care providers, which allows for an understanding of telehealth's contribution to clinical decision-making in primary care and its potential to reduce referrals to urban centers. The findings reinforce the benefits of telehealth and can inform the implementation of similar programs in Brazil and other contexts. However,

generalizability depends on the structural and digital conditions of each locality, and the sustainability of the telehealth service requires continuous investments in primary care and additional studies on its effectiveness in different settings.

Another limitation relates to the impact of the COVID-19 pandemic on the increase in the number of calls, which may have influenced the projections through 2030. It is possible that the high volume observed during the pandemic will not be sustained in subsequent years. Thus, greater emphasis is recommended on the forecasts for 2024, as they represent short-term projections and are therefore more reliable.

CONCLUSION

Analysis of the Telessaúde Goiás database (2015–2022) revealed a significant increase in calls, predominantly in the fields of medicine, nursing, and dentistry. The main concerns involved coronavirus infection, hypertension, pregnancy monitoring, classic dengue, sore throat, and anxiety. A reduction in referrals to urban centers was observed, along with high satisfaction among professionals regarding the clarification of their questions. Predictions indicated a growing trend in calls through 2030.

The findings suggest that Telessaúde Goiás contributes to expanding healthcare capacity and improving the quality of care in Primary Care, providing support for public policies, the expansion of telehealth, and the refinement of guidelines aimed at overcoming operational limitations.

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The authors declare that this observational, cross-sectional study utilized a pre-existing database from NUTTs/UFG, authorized through the issuance and signing of an Institutional Consent Form, with no possibility of individual identification, in compliance with the standards of the CEP/Conep System, as per CNS Resolution No. 510 of April 7, 2016. The analyzed datasets are not publicly available, as they are restricted to NUTTs/UFG. The authors declare no conflicts of interest. The study received financial support from the Coordination for the Improvement of Higher Education Personnel (CAPES – Finance Code 001), in accordance with CAPES Ordinance No. 206, dated September 4, 2018, linked to the Master's-level Scholarship Program of the Graduate Program in Health Care and Evaluation at the Federal University of Goiás. The authors thank NUTTs/UFG for providing the data from the Goiás Telehealth Program (2015–2022) that formed the basis of this study.