

The Evolution of Telemedicine in Pre-Post COVID-19 Period

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INTRODUCTION

In recent years, telemedicine has become increasingly widespread, with a marked rise in adoption during the COVID-19 pandemic. During the period of restrictions, telemedicine resulted to be particularly useful for managing various types of outpatient visits, both initial and follow-up. Several clinical studies have assessed the impact of telemedicine on patient compliance during the COVID-19 pandemic [1]. However, it remains unclear whether its use continued to grow in the post-pandemic period. This may depend on factors such as the efficiency of the telemedicine tools provided, the presence of a supportive organizational structure or patient's attitudes toward telemedicine [2].

OBJECTIVES

This study aimed to identify the typical patient using online monitoring, analysing demographics such as age, gender, and region, along with physician characteristics. It also examined which clinical units achieved the largest growth in telemedicine use. A secondary goal was to explore how patient preferences evolved over time. The analysis focused on telemedicine data from San Raffaele Hospital in Milan. The study period spanned from March 2020 to December 2024.

METHODS

Longitudinal data on visit frequency for patients aged over 18 years were analyzed, focusing on individuals with at least two visits during the study period. Generalized linear mixed models (GLMMs) with a random intercept for patient were used to account for within-subject correlation [3]. The outcome variable (visit count) was modeled using a negative binomial distribution due to overdispersion [4]. Two separate models were estimated to evaluate the characteristics of the visit and the ones of the patient. For the first case, the fixed effects included clinical unit, visit type, physician characteristics, and semester.

For the second case, fixed effects included patient characteristics, region, and semester. To further investigate the variability in the number of visits, aggregated visit counts were calculated by clinical unit, gender, geographical area, and year. A GLMM was fitted, incorporating a random intercept for clinical unit to account for repeated measures within each statistical unit. In this analysis, the number of visits was modeled using a Poisson distribution, given the absence of overdispersion.

RESULTS

In general, the clinical unit with the highest number of visits was psychology, likely due to the nature of the visits themselves. Consequently, it was selected as the reference category in subsequent analyses. Results from the GLMM focusing on visit characteristics revealed the highest number of visits per patient in diabetology unit compared to psychology unit ($p=0.013$). The semester variable was always positively significant, indicating a constant increase in visits over time compared to the reference category, i.e. the first semester of 2021 (all $p<0.001$). The only negative estimate was observed for the first semester of 2020 ($p<0.001$), reflecting the impact of the first wave of the COVID-19 pandemic.

In the analysis on patient characteristics, overall Generation X showed the highest number of online visits. This trend was confirmed by the GLMM results, in which all other generational groups (i.e., Greatest and Silent Generations, Boomers, Millennial, and Generation Z) had significantly fewer visits compared to Generation X. Again, the semester variable was positively associated with visit frequency, indicating a continuous increase over time respected to the first semester of 2021 (all $p<0.001$), except for the first semester of 2020 ($p<0.001$). Male patients had significantly fewer visits than female patients ($p<0.001$).

Finally, analyzing the visits per unit, the number of follow-up visits increased across all semesters, but declined significantly in the second semester of 2021 with respect to the first semester of 2021. Male patients had significantly fewer follow-up visits compared to female patients.

CONCLUSION

Our study highlighted a significant increase in the use of telemedicine from its initial implementation through 2024. Specifically, our data showed that psychology was the clinical unit with the highest overall number of telemedicine visits, likely due to its natural compatibility with remote care, but diabetology showed the highest number of visits per patient. From a generational perspective, the greatest users of telemedicine were the Generation X cohort, and the women were the major users with respect to men. Identifying such characteristics may be crucial for tailoring public health strategies and improving access to and the quality of telemedicine services across diverse patient populations.

Further insights may be gained through analysis of more specific visit-related characteristics and reasons for visit.

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Figure 1. Trend of monthly visits per patient across the most required clinical units in total sample

