BMJ Open

Reducing outpatient wait times through telemedicine: a systematic review and quantitative analysis

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To cite: Capodici A, Noci F, Nuti S, *et al*. Reducing outpatient wait times through telemedicine: a systematic review and quantitative analysis. *BMJ Open* 2025;**15**:e088153. doi:10.1136/bmjopen-2024-088153

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-088153).

Received 29 April 2024
Accepted 04 December 2024

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ABSTRACT

Objectives Population ageing and the rise in chronic diseases place continual stress on healthcare systems. Scarce resources often impede equitable access to healthcare, particularly in rural areas, resulting in prolonged waiting times and heightened risks of morbidity and mortality. Telemedicine has emerged as a promising solution, offering remote and equitable care that could potentially bridge access gaps and enhance health outcomes. This systematic review aims to quantitatively examine the impact of telemedicine implementation on waiting times, defined as the time passed from the booking of a visit for an outpatient to the administration of the service.

Design A systematic review was conducted using studies on telemedicine interventions that specifically addressed waiting times. Bias assessment was performed with three tools: ROBINS-I ("Risk of Bias In Non-Randomized Studies of Interventions"), AXIS ("Appraisal tool for Cross-Sectional Studies") and RoB-2 ("Risk of Bias-2"). A weighted mean approach was used to synthesise results, with medians synthesised using a median approach.

Data sources Articles in English were retrieved from the PubMed and Scopus databases.

Eligibility criteria Studies were excluded if they did not specifically address waiting times related to telemedicine interventions. Only studies that considered waiting times defined as the time passed from the booking of a visit for an outpatient to the administration of the service and any telemedicine intervention were included.

Data extraction and synthesis A total of 53 records were included, encompassing 270 388 patients in both the experimental and control groups. The weighted mean reduction in waiting times was calculated, and bias was assessed. No record was evaluated to be at high risk of bias, with 69.8% of studies evaluated at low risk and 26.4% at moderate risk (3.8% were surveys). Results were synthesised using a weighted mean approach for studies reporting means, and a median approach for studies reporting medians.

Results Overall, a weighted mean reduction of 25.4 days in waiting times was observed. Focusing on clinical specialties (n=114 042), the weighted mean reduction amounted to 34.7 days, while in surgical patients (n=156 346), telemedicine was associated with a weighted mean of 17.3 days saved.

Conclusions The implementation of telemedicine solutions may significantly improve waiting times, potentially leading to more efficient and equitable healthcare systems.

PROSPERO registration number CRD42023490822.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Large patient population included (270 388 patients).
- ⇒ Inclusion of both clinical and surgical specialties.
- ⇒ Rigorous inclusion criteria focus specifically on waiting times.
- ⇒ High heterogeneity among studies prevented meta-analysis.
- ⇒ Lack of standardised reporting reduces the comparability of results.

INTRODUCTION

The growing phenomenon of population ageing has intensified pressure on healthcare systems worldwide, creating an unprecedented demand for both acute and chronic care services. Despite this rising need, critical resources—including medical personnel, infrastructure and diagnostic equipment—remain constrained.[1] Consequently, extended waiting times for essential healthcare services, especially for outpatients, have emerged as a challenge for healthcare systems globally.[2–5]

Long waiting times for outpatient clinics and limited access to healthcare services significantly increase the risk of morbidity, hospitalisation and mortality,[6] as delays in diagnosis and treatment can exacerbate health conditions and hamper timely clinical or surgical interventions.[6–11] The estimated premature mortality caused by delays in healthcare access for both acute and chronic conditions has been estimated to be as high as 17%.[6] On the other hand, adequate access to healthcare seems to improve life expectancy.[12]

The need for access to healthcare is critical in rural areas, where underserved populations often struggle to obtain timely care.[13 14] Individuals living in remote areas often experience higher mortality and lower life expectancy, underlining the need for targeted interventions to improve access to healthcare.[15 16] This is particularly important also in light of the Ottawa Charter,[17] which stresses the importance of granting equitable access to healthcare to everyone, independently of geographical position.

In recent years, new technologies have steadily been creating positive waves in the healthcare industry, holding the promise of improving access to care and quality of service, especially for the underserved.[18] The advent of telemedicine may be a game changer, offering opportunities to bridge the gap in healthcare access,[19 20] especially during and after the COVID-19 pandemic.[19–21]

Telehealth services allow remote diagnosis and treatment, reducing the need for physical travel and enabling timely clinical and/or surgical interventions and potentially shortening waiting times.[22–24] As an example, it has been reported how patients assessed through eConsults wait less than those assessed through traditional care.[25] Furthermore, several studies showed the non-inferiority or even superiority of telemedicine's service quality when compared with traditional care, thus representing a promising tool for improving healthcare delivery.[26–30] As an example, Demaerschalk *et al* showed that for patients whose diagnosis relies heavily on medical history, telemedicine allows for quick and accurate assessments without significant loss of diagnostic concordance compared with in-person visits.[26]

Teleservices have gone beyond the simple phone call, now offering a toolbox of options. Among these, synchronous consultations, asynchronous e-consults and remote monitoring nowadays are realities widely adopted.[31 32] Despite the vast array of technological capabilities available, the implementation of telemedicine is often hindered by managerial and economic constraints.[33] While technology presents opportunities for efficiency and optimisation, its effective integration requires a comprehensive understanding of its potential advantages, which include quicker diagnoses, reduced patient anxiety and reduced costs for the organisation.

As the extent of time reduction in either the surgical or the medical settings related to telemedicine has not yet been systematically assessed, and clear evidence on this topic might enable policymakers in taking data-informed decisions, this systematic review aims to compare waiting times for telemedicine services vs traditional ones, measuring quantitatively the effect of telemedicine on waiting times experienced by the patients from request to delivery of care.

METHODS

This systematic review has been reported following the Preferred Reporting Items for Systematic Review and Meta-Analysis approach.[34] The initial search was implemented on 1 January 2024. The search was re-run before analysis, on 31 January 2024. The search query consisted of terms considered pertinent by the authors. The protocol was registered on PROSPERO and can be found with reference: CRD42023490822, accessible at: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=490822.

Patient and public involvement: none.

Search strategy

The search included peer-reviewed publications retrieved on PubMed and Scopus as detailed in online supplemental material S-1.

Eligibility criteria

This systematic review's PICO(S) was defined as follows:

- Population: patients requiring healthcare services, specifically in outpatient clinics and/or pre-hospitalisation visits, across both clinical and surgical specialties.
- Intervention: telemedicine services of any kind used to provide healthcare remotely.
- Comparison: traditional, in-person healthcare services. The comparison assesses the difference in waiting times between patients who received care through telemedicine and those who followed conventional healthcare pathways.
- Outcomes: reduction in waiting times for healthcare services (measured in days).
- Study: systematic review of peer-reviewed studies (of any kind, presenting original data or results referring to our aim and written in English) published from 1980 to 2023, excluding reviews, meta-analyses, case reports and opinion papers. Studies were also excluded if they did not focus on waiting times defined as the time the patient has to wait from the date on which the visit is booked to when the service is administered.

Study selection

The search string was launched first on 1 January 2024 and re-launched before analysis on 31 January 2024. Studies were selected by two reviewers (AC and FN) independently. The first step was to assess titles, while the second and third steps were, respectively: abstract screening and full-text screening. Disagreement was resolved through discussion and, if an agreement was not reached, an independent tiebreaker (AG) was asked to resolve it.

Data extraction

Data were extracted by two reviewers (AC and FN) independently. Disagreement on extracted data was discussed with an independent tiebreaker (AG).

Descriptive variables extracted from each article were publication year, first author's affiliation country, study design, specialty, experimental population number, control population number, SD for experimental population, SD for control population, CIs for both the experimental and control group, mean wait time for experimental group (MWE) and mean wait time for control group (MWC), median wait time for control group (MeWC), median wait time for experimental group (MeWE) and type of intervention. Mean difference in waiting times between the experimental and the control groups was calculated as MWC − MWE or MeWC − MeWE. Each of those was extracted and noted in Excel. For any result expressed narratively, such as for surveys, not displaying the reduction in waiting time in days, a note column was added.

Quality assessment of selected studies

The quality assessment was performed according to the type of study analysed. All records were independently assessed by two reviewers (AC and FN). Any conflicts in evaluations were resolved through discussion. Studies that involved interventions were assessed through the ROBINS-I tool,[35] cross-sectional studies were assessed through the AXIS tool[36] and, finally, randomised controlled studies were assessed using the RoB-2 tool.[37]

Quantitative synthesis

A random effects meta-analysis was attempted, grouping all similar interventions together, as well as grouping surgical populations vs clinical populations. The analysis was performed in R, through the 'metafor' package. Results were double-checked through the Meta-Mar tool.[38] Extracted data on specialty and type of intervention were collapsed into dummies ('Surgical', 'Clinical' and 'e-consult', 'e-referral', respectively). As selected records did not always report results disaggregated by sex and gender, the present review does not try to disaggregate them as results presented in such cases might be faulty due to assumptions.

Qualitative results, such as opinions, and quantitative results reporting on percentage variations of waiting time were analysed separately, whenever the respective quantitative results on mean/median of intervention or control groups were not presented nor were they estimable from the showed data.

Estimation of means for both the experimental and the control groups, as well as SDs, were calculated through the Wan *et al* approach.[39]

Estimation of SD from CIs was obtained assuming that the authors used the formula for inference based on the Student's t-distribution or, for large samples, standardised normal distribution, as the sizes of the populations studied allowed for the assumption of a normal distribution; this was performed through the following formula for estimation in Excel: '=RADQ(N) × (Upper CI − Lower CI) / (INV.T.2T (0.05; N−1) × 2)', according to Snedecor *et al*.[40]

The means were summarised among themselves through the weighted mean, following the formula $Weighted\ Mean = \frac{\sum_{i=1}^{n} Di \times Wi}{\sum_{i=1}^{n} Wi}$; W_i being the sum of the control and experimental population, while D_i being the difference in mean wait time for controls minus experimental populations.

RESULTS

Records distribution

Initially, 1962 records were retrieved from PubMed and 2749 from Scopus. Of the total 4711 records, after duplicate identification and title screening, 4432 records were removed. The remaining 279 abstracts were evaluated, and 180 additional records were removed. Finally, 283 unique records were screened in full text for eligibility, and a total of 53 records were included in the review, as shown in figure 1.

Out of the 53 records, 41 (77.4%) were related to clinical specialties and 12 (22.6%) to surgical specialties. Among the clinical specialties, the most represented was dermatology, comprising 12 (29%) of the articles. Among the surgical specialties, the most represented was otorhinolaryngology, comprising 2 (25%) articles. The most represented country for article output was the USA, with 37.7% (n=20) articles. All the included articles and their characteristics are shown in the online supplemental material S-2.

Regarding the type of intervention, the most common was e-consult, either as synchronous or asynchronous, amounting to 46 (86.8%) articles, while the remainder assessed various forms of e-referral systems, either with specialised portals or with photo attachments.

Regarding the date of publishing, 27 (51%) were published between 2006 and 2019, and 26 studies (49%) were published from 2020 onward. Of the articles published in 2020, 1 out of 9 cited the COVID-19 pandemic, which in articles published after 2020 was mentioned in 12 articles out of 17 (71%).

Finally, as for quality assessment, no records were evaluated to be at high risk of bias, with 37 (69.8%) being evaluated at low risk of bias and 14 (26.4%) at moderate risk of bias. Two studies (3.8%), being surveys, were not assessed. Four studies qualified as RCTs. Quality appraisal of each study and their individual checklists are shown in online supplemental material S-3.

Assessment for meta-analysis

As the estimation of I^2 statistics showed heterogeneity superior to 20% (I^2=99%), it was deemed not appropriate to perform a meta-analysis, in accordance with the registered protocol; the tentative analysis can be found as online supplemental material S-4.

Quantitative synthesis of mean saved days

A total of 25 studies[41–65] out of 53 (47%) either reported or provided enough information to estimate mean wait time for experimental group and control groups, experimental population number and control population number.

Overall, these studies pooled 270 388 patients, including both the experimental and the control groups. Of these, 114 042 patients (42.2%) were evaluated in the context of clinical specialties,[41–44 47–52 54–57 59–62 65] while 156 346 patients (57.8%) were related to surgical specialties.[45 46 53 58 63 64]

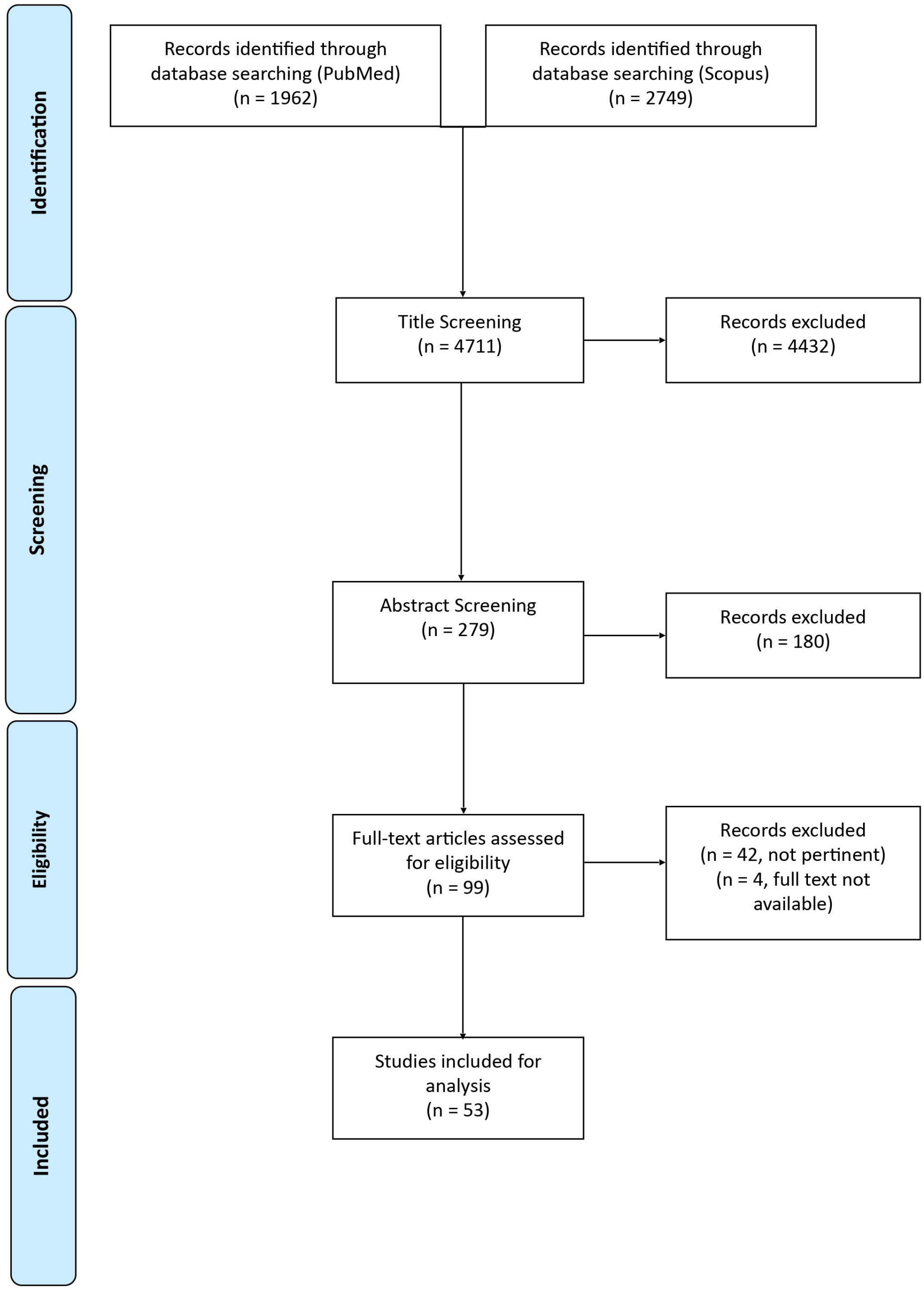

Figure 1 PRISMA ("Preferred Reporting Items for Systematic Review and Meta-Analysis") flow chart.

Including both medical and surgical specialties, a weighted mean reduction of 25.4 days was obtained through the implementation of telemedicine in the form of e-consults for experimental groups as compared with the control groups. Focusing on clinical specialties, the weighted mean reduction amounted to 34.7 days. In surgical patients, telemedicine was associated with a weighted mean of 17.3 days saved.

Quantitative synthesis of median saved days

A total of 16 studies[66–81] reported their results through medians. Clinical specialties pooled a total of 36 674 patients between the experimental group and controls,[66–77] and their median was 39.5 saved days for experimental groups when implementing telemedicine.

Surgical specialties pooled 2004 patients,[78 80 81] with a median of 112 saved days, when implementing telemedicine. One study,[79] not included in the previous synthesis, did not report the total population but reported a median of 51 saved days.

Qualitative synthesis

Studies for which it was not possible to summarise the results according to the data synthesis plan are presented here and are summarised in more detail in online supplemental material S-5.

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Overall, all retrieved studies presented a reduction in waiting times after the implementation of telemedicine.[82–90] Two surveys also investigated satisfaction among patients. The first one[86] found that 85.1% of endocrinology patients were satisfied with telemedicine-related wait times. Conversely, the second study[87] revealed dissatisfaction among general practitioner patients regarding waiting times for phone calls and video consultations, rating them as 'poor', even when the target of three working days for a returned call was met.

Three studies presented mean reduction in waiting times; however, due to the absence of reported control group sizes and their study designs, these were not included in the previous summary. Specifically, they all focused on clinical cohorts and documented mean time savings of 417 and 66 days for the implementation of an e-consult[91 92] and 238 days for the implementation of e-referral.[93]

DISCUSSION

This systematic review aimed to assess the impact of telemedicine on patient wait times from the request to the delivery of care. Even though high heterogeneity was noted in pooling together studies' results, extracted data suggest a marked reduction in waiting times associated with telemedicine interventions, adding up to a weighted mean reduction of 25.4 days across all specialties. This result was found to be consistent regardless of the intervention type and population type, which might have been the cause of such high heterogeneity; furthermore, it is consistent with what was previously reported by Caffery *et al*.[94]

The quantitative synthesis, weighted on over 200 000 patients, for both clinical and surgical specialties, is the main strength of the present study, showing a striking reduction in wait times when telemedicine is adopted. This was also substantiated by median analyses. Alongside the main strengths of this study, a few limitations should be acknowledged. First, this systematic review did not explore the underlying mechanisms driving the reported improvements in waiting times, an important issue that remains unexplained. Second, the high statistical heterogeneity observed across studies prevented us from conducting a meta-analysis. Furthermore, the lack of standardised reporting methods across the studies included significantly prevents us from making reliable comparisons. Although those issues are not a direct limitation related to our methodology, these inconsistencies in the literature are associated with important implications for results interpretation. Finally, the search strategy was restricted to the PubMed and Scopus databases, potentially missing relevant studies from other sources, and publication bias was not assessed, which may have resulted in an over-representation of positive telemedicine outcomes in our analysis. Although limited by inconsistencies in reporting standards across studies and high heterogeneity in the extracted records, this systematic review's findings show *how much* waiting time is saved through the implementation of telemedicine.

Telemedicine represents a pivotal step in healthcare delivery, and COVID-19 has undoubtedly propelled the development and adoption of telemedicine technologies.[19] Simultaneously, telemedicine presents a significant opportunity for remote areas that are often unattractive to healthcare professionals due to their geographical location and economic factors. In these areas, the volume of medical visits often does not justify the establishment of local healthcare centres,[95 96] leaving patients burdened with more travel and delaying timely care.

Beyond timely access to healthcare, inequalities related to access to care might be mitigated too, as living in a 'medical desert'[97] does not hinder virtual consultations, provided an internet connection is available.[98] This is especially relevant when considering the risk of morbidity, hospitalisation and mortality associated with delayed access to healthcare services, especially in remote areas.[99–104] Telemedicine has shown promise in mitigating this risk by offering quicker triage and access to care, as substantiated by this review's results. This could be particularly beneficial for chronic disease management and acute conditions where early intervention can prevent complications.[105–108]

Despite the positive prospects offered by telemedicine, it is crucial to acknowledge the interconnection between visit rates and waiting times: if the number of visits surpasses the system's capacity to deliver them, waiting times might lengthen. Given the healthcare system operates uniquely, as supply often guides demand,[109] one must also consider potential instances of backfire with the widespread adoption of telemedicine, as it could inadvertently exacerbate waiting lists.

Moreover, it is noteworthy that while the selected records have examined changes in patient waiting times following the implementation of telemedicine, they did not investigate *why* waiting times decreased. This explanation could stem from resource-related factors, such as the more efficient use of personnel time or the elimination of geographical travel, as well as organisational factors, including streamlined communication, reduced administrative bottlenecks and the ability to implement more flexible scheduling.

In conclusion, this systematic review presents evidence of potentially relevant reductions in wait times through telemedicine, with slight differences between surgical and clinical specialties.

Despite the challenges, telemedicine seems to have the potential to increase access to care, especially by reducing real-world inefficiencies in time management, as well as by overcoming logistical constraints. Further research, particularly with standardised reporting and a focus both on diverse healthcare specialties, and on the ethical aspects of telemedicine, is essential for a comprehensive understanding of telemedicine's efficacy and its holistic impact on healthcare delivery.

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Contributors AC: conceptualisation, methodology, investigation, formal analysis, results interpretation, data curation, writing—original draft preparation, writing—review and editing and guarantor. FN: methodology, investigation, formal analysis, results interpretation, data curation and writing—original draft preparation. SN, ME, SD, CP and TMH-B: results interpretation and writing—review and editing. AG: results interpretation, data curation, writing—original draft preparation, writing—review and editing, supervision and funding administration.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. All data will be shared upon reasonable request to the corresponding author.

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