JHPM Journal of Health Policy and Management (2023), 08(03): 178-188
Masters Program in Public Health, Universitas Sebelas Maret

Meta-Analysis

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Meta-Analysis of the Effectiveness of Teledentistry on Patients Satisfaction

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Received: 29 March 2023; Accepted: 25 May 2023; Available online: 16 September 2023

ABSTRACT

Background: Preventive strategies of caries prevention, such as topical fluoridation or drinking water, have been effective in inhibiting the development of carious lesions. Teledentistry is an alternative service that combines dentistry with long-distance telecommunication technology for consultation and treatment planning that can be used for dental and oral health education to increase public awareness. The purpose of this study was to analyze the effectiveness of teledentistry on patient satisfaction.
Subjects and Method: This study was a meta-analysis with the following PICO, population: patients. Intervention: teledentistry. Comparison: conventional (outpatient). Outcome: patients satisfaction. The articles used in this study were obtained from three databases, namely Google Scholar, Pubmed, and Science Direct. Keywords to search for articles are "teledentistry" OR "oral hygiene" AND "multimedia" OR "smartphone app" OR "online social media" AND "patient satisfaction". The articles included are full text English with a randomized control trial study design from 2013 to 2023. The selection of articles was carried out using the PRISMA flow diagram. Articles were analyzed using the Review Manager 5.3 application.
Results: A total of 9 case studies from the continents of Europe (Netherlands, Germany, Italy), North America (Pennsylvania), and Asia (India, Saudi Arabia, Iran) were selected for systematic review and meta-analysis. The results showed that 1.05 units of teledentistry increased patient satisfaction compared to not being given teledentistry. Statistical results (SMD = 1.05; 95% CI= 0.64 to 1.46; $p < 0.001$).
Conclusion: Teledentistry increased patient satisfaction

Keywords: teledentistry, oral hygiene, online social media, patients satisfaction

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Cite this as:
Utsani WS, Demartoto A, Murti B (2023). Meta Analysis of The Effectiveness of Teledentistry on Patients Satisfaction. *Health Policy Manage*. 08(03): 178-188. https://doi.org/10.26911/thejhpm.2023.08.03.02.

BACKGROUND

Cavities (dental caries) are damage to the hard tissue of the teeth that develop from small holes to holes that could damage the teeth. Caries is currently one of the dental and oral diseases with the highest prevalence. According to Basic Health Research data (2018), 45.3% of Indonesia's population has cavities. In West Sumatra, caries prevalence is also not much different from the national

prevalence, namely 43.87%. The caries occurrence process involves dynamic collaboration between Streptococcus mutans bacteria that use free sugar as a substrate. Fermented carbohydrates are used as energy and cause acid as a metabolic product. When the pH becomes more acidic, up to a critical pH (5.5), exposed enamel or dentin undergoes demineralization. If this process continues, the enamel is unable to compensate for the damage to the tooth structure, so that caries is formed (Forssten et al., 2020).

Preventive strategies of caries prevention such as topical fluoridation or drinking water have been effective in inhibiting the development of carious lesions, but do not focus on the main cause of caries, namely a high carbohydrate/sugar diet. 5 Clinical and population-based studies have shown a correlation between caries and the sugar content of the daily diet (Alkan et al., 2012).

The progressive development of caries may indicate the need for a strategy to intervene in caries causes from a dietary perspective (Sivakumar et al., 2016). One approach to improving dietary patterns is through education and counseling. The effectiveness of education is not known in the long term, but dietary counseling can reduce caries rates and reduce high-risk dietary behaviors.

Teledentistry is a technology-based practice using video conferencing to administer and plan treatment remotely. Teledentistry makes it possible to predict the threat of outbreaks based on remote media and to disseminate information quickly to the public so that it is suitable for use in the alert and preparedness phase (Yandi et al., 2022). Teledentistry is done in the form of communication or consultation. It is also possible for dentists to provide advice and prescribe medication to patients who may be exposed to COVID-19 during the history and postpone patient visits to the clinic, but remain in direct contact with patients via telephone or text messages (Pereira et al., 2020).

The communication system in teledentistry can be done through short message applications such as WhatsApp, Telegram, SMS, or Messenger) and can also be done through video applications such as (Google meets, Skype, Facetime). The use of WhatsApp during the consultation showed that 82% was a good choice.

The purpose of an online consultation can be in the form of an initial consultation where the patient consults for the first time or an old patient who has not consulted for more than 6 months and the patient also wants to consult a different case or complaint. Teledentistry is used in hospital outpatient services as the application of information technology in the production process of outpatient services in order to create quality health services by avoiding waste. Digitalization of health services is needed to increase the effectiveness of the process of providing health services (Samad et al., 2021).

Teledentistry can reduce waiting times, adjust service volume based on customer expectations, improve service coordination and collaboration, reduce costs, increase product innovation and customer value. Finally, teledentistry can promote effective access to information to ensure on-time delivery assurance, customized products, customer satisfaction with shorter production times. Voices from customers need to be continuously heard so that teledentistry developers can improve the process of developing health care services. Technology-based care is also ongoing to develop more to meet patient and provider needs (Lubis, 2021).

Teledentistry also has weaknesses, namely not being able to carry out clinical examinations and it is difficult to carry out investigations that require direct contact with patients who will help with an accurate diagnosis (Rahman et al., 2020). This condition

will certainly indirectly affect patient satisfaction. Patient satisfaction is also another important thing that must be considered in the use of teledentistry. Patient satisfaction with teleconsultation in medicine has generally been shown to be high, however, this should be looked at more carefully with the available evidence (Estai et al., 2020).

According to Kosanke, patient satisfaction is seen from the level of consumer feelings and responses to the services provided by the organization. Meanwhile, dissatisfaction arises when the results obtained do not meet patient expectations. If the work discipline received is as expected, the patient will feel satisfied, and vice versa (Kosanke, 2019). According to Lubis, "quality of service (reliability, responsiveness, confidence and tangible and empathy) together have a positive and significant impact on patient satisfaction" (Lubis, 2021).

This study aimed to estimate the effect of teledentistry on patients satisfaction.

SUBJECTS AND METHOD

1. Study Design

This study was a systematic and meta-analysis research. The articles used in this study were obtained from several databases, namely Google Scholar, Pubmed, and Science Direct between 2013 and 2023. The selection of articles was carried out using the PRISMA flowchart. The keywords to search for articles are as follows: “teledentistry” OR “oral hygine” AND “multimedia” OR “smartphone app” OR “online social media” AND “patient satisfaction”.

2. Steps of Meta-analysis

The meta-analysis was carried out through 5 steps as follows:

1) Defining research questions with PICO (Population: Workers, Intervention: Using a mobile-based stress management application: Not Using a mobile-based stress management application Outcome: Stress and depression
2) Searching main study articles from electronic databases such as PubMed, Google Scholar, ProQuest, Science Direct, and Scopus
3) Conducting screening and critical appraisal of the main study articles.
4) Performing data extraction and synthesize effect estimates into Rev-Man 5.3.
5) Interpreting and making conclusions.

3. Inclusion Criteria

Inclusion criteria in this study article were: full-text article with randomized control trial design, research subjects were patients, study results were patient satisfaction, multivariate analysis with standardized mean difference (Mean – SD) to measure the estimated effect.

4. Exclusion Criteria

The exclusion criteria in this study article were: articles published in languages other than English, statistical results reported in the form of bivariate analysis, articles before 2013.

5. Operational Definition of Variables

Article search was carried out by considering the eligibility criteria determined using the PICO model. Population: Patients. Intervention: teledentistry. Comparison: conventional (outpatient). Outcome: Patients satisfaction.

Teledentistry is alternative services that combine the field of dentistry with technology and telecommunications.

Patients satisfaction is consumer attitudes after receiving the service, in the form of degrees of liking and disliking of the same service.

6. Study Instruments

The study was guided by the PRISMA flowchart and quality assessment using the Critical Appraisal Randomized Control Trial.

7. Data analysis

The data in the study were analyzed using the Review Manager application (RevMan 5.3).

Forest plots and funnel plots are used to determine the size of the relationship and the heterogeneity of the data. The fixed effects model is used for homogeneous data, while the random effects model was used for heterogeneous data across studies.

RESULTS

The process of searching for articles was carried out through several journal databases including Google Scholar, Pubmed, and Science Direct. The review process for related articles can be seen in the PRISMA flowchart in Figure 1. Research related to the effectiveness of teledentistry on patient satisfaction consisted of 9 articles from the initial search process resulting in 2,769 articles, after the deletion process published articles with 573 requirements for further full text review. A total of 9 articles that met the quality assessment were included in the quantitative synthesis using meta-analysis. It can be seen in Figure 2 that research articles come from 3 continents, namely from Europe (Netherlands, Germany, Italy), North America (Pennsylvania), and Asia (India, Saudi Arabia, Iran). Table 2, the researcher conducted an assessment of the quality of the research using the critical appraisal tools randomized controlled trial (RCT) published by CEBM University of Oxford, 2014.

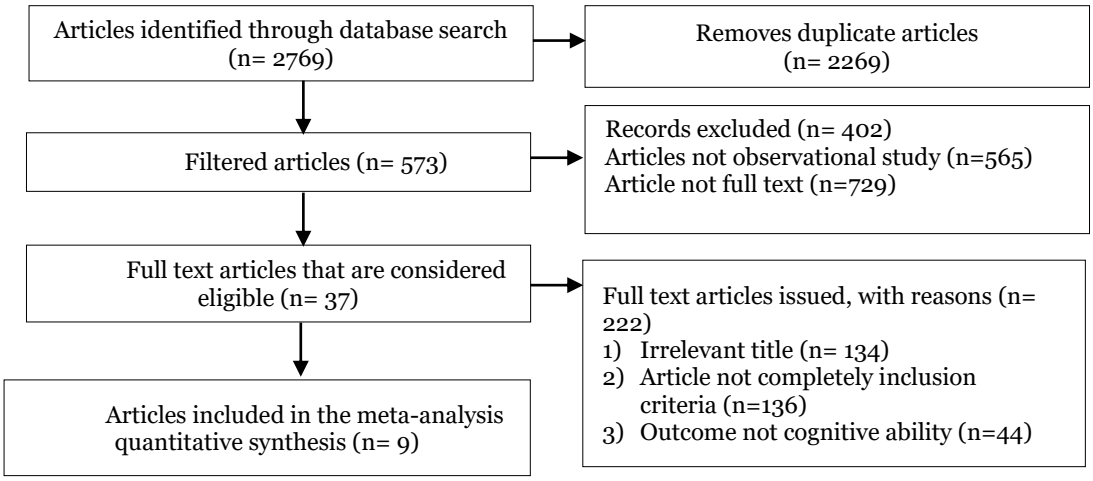

Figure 1. PRISMA flow diagram

Figure 2. Map of the study area of the effect of teledentistry on patients satisfaction

Table 1. Summary of primary randomized controlled trial (RCT) articles with each PICO (N=1.094)

Author (Year)	Country	Sample Size	P Population	I Intervention	C Comparison	O Outcome
Kumar (2018)	India	60	Patients receiving fixed orthodontic treatment (braces)	Receive text messages	No text message	Patients Satisfaction
Scheerman (2020)	Sweden	132	Adolescent patients who use fixed orthodontics (braces)	Receive access to the White Teeth application in addition to the usual care	No access	Patients Satisfaction
Alkadhi (2017)	Saudi Arabia	44	Adolescent patients who use fixed orthodontics (braces)	Receive an application that sends active reminders of oral hygiene three times a day	Receive verbal oral hygiene instructions during routine orthodontic visits	Patients Satisfaction
Alkilzy (2018)	German	49	Pediatric patient with dental caries	Provided additional smartphone applications	No additional applications are provided	Patients Satisfaction
Bowen (2015)	Pennsylvania	40	Patients receiving orthodontic treatment	Receive text messages	Not receiving Cognitive text messages	Patients Satisfaction
Baherimoghadam (2022)	Iran	58	Patients receiving orthodontic treatment	Receive text messages via whatsapp	Not receiving text messages via Whatsapp	Patients Satisfaction
Hamilton (2020)	Sweden	331	Patients receiving orthodontic treatment	Receive text messages via Telegram	Not receiving text messages via Telegram	Patients Satisfaction
Zotti (2016)	Italy	80	Patients using fixed multi-bracket	Receive text messages via Whatsapp	Not receiving text messages via Whatsapp	Patients Satisfaction
Zotti (2019)	Italy	100	Pediatric patients aged 4-7 years old	Receive oral hygiene reminder application	Not receiving the reminder application	Patients Satisfaction

Table 2. Results of Randomized Control Trial Quality Assessment on the Effectiveness of Teledentistry on Patient Satisfaction

Author (Year)	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Kumar (2018)	1	1	1	1	1	1	1	1	1	1	0	1	11
Scheerman (2020)	1	1	1	1	1	1	1	1	1	1	0	1	11
Alkadhi (2017)	1	1	1	1	1	0	1	1	1	1	0	1	10
Alkilzy (2018)	1	1	1	1	1	1	1	1	1	1	1	1	12
Bowen (2015)	1	1	1	1	0	1	1	1	1	1	0	1	10
Baherimoghadam (2022)	1	1	1	1	1	1	1	1	1	1	0	1	11
Hamilton (2020)	1	1	1	1	1	1	1	1	1	1	0	1	11
Zotti (2016)	1	1	1	1	1	1	1	1	1	1	0	1	11
Zotti (2019)	1	1	1	1	1	1	1	1	1	1	0	1	11

Question criteria descriptions:

1 = Does the research address a clearly focused statement/problem?

2 = Is the Randomized Controlled Trial research method suitable for answering research questions?
3 = Are there enough subjects in the study to establish that the findings did not occur by chance?
4 = Are the subjects randomly allocated to the experimental and control groups? If not, could this introduce bias?
5 = Are inclusion/exclusion criteria used?
6 = Are the two groups comparable at study entry?
7 = Are objective, unbiased outcome criteria used?
8 = Are objective and validated measurement methods used to measure the results? If not, are the results assessed by someone who is not aware of the group assignment (i.e. is the assessment blinded)?
9 = Is the effect size practically relevant?
10 = How precise is the estimated effect? Are there confidence intervals?
11 = Could there be confounding factors that haven't been taken into account?
12 = Can the results be applied to your study?

Description of the answer score:

0 = No
1 = Yes

Table 3. Effect estimates (Mean SD) of all primary studies performed in the meta-analysis (N=1.094)

Author (Year)	Teledentistry		Non-Teledentistry	
	Mean	SD	Mean	SD
Kumar (2018)	1.92	0.74	0.92	0.72
Scheerman (2020)	2.88	0.95	2.53	0.51
Alkadhi (2017)	0.98	0.52	0.67	0.31
Alkilzy (2018)	1.49	0.73	0.48	0.44
Bowen (2015)	0.58	0.17	0.23	0.08
Baherimoghadam (2022)	1.82	0.78	1.25	0.76
Hamilton (2020)	20.9	9.30	20.1	8.20
Zotti (2016)	1.79	0.54	1.06	0.47
Zotti (2019)	2.3	0.64	1.52	0.73

1. Forest Plot

Based on Figure 3, it showed that teledentistry was effective in increasing patient satisfaction. Patients who received teledentistry had an average level of patient satisfaction by 1.05 higher than those who did not receive teledentistry, and the effect was statistically significant (SMD = 1.05; 95% CI= 0.64 to 1.46; $p < 0.001$). Figure 4.3 showed the heterogeneity of the large study effect estimates ($I^2 = 87\%$). The calculation of effect estimation was carried out using a random effect model approach.

2. Funnel Plot

Figure 4 showed that the distribution of effect estimated between studies was not symmetrical to the right and left of the estimated average vertical line. The distribution of effect estimates lies more to the right than to the left of the vertical line, thus indicating publication bias. Because the distribution of effect estimates was located to the right of the location of the diamonds in the forest plot of Figure 4.3, the publication bias of effects overestimated.

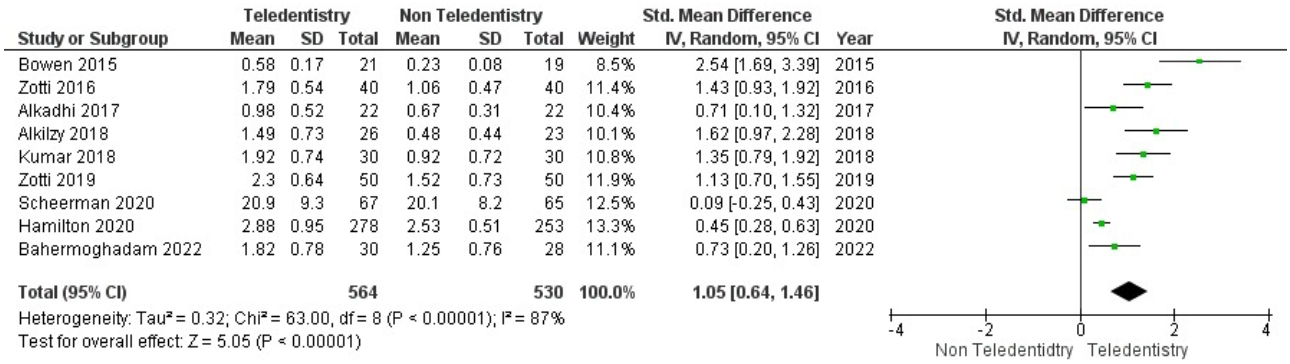

Figure 3. Forest Plot of the Effectiveness of Teledentistry on Patient Satisfaction

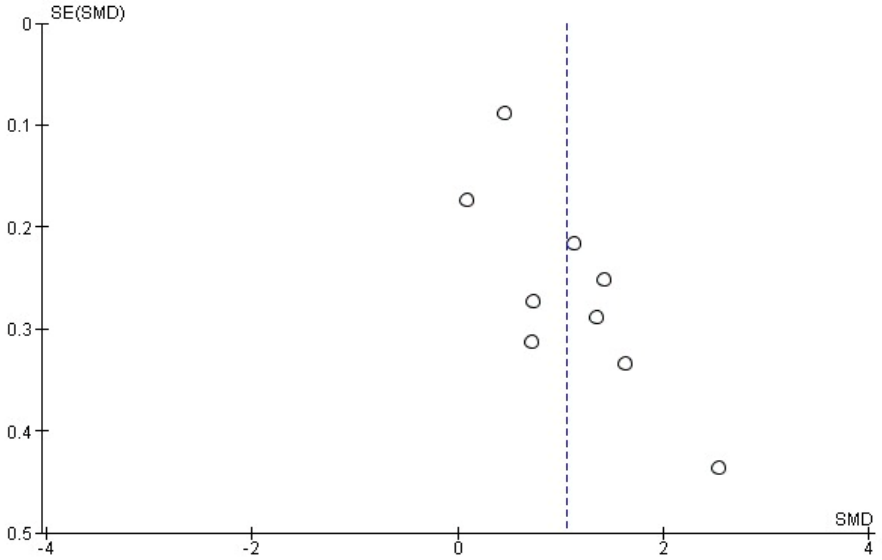

Figure 4. Funnel Plot the Effectiveness of Teledentistry on Patient Satisfaction

DISCUSSION

This study is a systematic and meta-analysis research with the theme of the effectiveness of teledentistry on patient satisfaction. This systematic study and meta-analysis used controlled research for confounding factors that could be seen from the study's inclusion requirements, namely multivariate analysis, and statistical results reported Standardized mean difference (Mean – SD). Teledentistry estimates of patient satisfaction are processed using RevMan 5.3 with the generic inverse variance method.

The results of systematic studies and meta-analyses are presented in the form of forest plots and funnel plots. Forest plots provide an informative overview of each study examined in the meta-analysis, and estimates of the overall results (Murti, 2018). The funnel plot visually shows the amount of variation (heterogeneity) (Akobeng, 2005 in Murti, 2018). Funnel plots show the relationship between study effect sizes and sample sizes of the different studies studied, which can be measured in a number of different ways.

Primary studies that fulfill the criteria regarding the effect of the effectiveness of teledentistry on patient satisfaction obtained 9 articles originating from 3 continents,

namely from Europe (Netherlands, Germany, Italy), North America (Pennsylvania), and Asia (India, Saudi Arabia, Iran). This study shows that teledentistry can increase patient satisfaction by 1.05 times in patients compared to conventional care and these results are statistically significant (SMD = 1.05; CI 95%= 0.64 to 1.46; p <0.001). The heterogeneity of the research data shows I^2= 87% so that the spread of the data is stated to be heterogeneous (random effect model).

Teledentistry is an alternative service that combines dentistry with technology and telecommunications involving the remote exchange of clinical information and images for dental consultations and treatment planning. Teledentistry has the ability to increase access to dental and oral health, and reduce costs and has the potential to eliminate disparities/ equity in oral health care between rural and urban communities. Teledentistry can also be used for education and outreach to increase public awareness of dental and oral health (Astoeti and Sari, 2020).

Teledentistry, similar to telemedicine, has emerged as a new tool with promising benefits for a variety of dental disciplines including endodontics, orthodontics, oral surgery, and pediatric dentistry. It has the potential to improve access and delivery of oral health care in rural and disadvantaged areas. Additionally, teledentistry has the potential to save resources and reduce overall healthcare costs. A study in Australia reported potential savings of up to 40 million dollars per year if teledentistry was applied to screen children at low caries risk. Fajrin et al., (2022) succeeded in proving the use of teledentistry in oral medicine at a dental health service in Belfast, Northern Ireland, using a prototype of the teledentistry system. Pereira et al., (2020) explained that remote diagnosis is an effective alternative in diagnosing oral lesions by sending digital images by e-mail In diagnostic dentistry, the precise diagnosis of oral lesions, including oral cancer, can be challenging, especially in underserved communities with limited access to specialized dental care. Therefore, teledentistry can fill this gap and improve the standard of care (Almazoora, 2021).

Kumar et al., (2018) states that oral hygiene status is improved by reminder text messages. Therefore, text message reminder helps in improving the oral hygiene of patients under orthodontic treatment. This study has shown that text message reminders help improve the oral health of patients undergoing orthodontic treatment.

The results of a study by Alkadhi et al., (2017) stated that patients compliance is an important part of good oral hygiene, using technology such as mobile application notifications can significantly improve patients compliance and therefore, reduce plaque accumulation and gingival inflammation.

This study suggests the use of a reminder system as used in this study is an important tool to improve patient adherence. It would be interesting to investigate the effect of using a game mobile app to motivate patients to better adherence to oral hygiene instructions so that patients will be satisfied with the results and services provided.

This study shows the positive effects of teledentistry. The results of this meta-analysis support a small but significant increase in patient satisfaction following teledentistry. It was found that teledentistry was used for dental and oral health education to increase public awareness. Teledentistry can reduce waiting times, adjust service volume based on customer expectations, improve service coordination and collaboration, reduce costs, increase product innovation and customer value. The conclusion from this study is that teledentistry is effective in increasing patients satisfaction.

AUTHOR CONTRIBUTION

Wimmy Safaati Utsani is the main researcher who selected topics, explored and collected the data. Bhisma Murti and Argyo Dermatoto played a role in analyzing the data and reviewing research documents.

CONFLICT OF INTEREST

There was no conflict of interest in the study.

FUNDING AND SPONSORSHIP

This study is self-funded.

ACKNOWLEDGEMENT

We are very grateful to the database providers namely PubMed, Google Scholar and Science Direct.

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