Outcomes of smart glasses: Protocol for a systematic review and meta-analysis

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Method Article

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Abstract

Smart glasses have revolutionized healthcare delivery with their hands-free functionality, voice command operation, and ability to project data onto lenses. This protocol outlines a systematic review and meta-analysis to assess the outcomes of smart glasses in healthcare. Following PRISMA-P guidelines, this review will include peer-reviewed English randomized controlled trials (RCTs) comparing smart glasses to non-smart glass interventions across diverse patient populations and settings. Exclusion criteria comprise non-RCTs, non-peer-reviewed resources, and studies where smart glasses are not the primary intervention. The search, conducted in PubMed, Scopus, and the Web of Science, without time limitations, will be systematically managed and documented, including the selection process, represented through a PRISMA flow diagram. Data extraction will cover key study characteristics and outcomes. Risk of bias will be assessed using the ROB 2 tool. Studies with comparable outcomes will be pooled for meta-analysis, employing the DerSimonian and Laird method in R software, with heterogeneity assessed via the I-squared statistic. A meta-regression analysis will explore age-related heterogeneity, and subgroup analysis will investigate bias risk levels. Publication bias will be assessed using the Trim and Fill technique and Egger and Begg tests. The outcomes' quality will be evaluated using the GRADE framework. The findings are expected to guide future research, influence health policy, and inform healthcare professionals and policymakers about integrating smart glasses into healthcare systems.

Introduction

In recent years, the healthcare industry has witnessed a substantial escalation in the integration of health information technology (HIT). This development is primarily driven by the objectives of elevating the standard of patient care [1], diminishing operational [2,3], and augmenting the productivity of healthcare personnel [4]. The increasing reliance on HIT is reflective of a broader trend towards technology-driven solutions in healthcare, signifying a paradigm shift in how patient care and administrative tasks are approached. The driving force behind this trend is the Health Information Technology for Economic and Clinical Health (HITECH) Act. This act has been pivotal in steering the healthcare sector towards more innovative and efficient use of digital technologies in patient care and administrative processes [5].

Mobile health, commonly known as mHealth and included in the scope of health information technology (HIT), is all about leveraging mobile devices to enhance clinical medicine. It's a remarkable example of how technology is transforming healthcare delivery by bringing medical support right to our fingertips [6]. The use of smartphones and tablets has demonstrated a capacity for cost reduction and increased efficiency [7,8]. A recent innovation in the mHealth arena is the emergence of smart glasses. These are essentially wearable, web-integrated computers designed like ordinary eyewear. Their unique advantage lies in their hands-free functionality and voice command operation, effectively resolving the manual input challenge [9]. The most notable feature of smart glasses in mHealth is their capability to project data directly onto their lenses. Additionally, they are equipped with a special front-facing camera, allowing for the capture of images and videos, a significant advancement in medical technology [10].
The recent unveiling of smart glasses to the public has sparked considerable enthusiasm among healthcare experts. This phenomenon is clearly visible in their integration into the daily operations of clinics and hospitals [10]. Google Glass stands out in the healthcare sector, significantly influencing firms to advance their development of apps and hardware for smart glasses. It first gained prominence by streamlining interactions with Electronic Health Records and playing a pivotal role in broadcasting surgeries, aiding in the training of medical residents [11].

Since their introduction to the market in 2011, smart glasses have become a notable topic in medical research. This body of literature predominantly includes various studies that examine their application in healthcare contexts [12–14]. To the best of our understanding, this systematic review represents the first meta-analysis of the outcomes of smart glasses. Therefore, this study will first systematically review the current literature regarding the effects of smart glasses on outcomes. Subsequently, it will pool the evidence on the impact of smart glasses as documented in the existing health literature using meta-analysis methods.

### Reagents

### Equipment

### Procedure

### Methods

The protocol for the current systematic review has been developed in accordance with the PRISMA-P guidelines [15].

### Eligibility Criteria

Eligibility for this review will be limited to full-text, peer-reviewed English randomized controlled trials (RCTs) that compare the effects of smart glasses in one arm against a control group receiving a non-smart glass intervention, such as placebo or usual care, targeting outcomes across all patients and populations. More specifically, the PICOS framework for the current study is as follows:

**Population:** All human patient groups and populations, encompassing any health conditions and clinical characteristics, across all age groups, genders, and races.

**Intervention:** This includes the use of smart glasses as the intervention in one arm of the randomized controlled trials (RCTs), focusing on their effectiveness compared to a control group.

**Comparator:** All interventions not involving smart glasses, including placebo and usual care, will be considered for comparison.
Outcome: This encompasses all outcomes reported in RCTs as a result of implementing smart glasses as the intervention, across all patient and population groups.

Study Design: The review will exclusively include Randomized Controlled Trials (RCTs).

Setting: The study will consider RCTs conducted in all settings, including clinical environments, remote home-based scenarios, and non-clinical settings.

**Exclusion criteria**

Resources that are not peer-reviewed, such as abstracts, conference articles, book chapters, and similar publications, will be excluded. Additionally, non-RCT studies, including observational studies and review articles, as well as non-original works like protocols and letters, will not be considered. Animal studies and any studies where smart glasses are not used as an intervention will also be deemed inappropriate for this review.

**Search strategies**

The search for relevant studies will be conducted in three primary electronic databases: PubMed, Scopus, and the Web of Science. The keywords for this search will include 'smart glass,' 'smart glasses,' 'google glass,' and 'google glasses' using OR operator. The search will be conducted without any time limitations. In PubMed, the document type will be specifically limited to 'Randomized Controlled Trial' (RCT) in the article type limiter. In Scopus and the Web of Science the following keywords will be combined with AND to identify RCT studies: "clinical trial" OR RCT OR "Randomized controlled trial" OR "Randomised controlled trial". The reference lists of the final eligible studies will also be reviewed to find any appropriate article [16].

**Selection of Studies**

Initially, articles retrieved from each electronic database search will be downloaded and stored in an Excel file. To identify and remove duplicates, DOI numbers will be utilized. In cases where DOI numbers are not available, titles will be used to identify duplicates. Following the removal of duplicates, two independent reviewers (HM-N and AS) will examine the titles and abstracts of the articles to exclude those that do not meet the inclusion criteria. Subsequently, the remaining articles will undergo full-text screening by the same two reviewers independently, to determine which articles satisfy the specified inclusion criteria. During both screening phases, in the event of a disagreement between the two reviewers, a third reviewer (HS) will take the final decision. To visually depict the search and selection process, a PRISMA flow diagram will be utilized. Additionally, we will provide a list of studies excluded during the full-text screening phase, accompanied by the specific reasons for their exclusion.

**Data extraction**
In the process of conducting the review, HM-N and AS will function as independent reviewers for the purpose of data extraction from studies that are deemed eligible for inclusion. Essential data points to be extracted include the year of publication, the name of the first author, the originating country, and population demographics encompassing clinical attributes, gender, and age. Additional information such as the details of the intervention, the duration of follow-up, the nature of the comparator utilized, and the type and magnitude of the outcome, inclusive of its 95% confidence intervals or standard error, will also be extracted. Furthermore, the total number of participants and the distribution of participants across different arms of the study will be noted. In instances where the effect size is not explicitly reported within the study, it will be computed from the available data. For a coherent and systematic presentation of the study characteristics, a tabular format will be employed, enabling a structured and clear depiction of the pivotal elements of each study. A table will represent the characteristics of the included studies.

**Risk of bias assessment**

All the final eligible studies will have their risk of bias assessed using the ROB 2 tool [17] by two reviewers (HM-N and AS) independently. In the case of any discrepancies, the reviewers will discuss the issues to reach a final agreement. The results of this assessment will be visualized using a graph.

**Evidence synthesis methods**

Studies included in this review will be systematically classified according to the nature of their reported outcomes and their populations. Investigations that delineate comparable populations, outcomes, and similar types of effect will be pooled. Where practicable, effect sizes reported for akin outcomes will undergo transformation into a consolidated effect size type, in instances where such uniformity is absent in the original research. This process is designed to standardize effect size metrics across varied studies, thereby facilitating meta-analyses. For the purpose of these analyses, the DerSimonian and Laird method will be employed, utilizing the R programming software to conduct a meta-analysis for each outcome separately. In situations where the studies present divergent effect sizes, endeavors will be undertaken to compute effect sizes that are comparable, wherever it's feasible. Studies characterized by effect sizes that prove to be incompatible, or those where reliable estimation of effect size is unattainable, will be omitted from the meta-analysis. For assessing heterogeneity in the meta-analysis, we'll use the I-squared statistic. If the I-squared value soar above 50%, signaling notable heterogeneity, we'll dive into a basic meta-regression analysis, focusing on age groups to see if age plays a part in this heterogeneity. Also, our meta-analysis will include a subgroup analysis. This will pivot around the different levels of risk of bias, to unearth any significant disparities between the overall pooled effect size and those in the subgroups. And to catch any publication bias in the meta-analysis, we will use the Trim and Fill technique [18] and the Egger and Begg tests [19]. Each meta-analysis will be depicted using a forest plot.

**Quality of evidence assessment**

In evaluating the robustness of the evidence underpinning the outcomes, each outcome will be individually assessed using the GRADE framework (Grading of Recommendations Assessment,
Development, and Evaluation) [20,21]. This methodology appraises the meta-analysis evidence quality by examining five crucial elements: the risk of bias, presence of publication bias, levels of inconsistency, degree of imprecision, and any indirectness. The collective assessment of these elements will inform the overall confidence in each outcome, which will then be classified within a spectrum ranging from High to Very Low [22]. A tabular representation will illustrate the evidence quality pertaining to each outcome.

Troubleshooting

Time Taken

Anticipated Results

The data collection procedure will commence once this protocol is established and operational. Starting in April 2024, we will begin searching, screening, and extracting data following the criteria and methods outlined in this protocol.

Discussion

The proposed systematic review and meta-analysis on the outcomes of smart glasses in healthcare will address a gap in the current body of medical literature. By focusing on randomized controlled trials (RCTs), this study aims to provide a high-quality evidence synthesis on the effectiveness of smart glasses across diverse patient populations and healthcare settings. The study aims to offer conclusions that could guide future research and practice in health information technology. This systematic review has the potential to provide insights into the role of smart glasses in optimizing healthcare delivery and operational efficiency.

Conclusions

This systematic review and meta-analysis protocol outlines an approach to evaluate the outcomes of smart glasses in healthcare. The findings of this review are expected to have significant implications for the future of mobile health technology, particularly in enhancing patient care and healthcare operations. By offering an evidence-based assessment of smart glasses, this study could influence the development of policies and practices surrounding the adoption of health information technology. It also has the potential to guide healthcare professionals and policymakers in making informed decisions about integrating advanced technologies like smart glasses into healthcare systems. The outcomes of this systematic review and meta-analysis could serve as a cornerstone for future research and innovation in the rapidly evolving field of health information technology.

References


