Dec 11, 2023

Applications based on Artificial Intelligence for swallowing analysis described in the literature: Scope Review

DOI
dx.doi.org/10.17504/protocols.io.rm7vzxq42gx1/v1

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DOI: https://dx.doi.org/10.17504/protocols.io.rm7vzxq42gx1/v1

Protocol Citation: maiara tomanchieviez, Rafaela Soares Rech, Fernando Neves Hugo 2023. Applications based on Artificial Intelligence for swallowing analysis described in the literature: Scope Review. **protocols.io https://dx.doi.org/10.17504/protocols.io.rm7vzxq42gx1/v1**

Protocol status: Working
We use this protocol and it's working

Created: December 11, 2023

Last Modified: December 11, 2023

Protocol Integer ID: 92126

Keywords: Artificial Intelligence, Machine Learning, Deglutition Disorders, Dysphagia, swallowing analysis, joanna briggs institute scoping review protocol, objective of this publication, scoping review protocol, scoping review, google scholar, study, research, approval from the research ethics committee, using google scholar, real clinical application of these process, involving artificial intelligence strategy, artificial intelligence, research ethics committee, review protocol, web of science, artificial intelligence strategy, publication, real clinical application, heterogeneity of study

Disclaimer

Author Contributions
All authors contributed to defining the theme and constructing the study design. MT and RSR developed this protocol under review by FNH. All authors will read and approve the final version of this protocol and this will also occur when writing the review.

Conflicts of interest
We declare that there are no conflicts of interest.

Abstract

Introduction: Considering the growing number of articles involving artificial intelligence strategies for analyzing the biomechanics of swallowing, understanding which mechanisms are being described in the studies and how the methodologies are outlined is essential to evaluate the real clinical application of these processes. Given the heterogeneity of studies found in the literature to provide an overview of this field, we considered carrying out a scoping review. The objective of this publication is to present a scoping review protocol on which applications based on Artificial Intelligence for swallowing analysis are described in the literature. Methods and analysis: The review will follow the Joanna Briggs Institute Scoping Review Protocol. The databases used for research will be Pubmed, Embase, Scopus and Web Of Science, in addition to gray literature using Google Scholar. Two independent reviewers will select the articles and disagreements will be resolved by a third reviewer. The results will be analyzed using descriptive statistics. Ethics and dissemination: An article will be published with the results of this review in a peer-reviewed journal. This study does not require approval from the research ethics committee.

Guidelines

Strategies involving Artificial Intelligence (AI) and machine learning have grown exponentially in healthcare practices, proposing new assessment, diagnosis and intervention strategies[1]. In medicine, its applicability can be virtual or physical, covering control of health management systems including electronic health records, patient support robots and even robotic surgery systems, for example[2].

The use of AI is promising and can help expand access and quality of care, increase the efficiency and safety of services provided, train different actors in the clinical process, support research and innovation, increase health sustainability and ecological responsibility[3,4].

In speech therapy, studies involving machine learning are recent and demonstrate that these strategies are capable of contributing to the assessment and diagnosis of disorders in the areas of voice[5], language[6], cognition[7] and swallowing[8,9, 10]. AI can help by minimizing the weaknesses harshly criticized in traditional speech therapy, which is too subjective and dependent on the professional's clinical experience.

Regarding the biomechanics of swallowing, articles have been published relating AI-based applications to the various parameters of its assessment, such as swallowing sounds[8, 9, 10], laryngeal movements and respiratory flow[11], in subjects with pathologies and without [12] and in controlled situations [10] or close to everyday life [14]. It is expected to speed up care, freeing the workforce from laborious routine tasks, increasing access to healthcare, reducing costs and facilitating personalized, predictive and participatory speech therapy.

In order to unify the evidence found to provide an overview of these AI processing strategies for swallowing assessments, a scoping review will be carried out. Scoping reviews are a recent type of knowledge synthesis that systematically maps the evidence on a specific topic, identifying concepts, theories, sources of evidence and research. The methodological protocol followed by this work will be the Joanna Briggs Institute guidelines. Therefore, this document presents a scoping review protocol whose objective is to map the applications based on Artificial Intelligence for swallowing analysis described in the literature.

Materials

Research Question, objective and context
The topics of interest in this study are artificial intelligence and swallowing analysis. The guiding research question is: What are the AI-based applications for swallowing analysis described in the literature? The question encompasses the concept of AI and strategies applied to swallowing assessment. The objectives are to map the AI-based applications for swallowing analysis described in the literature, describe the forms of swallowing assessment found and point out possible gaps in the literature.

Inclusion Criteria
The pre-planned inclusion specifications are what the study contains as a basis for analyzing AI-based swallowing applications.

Exclusion criteria
Studies that do not compare scientific applications in artificial intelligence with swallowing videofluoroscopy. In the study analysis process, other exclusion criteria can be defined.

Types of participants
This work is focused on studies that carried out swallowing assessments with AI-based applications and compared these results to swallowing videofluoroscopy exams in individuals over 18 years of age, regardless of the pathology.

Search and selection of studies
This review work will follow the five steps described by Ashley and O'Malley: (1) identify the research question, (2) identify relevant studies, (3) study selection, (4) data collection, (5) mapping , summary and description of results. To construct the research question, we used an adaptation of the PECO strategy (acronym for: population, exposure, control and development/result), where we used to construct the research question only “P” corresponding to adults, “E” corresponding to swallowing and desphagia and “O” to specific applications in artificial intelligence.
The health descriptors used to reference artificial intelligence applications will be: Deep Learning, Hierarchical Learning, Neural Networks, Computer, Model, Neural Network, Computational Neural Network, Perceptron, Connectionist Models, Support Vector Machine, Support Vector Network, Machine Learning, Transfer Learning, Artificial Intelligence, Computational Intelligence, Machine Intelligence, Computational Reasoning, Computer Vision System, Knowledge Acquisition (Computer), Supervised Machine Learning, Unsupervised Machine Learning, and those used for swallowing and dysphagia will be: Disorders Swallowing, Swallowing, swallowing, swallowing, swallowing, oropharynx, oropharyngeal, problem, disorder, impairment, difficult, Swallowing Disorders, Swallowing Disorders, Dysphagia, Oropharyngeal Dysphagia, Swallowing. Using the Boolean operators “AND” and “OR”, the search will be carried out in the Embase, Pubmed, Web Of Science and Scopus databases, without delimiting publication data. Additionally, a search was conducted on the gray literature using the Google Scholar search engine.
To identify articles potentially eligible for the study, titles and abstracts will be read and detailed and selected studies will be read in full by two independent reviewers (MT and RSR), when relevant, data will be extracted. For extra information, we can contact the authors of the included studies. Possible disagreements during the

article selection phase can be resolved through discussion meetings. In case of non-agreement, a third reviewer will be consulted (FNH). To organize the screening and extraction of data, reference manager software will be used.

Extracting and mapping the data
Data removal will occur in the excel file. The data extracted from the works will be: Title, author, year of publication, periodical of publication, country, objective, method (application of artificial intelligence used, swallowing assessment method, sample characteristics, variables explored) and results. The studies will be classified according to the two main pillars of this review: the artificial intelligence applications used and the swallowing assessment methods.

Summary and report of results
The results of the selected studies will be summarized. To analyze the results, descriptive statistics will be performed. The data from the selected studies will be organized according to the characteristics of the subjects, underlying pathologies, application of artificial intelligence used and aspects evaluated in swallowing. The prism extension [15] will be used in this review. An article will be published with the results of this study in a peer-reviewed journal.

Troubleshooting

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