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Machine Learning in Health: A Systematic Review

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ADMINISTRATIVE INFORMATION

Support - Nothing.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 27 April 2025 and was last updated on 27 April 2025.

INTRODUCTION

Review question / Objective This research aims to answer this fundamental question: What are the machine learning methods most commonly used for solving health-related problems?

Condition being studied The aim of this study is to construct a taxonomy of Machine Learning (ML) techniques most commonly employed in health applications.

METHODS

Participant or population Population: Within the scope of our study, the population included research involving adults and children, of any age and gender, in a variety of health contexts.

Intervention Intervention: Articles that have used machine learning technique and belong to the health application research for any pathology or disease.

Comparator Comparisons: In the context of solutions to health problems, the comparison between: different types of machine learning used; different data sets; different metrics for evaluating ML models; the performance of ML algorithms versus conventional or manual methods.

Study designs to be included This research aims to answer this fundamental question: What are the machine learning methods most commonly used for solving health-related problems? This research question (RQ) leads to some specific objectives like: (a) to identify and to classify ML techniques employed in health problems; (b) to identify diseases and health conditions and to map health application areas; (c) to identify the most relevant evaluation metrics and factors for analyzing ML methods in health applications; (d) to highlight future directions of researches on healthcare applying ML.

Eligibility criteria The following inclusion criteria (IC) were applied: a) Original Articles; b) Articles in English; c) Articles published in journals,

conferences and workshops; d) Studies published between January 1st, 2013 and October 25th, 2023 in English; e) Studies focused on Machine Learning techniques for health applications.
The following exclusion criteria were applied: a) Studies or experiments with animals; b) Any information about clinical data; c) Articles published in books; d) Artificial Intelligence; e) Case Study; f) In vitro clinical studies; g) non-open access articles; h) Not quantitative; i) Only articles in English; j) Papers that are solely technical, analytical, and computer science in nature; k) Reviews; l) Type of evaluation metrics not specified; m) Type of machine learning not specified; n) Virtual Reality.

Information sources The literature search was performed through MEDLINE and PubMed databases focused on human studies. We performed a search - during the months of September and October 2023 - of articles published in the ten previous years (between January 1st, 2013 and October 25th, 2023). In the searches, the following English Medical Subject Headings (MeSH) terms were considered: “Machine Learning” and “Health Application”. Following search strings used for the literature study: On the Embase database we found 8314 papers and we, applied the following query: ('machine learning'/exp OR 'machine learning' OR (('machine'/exp OR machine) AND ('learning'/exp OR learning))) AND ('health application' OR (('health'/exp OR health) AND ('application'/exp OR application))) AND [english]/lim AND [humans]/lim AND [01-01-2003]/sd NOT [26-10-2023]/sd. On the PubMed database we found 4815 papers and we, applied the following query: (("machine learning"[MeSH Terms] OR ("machine"[All Fields] AND "learning"[All Fields]) OR "machine learning"[All Fields]) AND ("health"[MeSH Terms] OR "health"[All Fields] OR "health s"[All Fields] OR "healthful"[All Fields] OR "healthfulness"[All Fields] OR "healths"[All Fields]) AND ("applicabilities"[All Fields] OR "applicability"[All Fields] OR "application"[All Fields] OR "applications"[All Fields] OR "applicative"[All Fields])) AND ((humans[Filter]) AND (2013/1/1:2023/10/25[pdat]) AND (english[Filter])).

Main outcome(s) Outcomes: ML metrics or statistics for model evaluation; Impact of the ML solution in the medical field; Robustness and generalizability of the model; Availability of a final product for use by healthcare professionals.

Quality assessment / Risk of bias analysis This systematic review is descriptive in nature and was conducted with a focus on characterizing the current state of the literature on Machine Learning in health, without applying methods to assess risk of bias or quality of evidence.

Strategy of data synthesis Not applied.

Subgroup analysis Not applied.

Sensitivity analysis Not applied.

Language restriction Only articles in English.

Country(ies) involved Brazil.

Keywords [Machine Learning];[Health];[Review].

Contributions of each author
Author 1 - Alessandra Rodrigues Cardoso Padovam - Development of search strategies, selection of articles in databases, export of articles to the Chrocane platform, selection of articles in pairs, writing of this systematic review article.
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