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Abstract

With increased computational power and the ease of medical information collection, Artificial Intelligence has helped all areas of health develop algorithms and techniques for the diagnosis and staging of diseases. The technology has been applied in several areas, due to its wide range of resources, some activities become simpler with its assistance. Thus, this study aimed to identify the main computational models for predicting diseases. The collection of the foi data performed in the virtual databases present in the Research Portal of the Health Library (VHL): LILACS: Latin American and Caribbean Literature in Health Sciences, Scielo – ScientificElectronic Library Online and Medical Literature Analysis and Retrieval System Online (MEDLINE). Fifty-two articles were found and 10 of these included in the review. From the reading and evaluation of the included articles it was observed that with the help of computational vision techniques, machine learning through neural networks and pattern recognition can be developed algorithms capable of identifying diseases. Therefore, from this diagnosis provided by the algorithm, the health professional will be able to propose early measures for disease prevention, diagnosis and treatment.

Keyword: Computational models. Prediction. It's sick.

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Summary

With increased computational power and the ease of medical information collection, Artificial Intelligence has helped all areas of health develop algorithms and techniques for the diagnosis and staging of diseases. The technology has been applied in several areas, due to its wide range of resources, some activities become simpler with its assistance. Thus, this study aimed to identify the main computational models for predicting diseases. The collection of the foi data performed in the virtual databases present in the Research Portal of the Health Library (VHL): LILACS: Latin American and Caribbean Literature in Health Sciences, Scielo – ScientificElectronic Library Online and Medical Literature Analysis and Retrieval System Online (MEDLINE). Fifty-two articles were found and 10 of these included in the review. From the reading and evaluation of the included articles it was observed that with the help of computational vision techniques, machine learning through neural networks and pattern recognition can be developed algorithms capable of identifying diseases. Therefore, from this diagnosis provided by the algorithm, the health professional will be able to propose early measures for disease prevention, diagnosis and treatment.

Keywords: Computational models. Prediction. It's sick.

ABSTRACT

With the increased computational power and ease of gathering medical information, Artificial Intelligence has helped all areas of health in developing algorithms and techniques for disease diagnosis and staging. The technology has been applied in several areas, due to its wide range of features, some activities become simpler with your help. Thus, this study aimed to identify the main computational models for disease prediction. Data collection was performed in the virtual databases present in the Health Library Research Portal (VHL): LILACS: Latin American and Caribbean Health Sciences Literature, Scielo - ScientificElectronic Library Online and Literature Analysis and Retrieval System Medical Online (MEDLINE). We found 52 articles and 10 of these in the review. From the reading and evaluation of the included articles, which can be aided by computer vision techniques, machine learning through neural networks and pattern recognition can be developed algorithms capable of identifying diseases. Thus, from this diagnosis provided by the algorithm, the health professional will have conditions for early prevention, diagnosis and treatment of diseases.

Keywords: Computational models. Prediction. Disease.

1. INTRODUCTION

Thes great technological advances, through the concepts conceived by it begin gradually to become a reality, especially with regard to the miniaturization of components and, above all, in relation to mobile devices (especially *smartphones* and *tablets*) at all times more present in an increasingly integrated way (FRANCO et al., 2011).

Due to these advances in information technology, it is dealt with a volume of data of greater complexity, due to different possibilities of uses that may exist in computerizedsystems. With this, it is necessary to use decisionsupport themes(SAD) (BONITA, BEAGLEHOLE, KJELLSTROM, 2010). These, touxiliam the man in tasks that involve decision-making, compiling a large amount of data to be analyzed, documents, prior knowledge on the subject or mathematical models to identify and find a solution that guides the decision required for the particular problem.

SAD are widely used in finance, credit analysis; marketing, in helping to define the target audience for campaigns; engineering, support project cost management and, in particular, in thehealtharea. Inthis area, the main objective of sad is to assist in the diagnostic and prognostic service in health units that provide primary care, causing the health professional,from the interaction with the system, to perform during screening, diagnosis and/or follow-up ofthe patient. Diagnosing is one of the most complex and important activities in the health area, as it involves several factors that depending on their values can define a treatment (BONITA, BEAGLEHOLE, KJELLSTROM, 2010).

In oncology,histopathological f guras in image collection libraries are also being tilized to foster research in image processing, computer-aided analysis and diagnosis as a way to assist in the decisions of traditional pathology. In radiation oncology, the use of these advanced technologies can predict the result of diagnoses and treatment that will be applied to patients(DANTAS, et al. 2018).

With the need to make use of as many formal methods as possible to collaborate in the performanceof thisactivity s,computational ones are being employed on a large scale,due to their characteristics of automation and optimization of tasks (GUSTAFSSON, 2011), which allows the realization of faster and more accurate diagnoses.

The increasing increase in information that may be available about the patient to the health professional can hinder clinical judgment, mainly in recognizing recurrent patterns, due to the inherent difficulty of the human being in dealing with data in high-dimensionality.

Computational evolution and application possibilities have caused this theme to be explored within universities and large companies in a short time. Thus, the present study aimed to identify the main computational models for predicting diseases. In view of the above, the study presents as a guiding question: What computational models are being used for the prediction of diseases?

Methodology

This was an integrative review. According to Whittemore and Knafl (2005) the integrative review has a great methodological approach to reviews, which allows experimental and non-experimental studies to be included, so that one has a complete understanding of the analysis.

The following steps were adopted for the preparation: identification (formulation of the problem); search in the literature (data collection); evaluation of the data; analysis of the articles included in the review; and presentation and interpretation of the results (WHITTEMORE; KNAFL, 2005).

Data collection was performed in the virtual databases present in the Health Library Research Portal (VHL), LILACS (LatinAmerican and Caribbean Literature in Health Sciences), Scielo (ScientificElectronic Library Online) and MEDLINE (MedicalLiterature Analysis and Retrieval System Online) via PubMed. The descriptors were used in Portuguese:Predição,Computational model and disease.

The PICo strategy was adopted, in which the P corresponds to the Participants, the I to the phenomenon of Interest and, the Co to the Context of the study (KARINO; FELLI, 2012). Controlled and uncontrolled descriptors (DNC) were selected from the consultation with Descriptors in Health Sciences (DeCS) and, Medical *Subject Headings (MeSH),*which are presented in Chart 1.

Table 1. Stratification of the study question following the PICo strategy, São Luís, Maranhão, Brazil,2019.

Description	PICo	Components	Descriptor	Type	DNC
Participants	P	Diseases	Disease Signs and Symptoms	DeCS MeSH	Diseases Illness Evolution of the concept of disease Disease Pathology Clinical Manifestations Clinical Observation Clinical Signs Symptom Clinical symptoms
Phenomenon of Interest	I	Computational model	Patient-Specific Modeling Fuzzy Logic Patient-specific Computational Modeling	DeCS MeSH	Fisioma Patient-specific modeling Patient-Specific Modeling
Context of the study	Co	Prediction	Precision Medicine Precision Medicine	DeCS MeSH	Individualized Medicine

Note: P- participants; I-phenomenon of interest; Co-Context of the study; MeSH = controlled vocabulary of pubmed base; DNC = descriptors uncontrolled; Cinahl titles = controlled vocabulary of cinahl base; DeCS = controlled vocabulary of lilacs base

The inclusion criteria adopted were: primary studies that addressed the computational models that are being used for the prediction of diseases; published inEnglish, Portuguese or Spanish; articles available free of charge in full. The exclusion criteria adopted were: studies of narrative review of traditional literature/review, systematic or integrative; selected studies in the search in another database; and studies that did not answer the guiding question. No time clipping was performed for the selection of articles, since the search for a broad approach to the results was performed.

The selection began, by reading the titles and abstracts, based on the inclusion criteria, totaling 1567 articles, of which 52 were considered adequate and selected for reading in full. From this reading, nine were included in the final sample of this integrative review, according to Figura 1, which followed the PRISMA recommendations (MOHER et al., 2009).

Full reading of the selected articleswas performed and the data were extracted using anadapted data collectionriver(USSR; GAVÃO, 2006) thepurpose ofensuring that all relevant data were extracted. The dataincluded:definition of subjects, methodology, sample size, and concepts used for basing.

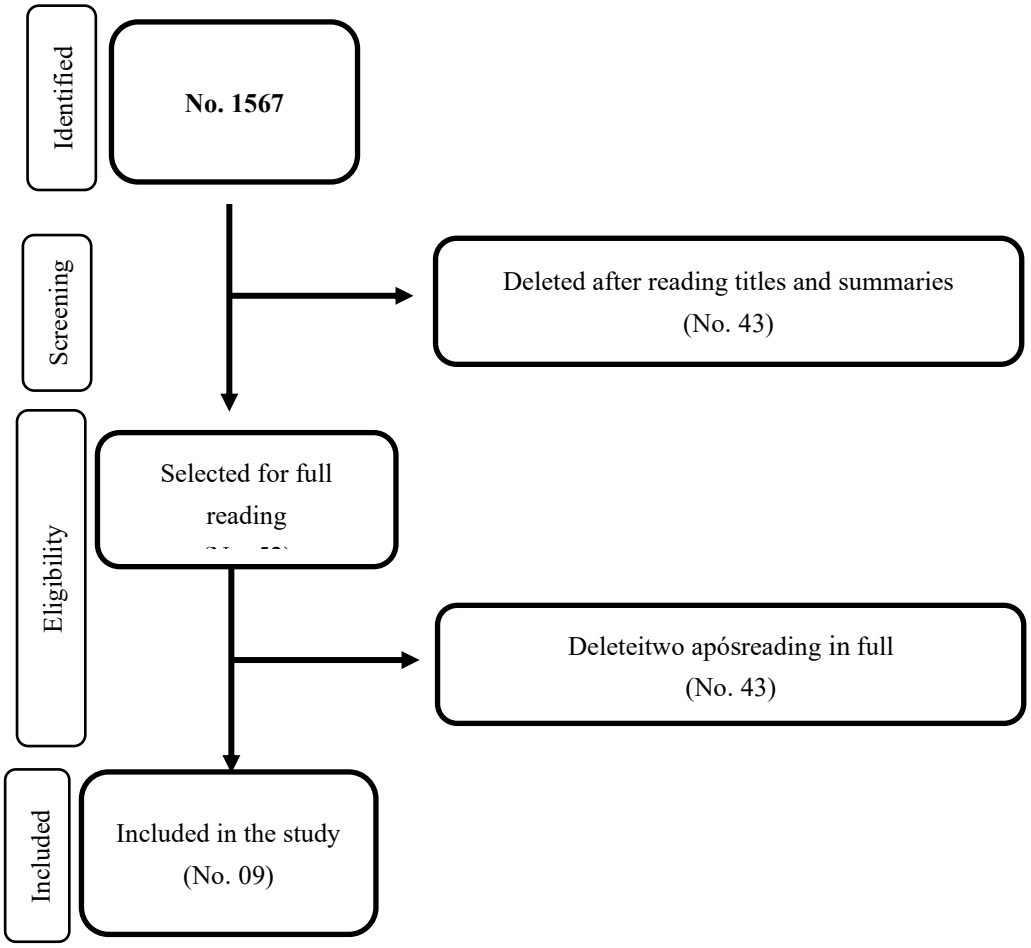

Figure 1 – Selection flowchart of studies according to Preferred Reporting Items for Systematic Reviews and *Meta-Analyses (PRISMA)*

The data found were presented in frame form. Regarding ethical aspects, there was concern to record the information necessary for the identification of the authorship of the articles.

3RESULTS AND DISCUSSION

Through the interpretative reading of the material found, in the search for studies that met the objective proposed in this study, we can select 9 scientific articles that portray the theme analyzed in this integrative review as shown in table 2 below.

Table 2 - Distribution of the second articles: author/year, title, method and objective.

Author	*Title*	*Method*	*Objective*
David et al., 2018	Fuzzy computational models to assess effects of air pollution in children.	Fuzzy logic	Build a fuzzy computational model to estimate the number of hospitalizations of children up to 10 years of age due to respiratory diseases, based on data on pollutants and climatic factors in the city of São José do Rio Preto, Brazil.
Coutinho, et al. 2015	Fuzzy model estimating length of hospitalization for cardiovascular diseases.	Computational model using fuzzy logic tools	Build a computational model using the properties of fuzzy logic to estimate the average length of hospitalizations due to cardiovascular diseases, based on the concentrations of air pollutants in the city of São José dos Campos, Brazil.
Kock, et al. 2016	Computational model of hyperinflation in lungs with obstructive pattern to airflow	Computational simulation	Mathematically modeling, through computational simulation, the hyperinflation mechanism during spontaneous breathing in lungs with obstructive pattern to airflow through variables related to respiratory mechanics: complacency and resistance of the respiratory system
Vieira et al. 2019	Fuzzy logic and hospitalizations for respiratory diseases using	Model "fuzzy" for prediction of hospitalizations	Develop and validate a "fuzzy" linguistic model to predict the number of hospitalizations due to respiratory diseases.

	data estimated by mathematical model		
Brandão et al. 2018	Nursing care for comfort of people with immunobous dermatoses: evaluation by fuzzy logic.	Application of fuzzy logic evaluation protocol.	Assess whether the interventions proposed in the client nursing care technology with immunobolhosa dermatoses contribute to reduce discomfort
Negreiro, et al. 2008	Integration of computational systems and logistics models of optimization for prevention and combat ing dengue	Logistics planning	Contemplate the use of operational research techniques in the organization and equation of logistics operations to combat dengue
Brazil; Days, 2017	Comparing computational optimization algorithms applied to the problem of predicting protein structures with HP-2D model.	Comparison between two methods applied to PSP using HP-2D model	Conduct a comparative study between these two optimization methods, in terms of minimum energy and computational times
Barreto et al. 2018	Using Artificial Neural Networks for the Diagnosis of Cervical Cancer	Prediction of cancer cases	Supporting clinical decision, network training was done in supervised mode using data from cervical cancer risk factors.
Navarro et al., 2014	Technological innovation and the reflective issues of the biosecurity field.	Literature Review	Reflect on the processes constructing of new technologies arising from the dynamics of the production of new scientific knowledge

Source: Belfort, 2019.

It is noted that all the articles selected from Quadro 1answered the objectives proposed in this review, because all publications sought to identify the computational models for prediction of some disease. Table 2 presents the distribution of studies according to the author and year of publication and the synthesis of the results that answered the objectives of this review.

Table 2 - Distribution of the results of the articles.

Author	*Results*
David et al., 2018	The model was effective in predicting the number of children's hospitalizations, and can be used as a tool in the hospital management of the studied region.

Coutinho, et al. 2015	This model can be used as a specialist system base, which can assist the municipal manager in assessing the risk of hospitalizations due to air pollutants.
Kock, et al. 2016	The implementation of this computational model demonstrated that respiratory mechanics variables can be used to predict air trapping.
Vieira et al. 2019	The fuzzy model is very simple and implies low computational expenses, making it possible to implement prediction of hospitalizations for pneumonia, bronchitis, bronchiolitis and asthma.
Brandão et al. 2018	Fuzzy's inferential analysis provided evaluating patterns of discomfort, pointing to the veracity of the hypothesis that technology contributes to promote the comfort of the clientele. Subjectivity in recognizing comfort patterns in clients with rare diseases directed the use of fuzzy logic due to attributes pain, mobility, sleep pattern, body exposure/injuries.
Negreiro, et al. 2008	The results of this computational application provided, after the tests, a better visualization of the dimension of the problem of coordination of combat for dengue managers, that is, they were fully successful in these pioneering experiments.
Drable, Rosana Gama; et. al. 2014	Use of an intelligent computational system, using nebulous logic as a method of reading the specialist in predicting the risk of development of preneoplastic lesion.
Navarro et al., 2014	Through this analytical dynamics, the essentiality of biosafety and its interface with technological innovations and bioethics are established by the aspects of the policy for the benefit of preventive actions, aimed at promoting the quality of innovative technological processes aimed at health.

Source: Belfort, 2019

It was demonstrated in the analysis of the 10 articles (Chart 2) that the computational vision has numerous applications, which help in the improvement of processes in general health,thus being a great object of study.

According to Brandão et al. (2018) in front of a clientele who needs care that goes beyond the competencies of the health professional,it is essential toproduce knowledge through clinical investigations with significant levels of evidence, directing the use of technologies to reduce discomfort and prevention of injuries.

David et al., (2018) emphasize that the fuzzy approach has been used as an alternative for several areas, including Medicine. Its great advantage is the ease to deal with linguistic terms and inaccurate and uncertain information, in addition to the low computational cost. Unlike classical theory, in which each element belongs or not to a set, fuzzy logic exists a degree of pertinence, and an element may be more or less belonging to a given set

For Coutinho, et al. (2015) fuzzy models emerge as a new tool option, due to its ability to deal with the inaccuracy and uncertainty of information, where values can be classified as partially true, has

ease of understanding and low computational cost. This approach has been used in several areas such as in control of industrial processes and medicine.

In the study by Kock, et al. (2016), the importance of airway evaluation in the hyperinflation mechanism was noticed. As presented in computational simulation, increased airway resistance has a very important effect on the obstructive pattern.

In the study by Negreiro, et al. (2008),a computational framework was presented to support dengue prevention andcontrol activities. In other words, practical operational situations related to dengue prevention and combat logistics are described, which configure problems to be addressed.

In this study, it was found that computational methods emerged as a viable alternative to these methods still limited. Computational approaches to prediction of protandica structureare *ab initio*, *threading* and homology (BRAZIL; DAYS, 2017).

The Scienceof Computing has positively influenced the development of algorithms and techniques for the diagnosis and staging of diseases. Clinical Decision Support Systems have the potential to reduce the amount of medical errors and improve the quality and efficiency of the clinical treatment offered. In this context, we highlight the use of Artificial Neural Networks (RNA), which are computational models inspired by biology and can be used in a wide variety of machine learning problems (BARRETOet al. 2018).

It should be noted that the use of the computer to aid the analysis of radiological images has been shown to be efficient in the aid of diagnosis in several medical specialties; thus, it does not initially need high accuracy and, yes, obtain a performance close to that of the specialist to serve as support and not substituto, even seeking to assist the medical teaching process.

The technological process and its innovations are presented to society as a paradoxical factor. It generates positive and negative expectations, uncertainties and challenges, such as demonstrative factors of constant constructions and reconstructions of the notions of risk, based on the informational impact and the social and conjuncture context that involves a certain risk. The dynamics of current technological processes are anchored from the perspective of the triple dialogue between scientific knowledge, industry and market interests, aimed at optimizing profit through the capacity of innovation potential (NARRARO et al., 2014)

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4 CONCLUSIONS

A list of computational procedures and technologies most used in the diagnostic activity for predicting diseases was found, which can be used to serve as a basis in new research in this area. This list is composed of supervised learning methods and image segmentation. However, it was seen that the term "computational methods" is not widely used.

It is believed that the use of these methods is greater than that found in this review, and the descriptors are named in different ways. This hypothesis could be proven in new reviews using other synonyms, such as "computational tools" or "computer science", and in other databases.

In one of the articles, it was found that the advance of the use of Artificial Intelligence in Clinical Decision Support Systems focused onncology, enabling the future elaboration of automated diagnostic

systems, in order to help primary health care professionals to perform more accurately a diagnosis and early referral of cervical cancer, thus avoiding possible cases of death and improving treatment efficiency.

Finally, it should be noted that the use of the computer to help the analysis of prediction of diseases has been efficient in several medical specialties; thus, it does not initially need high accuracy and, yes, to obtain a performance close to that of the specialist to serve as support and not substitute, even seeking to assist the teaching process-learning of health professionals.

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