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Chapter

Artificial Intelligence Starts the Big Bang of Modern Medicine and Surgery

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Abstract

Objective. To identify the areas of application and uses of artificial intelligence and expert systems in medicine, surgical procedures, and surgical specialties, classifying the degree of agreement in articles published between 2010 and 2019. Materials and Methods. The methodology consists of a relational database model and an entity-relationship model. To determine the quality of each article, the classification by degrees of agreement between "highly concordant", "relatively concordant" or "not concordant" was created on our initiative. Results. A total of 146 articles were found, of which only 28 were highly concordant with the subject of interest. Conclusions. Artificial intelligence is the new research science that is revolutionizing the way of intervention in the different disciplines of the area of medicine.

Keywords: application of artificial intelligence, expert systems medicine, surgical specialties, and surgical procedures, science, technology

1. Introduction

The pure sciences, such as mathematics and physics, have been fundamental in evolution and human survival; the great researchers in these areas were the first Nobel Prize winners in the history of world discoveries. Discoveries that have undoubtedly marked a line in time, in the postulations of the different theories of physics have led to technological advances in different areas of science, whose origin has been observational and experimental from the beginning [1].

At this point in history, the different questions, predictions, and estimates related to the behavior of a certain event or circumstance began to take shape, which was references to other research areas, especially in the medical sciences, for the study of diseases, from the causative agents to the damage caused to health [1].

These pure sciences gave rise to computational sciences, which were the gateway to research focused on artificial intelligence. Shortly after the Second World War, around 1950, when the first article on artificial intelligence was published in the philosophical journal MIND Computing Machinery and Intelligence, Alan Turing was the first mathematician and researcher who applied his knowledge in developing a computational machine that could perform mathematical analysis. And at the same time, he wondered if this same computational machine could have the ability to think like a human being [2, 3].

The first works developed with artificial intelligence were focused on mathematical sciences, statistical analysis, and on an event that marked history during the Second World War: algorithms to decode the Nazis' attack plan towards the allied countries against the government of Adolf Hitler, and whose intervention saved thousands of soldiers and civilians from each of these countries. On this occasion, artificial intelligence was used for the common good, to stop the machiavellian attacks from a sick and ambitious mind that took more than 20 million people [2, 3].

However, parallel to these feats uncertainty also grows to arise from the historical background of advances in the pure sciences. Such as the discovery of uranium and nuclear weapons, for human survival purposes, the discovery of dynamite to accelerate construction and firearms, for human defense. All of these have been questioned for their use in world wars, where human annihilation has prevailed, the most famous of all, the atomic bomb [2, 3].

Today we are thinking of artificial intelligence for the benefit of health, just health, which allows the approach from genetic and environmental risk factors and social and institutional determinants of the population. However, arises the concern as to whether the use of artificial intelligence is only of interest to ensure the survival of human beings from many diseases of the XXI century and its evolution, or whether we are approaching our annihilation [2–4].

The survival of the human race has been constantly threatened since ancient times by different outbreaks, epidemics, and pandemics of different infectious agents such as bacteria and viruses, an example of this, is the bubonic plague or black plague that wiped out 50% of the European population, and currently, the Covid-19, that had a demographic, social, economic and social impact. This has brought the world population to its knees and has made us understand that we are not indestructible, in fact, we are very vulnerable, and we must take into account nature's limits, the environment that surrounds us, and that exceeding them has led us to commit recklessness that has led to the annihilation of the human race [5].

The question we ask ourselves now is if we have learned the lesson from previous experiences, which have put human survival at risk. Or whether in this case, artificial intelligence will focus only on preserving human life and the environment around us improving our quality of life, or otherwise, we will be conquered again by the ambition for power, expansion, and wanting to be superior to others when we should be working together for our well-being.

The big bang of artificial intelligence focused on medicine and surgical procedures has already begun, the latest industrial revolution, a technological avalanche focused on the solution of more timely health interventions, reflecting real-time decision making, and influencing the health of different specific populations.

Likewise, it is urgent to regulate the uses and applications of artificial intelligence with laws and norms, imposing limits that guarantee the use of this technology only to preserve the human race, not replace it, much less annihilate it.

All countries, whether developed or developing, without exception, must sign international agreements and treaties in which they commit to use it only for the common good.

Being prudent in the development of these technologies and sharing this knowledge among sister countries that we are, without a doubt, would allow an unprecedented advance in science in general.

We must be very alert, and be able to impose limits on ourselves so that we do not engage in unethical behavior that puts the human race at risk.

We are in a historical moment, where technological advances have allowed the survival of the human race, it is important to mention that all the technology used for the creation in record time of vaccines against the covid-19 disease, which has taken so many lives worldwide.

In this way, we must unite our knowledge and efforts from all research fields, and educational institutions, such as universities worldwide, are the guarantors of imposing the limits of the different research approaches, thus favoring the good use of artificial intelligence applications.

If the academy is the one that produces the generation of knowledge for research purposes, and to solve problems, which in this case is focused on the solution of health problems, then it should impose the limits of uses on human beings and their environment.

Each research group, in their different areas, from different universities, should be able to build their methods focus on this discipline, to generate high-level knowledge, which can be translated into different computational languages, with the only purpose of making decisions in real-time.

Currently, the areas of development of artificial intelligence are focused on: Machine learning (machine learning, deep learning, unsupervised, supervised), driven by Massive Data (massive exploitation of data, identifying relationships between them, detecting patterns, making inferences, and learning through probabilistic mathematical models), natural language processing (content extraction, classification, translation, text generators), expert systems (knowledge and rule-based systems, diagnostics), computer vision (exploring the recognition and understanding of images and videos), robotics (advanced laparoscopic surgery such as Da Vinci, the Sojourner, Spirit, Opportunity, and Curiosity robots for space research) and speech recognition [6–8].

The applications, however, are focused on language analysis and understanding, information retrieval, information extraction, answer searches, automatic summaries, automatic translation, automatic document classification, speech recognition, chatbot, child content control, document and opinion detection, and anti-spam filters. Spam, voice assistants, Siri as Apple assistant, Cortana, Alexa, and Bixby all these applications use natural language techniques [6–8].

Search engines and entertainment and communications platforms such as Google Search, Google Maps, Netflix, and social networks such as Facebook, Pinterest, Twitter, Instagram, and Google Photos [6–8].

The challenge in the health areas is not only to create information systems with artificial intelligence, big data, and data mining with sophisticated algorithms for information management; making decisions in real-time is the key to intervening quickly in health problems [6–8].

2. Methodology

Descriptive methodology, with a systematic literature search in four phases, of potentially relevant articles published about artificial intelligence and expert systems applied in the areas of medicine and surgical procedures.

2.1 First phase (research question)

This phase will specify the structured research question, the population to be studied, the what, the when, the where, and the delimitation of the review time, which in this case is 10 years, and the context of interest, whose key event is the application of artificial intelligence in medicine, specialties, and surgical procedures.

In which areas of medicine, surgical specialties, and surgical procedures have artificial intelligence and expert systems been applied from 2010 to 2019?

How well do published articles on artificial intelligence and expert systems applied in the area of medicine, surgical specialties, and surgical procedures from 2010 to 2019 match?

In how many of these articles on artificial intelligence and expert systems applied in the area of medicine, surgical specialties, and surgical procedures were there decision-making from 2010 to 2019?

2.2 Second phase (selection and localization of databases - relational database model - entity-relationship model of the databases)

The location and selection of databases will be done, where the search for articles with the subject of interest will be carried out.

We will use a relational database model and an entity-relationship model to guarantee the referential entity of which the databases and the articles are part.

The Relational Model Relationship refers to the entities and their respective relationships with the other entities; therefore, it allows referential integrity to take place [9].

The Entity-Relationship Model consists of representing descriptively1 and through a diagram the information system, formalizing all the storage structure of the database (**Figure 1**) [9].

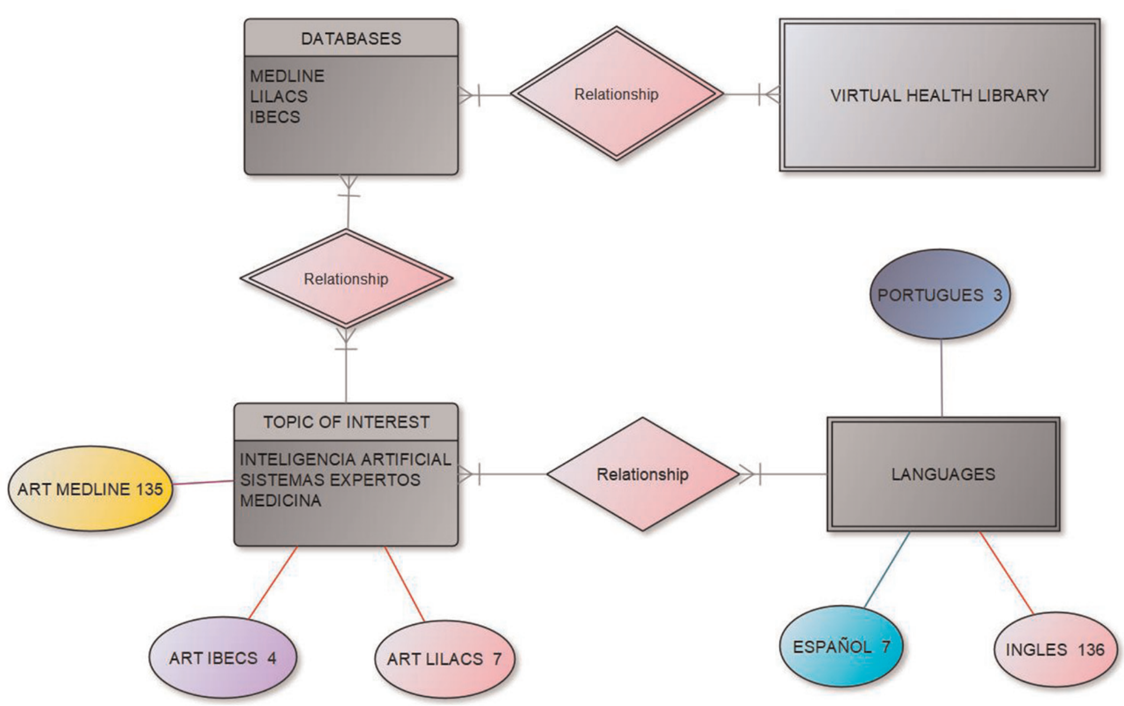

Figure 1.
Model entity general relationship model of the systematic review of the literature on a particular topic. Source: Taken and adapted from the book Relational Database Programming.

Inclusion and exclusion criteria will be applied to guarantee the following good selection of articles.

2.2.1 Inclusion criteria

The inclusion criteria will take into account the central theme, which is artificial intelligence and expert systems applied in medicine and surgical procedures, in English, Portuguese, and Spanish; other criteria will be electronic publications in the virtual health library from 2010 to 2019.

2.2.2 Exclusion criteria

The exclusion criteria included the Virtual Health Library database.

2.3 Third phase (selection of the articles in the languages of interest)

The list of eligible articles will be drawn up, and the concordance with the established objectives should be evaluated to avoid invalidating the results of the systematic reviews.

This list of eligible articles will be organized in a matrix with a degree of concordance; it will be identified qualitatively and quantitatively by identifying the titles and abstracts (**Figure 2**).

Very concordant = The title of the article and the research question have a clear relationship with the topic of artificial intelligence, expert systems, and description of uses.

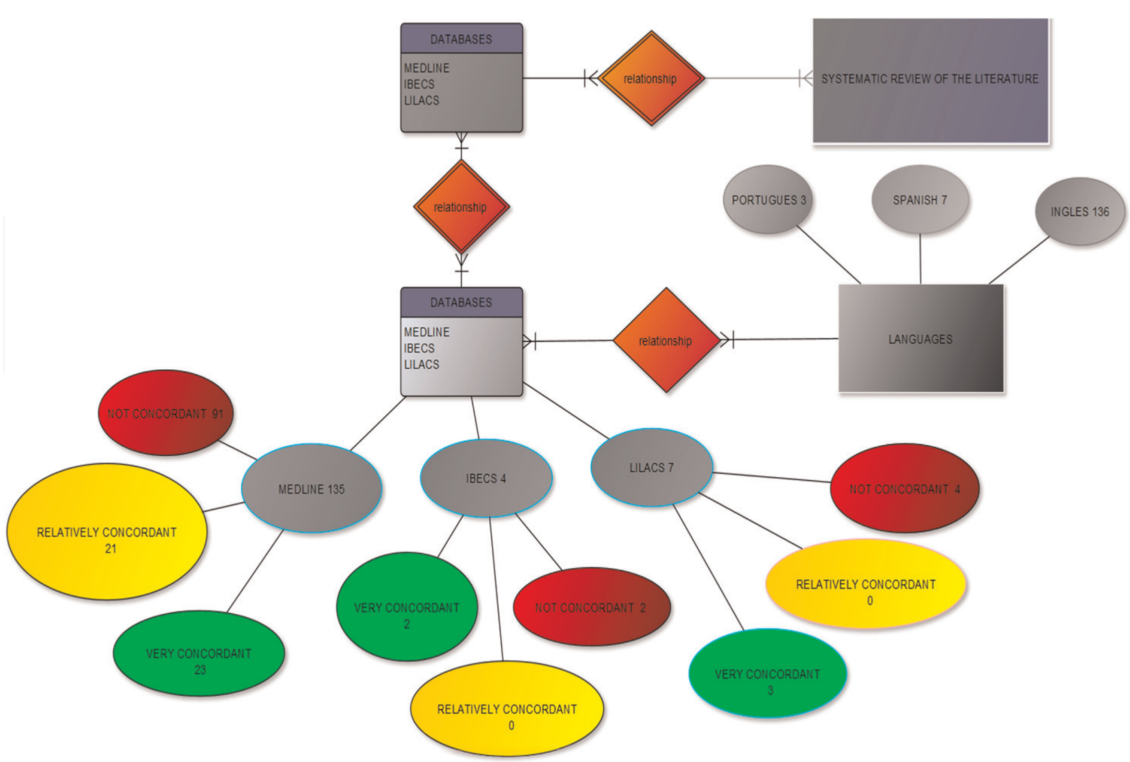

Figure 2.
Entity-relationship model of selected article databases. Source: Taken and adapted from the book Relational Database Programming.

Relatively concordant = The title of the article and the research question are partially related to the subject of artificial intelligence, expert systems, and description of uses.

not concordant = The title of the article is not related to the research question, subject of Artificial intelligence, expert systems, and uses.

2.4 Fourth phase (inspection, observation, and content extraction)

Inspection, observation, and extraction of the content of each of the articles relevant to the systematic review of the literature.

Each of the selected contents will also be organized in a matrix according to the degree of concordance.

Very concordant = The content of the article must be related to the subject of interest artificial intelligence, expert systems, objectives, and description of uses.

Relatively concordant = The content of the article must be partially related to the subject of interest artificial intelligence, expert systems, objectives, and description of uses.

Not concordant = The content of the article is not related to the subject of Artificial intelligence, expert systems, objectives, and description of uses.

3. Results

During the systematic reviews performed in the virtual health library database with the keywords artificial intelligence and surgical procedures, a total number of 100 articles were found. 65 from which did not match the keywords, 63 from which were from the MEDLINE database, and two from the LILACS database; 19 were relatively concordant, all from the MEDLINE database, and only 16 were highly concordant with the topic of interest, according to the MEDLINE database (see **Table 1**).

About the Systematic Reviews carried out with the keywords Artificial Intelligence and Medical Specialties, a total number of 39 articles were found, from which 29 were not concordant, eight were very concordant with the subject of interest, and only two were relatively concordant (**Table 2**).

Artificial intelligence in surgical procedures		Languages	Very concordant	Relatively consistent	Not concordant	Total
Medline	98	English (97) / Spanish (1)	16	19	63	98
Lilacs	2	Portuguese /Ingles	0	0	2	2
Total	100					100
Source: Own elaboration.						

Table 1.
Systematic review of artificial intelligence in surgical Procedures.Colombia,2019.

Artificial intelligence and medical specialties		**Languages**	**Very concordant**	**Relatively consistent**	**Not concordant**	**Total**
Medline	**35**	**English (35)**	**7**	**2**	**26**	**35**
Ibecs	1	English	0	0	1	1
Lilacs	3	Portuguese (2) Spanish 1	1	0	2	3
Total	39					39

Source: Own elaboration.

Table 2.
Systematic review of artificial intelligence and medical specialties. Colombia, 2019.

Artificial intelligence and expert systems in medicine		**Languages**	**Very concordant**	**Relatively consistent**	**Not concordant**	**TOTAL**
Medline	2	English	0	0	2	2
		Spanish (2)	2	0	1	3
Ibecs	3	English (1)				
Lilacs	2	English (2)	2	0	0	2
Total	7					7

Source: Own elaboration.

Table 3.
Systematic reviews of artificial intelligence and expert Systems in Medicine. Colombia, 2019.

In the Systematic Review with the keywords Artificial Intelligence and Expert Systems in Medicine, seven articles were found, from which four were highly concordant and three were not concordant (**Table 3**).

4. Final evaluation of the articles of the systematic review virtual health library

A total of 146 articles were evaluated, of which 97 were not concordant, 28 were highly concordant and 21 were relatively concordant.

The red non-concordance refers to the fact that the article does not make any reference to the stated objectives and the subject of interest, to the research question, or to the uses.

The highly concordant articles, identified with the green color, are directly related to the subject of interest, the stated objectives, the research question, and the uses.

In the case of the relatively concordant category, identified with the yellow color, they have partially related to the subject matter and the research question, but not to the objectives or uses (see **Table 4**).

During the Virtual Health Library Systematic Review, 135 articles from the MEDLINE database, seven articles from the LILACS database, and four from the IBECS database were analyzed.

Degrees of agreement	Total items
Very concordant	28
Relatively consistent	21
Not concordant	97
Total	**146**
Source: Own elaboration.	

Table 4.
Compliance follow-up matrix resulting from the evaluation of systematic review articles. Colombia, 2019.

Twenty-eight highly concordant articles were identified, whose analysis consisted of organizing them by areas of artificial intelligence; to be able to visualize the approaches that are currently being applied in medicine, surgical procedures, and medical specialties. This analysis produced the following findings from the evidence found by area of artificial intelligence:

5. Automatic reasoning or machine learning

Based on contexts of repeating patterns or parameters, it groups and analyzes them and then identifies the behavior or tendency of a certain event or circumstance to suggest different predictions. It is also a specialized tool in extracting stored information to answer questions and draw conclusions to detect patterns, draw conclusions to detect patterns, of certain epidemiological behaviors.

In this area of artificial intelligence, applications were recognized in Education research: digital health: intersections between scientific research and its mediatization. Medical education: opportunities for collaborative work towards artificial intelligence tools in medical education, improvement of pedagogical techniques for learning. Dermatology: diagnosis by dermatoscopy (sonification), laboratory, and prospective observational study. Public health: comparison of the performance of machine learning algorithms in predictive analytics in public health and medicine, predictive and probabilistic models for estimating the risk of health events or diseases. Occupational health: human activity recognitions based on feature selection in the smart home using a backpropagation algorithm. Deep machine learning for workflow recognition during surgery. Occupational medicine: artificial intelligence in occupational medicine. Pneumology: prediction of asthma exacerbations, and chronic disease changes, using algorithms and predictive models of Bayesian classifiers and support vector machines with artificial intelligence Internal medicine: mobile application of intensive insulin therapy based on artificial intelligence techniques. Anesthesiology: artificial intelligence system for endotracheal intubation. Pediatric surgery: preoperative prediction of surgical morbidity in children: comparison of five statistical models, logistic regression models. General surgery: development of an intelligent surgical training system for thoracentesis. Laparoscopic surgery: Analysis and counting of the uses of the multifunctional or modular tool in mixed procedures of cholecystectomies and Nissen judicature to reduce operating room time and decrease patient risk, by means of a video using fuzzy logic techniques, to analyze the types of instruments used, the duration of each use and the function of each instrument. Diagnostics. fuzzy naive Bayesian model for medical diagnostic decision support, medical applications as a diagnostic aid in medicine, SOFTEL-MINSAP experience, and segmentation methods based on machine learning algorithms for large-scale magnetic resonance imaging. Technological focus on diagnostic aids for cancerous lesions using learning algorithms. Anatomical diagnosis: stable segmentation based on atlas mapped prior (stamp) machine learning for large-scale multicenter MRI data. Diagnostic Microbiological Metabolic Profiling: predicting colonic polyps with machine learning based on urinary metabolomics. Cardiology: machine learning system to improve heart failure patient care, predicting heart attacks four hours in advance in patients with a history of heart disease with a tendency to myocardial infarction, and improving prediction times for cardiologists. This system was fed with clinical data from each patient, incorporating clinical parameters to make the prediction. Physiotherapy: a computerized behavioral system for home.

physiotherapy exercises using an RGBD camera. Research: artificial intelligence applied to evidence-based surgery. Rheumatology. identifies new pathways associated with demineralization in a viral model of multiple sclerosis, prediction of HIV-associated neurocognitive disorder from three genetic features of the gp 120 glycoprotein envelope, and Molecular biology prediction of interactions between HIV-1 and human proteins by information integration. Genetics prediction of virus mutations by statistical relational learning, Microbiology Genetics virus detection by statistical gene expression analysis, and classification of therapy resistance based on longitudinal biomarker profiles [10–25].

6. Big data and machine learning

The combination of big data and machine learning has enabled data processing and analysis to have a greater opportunity to participate in decision-making in a timely manner. There are many areas of healthcare in which such combinations of algorithmic functions have shown positive results for intervention in this case of chronic diseases and their respective treatments. Among these applications, the following stand out: Intensive care medicine: artificial intelligence in the intensive care unit using big data and machine learning in intensive care medicine. Improved specificity of networked distributed physiological alarms based on a simple deterministic reactive intelligent agent in the intensive care environment, Programmed databases to analyze clinical questions of patient diseases and treatments, and intervention protocols to generate new lines of research [26–28].

7. Computer vision

Explores the recognition and understanding of images and videos, The tool is able to perceive each of these. Recognized in Neurology: neuro GPS: automated neuron localization for brain circuits using the L1 minimization model, automated neuron localizations through biophysical models, concerning the morphology of the neural axoma, through a Neurog method, to localize neurons in various parts of the brain Oncology: detection of cancer cells to design a tool with precise optics for rectal colon biopsy. Diagnostic Endoscopy: the potential of artificial intelligence-assisted colonoscopy using an endocystocope with video optical biopsy, making use of an ultra-magnified endoscope [3, 29, 30].

8. Expert systems

Designed to solve complex problems by making decisions based on a knowledge base and rules for applying that knowledge. Recognized in Surgery: reduction of operating room time and reduction of patient risk through the use of modular surgical instrumentation with artificial intelligence. Internal Medicine: Improved specificity of networked distributed physiological alarms based on a simple deterministic reactive intelligent agent in the intensive care setting [31, 32].

9. Deep learning

Attempts to mimic the functioning of the human nervous system, using what is known as neural networks or layers of the processing unit (artificial neurons) that specialize in identifying characteristics or patterns determined in objects or unstructured data sets, without the need for prior training with a set of structured or labeled data. Neural networks: in Neurology, clinical applications of neural networks in sleep apnea-hypopnea syndrome were recognized, and *backpropagation* (BP) algorithms were also programmed. The BP algorithm is used to train the feed-forward neural network for human activity recognition in intelligent home environments in conjunction with probabilistic algorithms: the Naïve Bayes (NB) classifier and the Hidden Markov Model (HMM), neural networks for diabetes control using a multipanel graphic interface, neurological disease estimation [31, 33].

10. Automatic reasoning, expert systems, logistic regression

In these specialized areas of artificial intelligence, they have focused their algorithm progradation in the medical area of infectious diseases; machine learning has specialized in the realization of algorithms for statistical inferences, optimizing problems of analysis and interpretation of results from research studies, and the application of models for representations and evaluations of statistical data using techniques to predict response to antiretroviral therapy. Expert systems in organizing through knowledge based on rules and categories focused on diagnostics to solve decision making, and regression logistics in performing decision making based on a continuous variable, taking values and predicting the outcome for decision making [34, 35].

11. Analysis of artificial intelligence applications by tendency of use in medical areas

The trend of artificial intelligence in healthcare marks a meeting point between the pure sciences and the medical sciences.

The most pronounced trend is machine learning. In this application area, the medical specialties in which the greatest applications were developed were in the diagnostic area with the use of advanced optics, on a large scale for the observation of cancer cells in different parts of the body. Additionally in combination with Big Data and automatic reasoning in internal medicine, have intervened in important areas such as chronic non-communicable diseases, rheumatology, pulmonology, cardiology, and diabetes diseases for intensive insulin therapy. Additionally, the most intervened surgical specialties or surgery are pediatric surgeries, ophthalmologic surgeries, and general surgery.

The second trend is identified as Computer Vision, focused on image and video recognition with ultra-magnified large-scale optics and also identification with precise biopsy of colon cancer cells and finally, detection of cancer cells, and anatomical identification of neuron parts.

The third trend focused on expert systems, where genetics and genetic microbiology are identified in studies of viral mutations and DNA sequencing. Additionally, knowledge is based on diagnostic rules for early detection of cancer in its early stages and deep learning with the application of neural networks, estimation, and neurological diseases.

There are also applications combined with machine learning and big data for the use of physiological alarms structured in a network with intelligent agents, and evidence-based medicine through questions and answers of diseases and treatments, generating new research lines. Other combinations were machine learning, expert systems, and logistic regression used in antiretroviral treatment predictions.

12. Graphical representation simulation modified endemic index of the development trend of artificial intelligence by specialized medical areas

With this graphical representation, the behavior of the areas of development of artificial intelligence in medicine by medical specialty can be established, and the future behavior of each area can be monitored and, why not, predicted.

The results were organized in a traffic light fashion, with green being the most trending AI development behavior, yellow the second most trending development behavior and red the least trending.

In the green-colored success zone, the artificial intelligence area of Machine learning or Machine Learning is identified, it is the most developed area in medicine and health. This is because it was the first to be developed and put into practice, additionally because it has a lot of theoretical information. After all, it has been widely used in the financial and business area for predictions and analysis of economic behavior, financial profitability, and others. Nowadays it is used in the area of medical sciences and health.

Therefore, in this area of artificial intelligence, it is where great decisions have been made in the economic area and also in the health area, due to the large number of applications developed.

The majority of scientific publications in the area of artificial intelligence were found in this area of success, and the language in which most of them were published was English.

In the security zone, marked in yellow, Computer Vision is identified. This area was the second zone in which artificial intelligence applications were developed, focused on diagnostic methods with large-scale optics and in the English language.

In the red alarm zone, deep learning and expert systems were identified, where applications of neural networks were found, these being the most complex to develop, requiring a lot of expertise and focused on the central nervous system; however, expert systems are also complex, given the rule-based systems in which they are structured, they can be a good area of application that could be focused on molecular biology and DNA sequencing.

Finally, in this area, the smallest number of artificial intelligence applications were developed, since it is the least explored due to its degree of complexity, also in English (**Figure 3**).

In the three zones of the traffic-light simulation, developed countries were involved, with a notorious difference in participation compared to developing countries.

Investments in education focused on technological areas have allowed for significant progress in the different academic and research sectors.

The advantage that developed countries have over developing countries is related to budget allocations and investments in the education and technological innovation area.

Therefore, they are the pioneers in presenting the different advances in areas related to information systems, research, health, economics, pedagogical and educational strategies, robotics, and other areas (**Figure 4**).

The following graph shows the development trend of artificial intelligence by area and medical specialty. The most developed area of artificial intelligence was machine learning, being located in the zone of success since it was applied in several medical specialties; to name, including medical education, and specialized surgeries such as ophthalmology, general surgery, and pediatrics. However, much progress has been

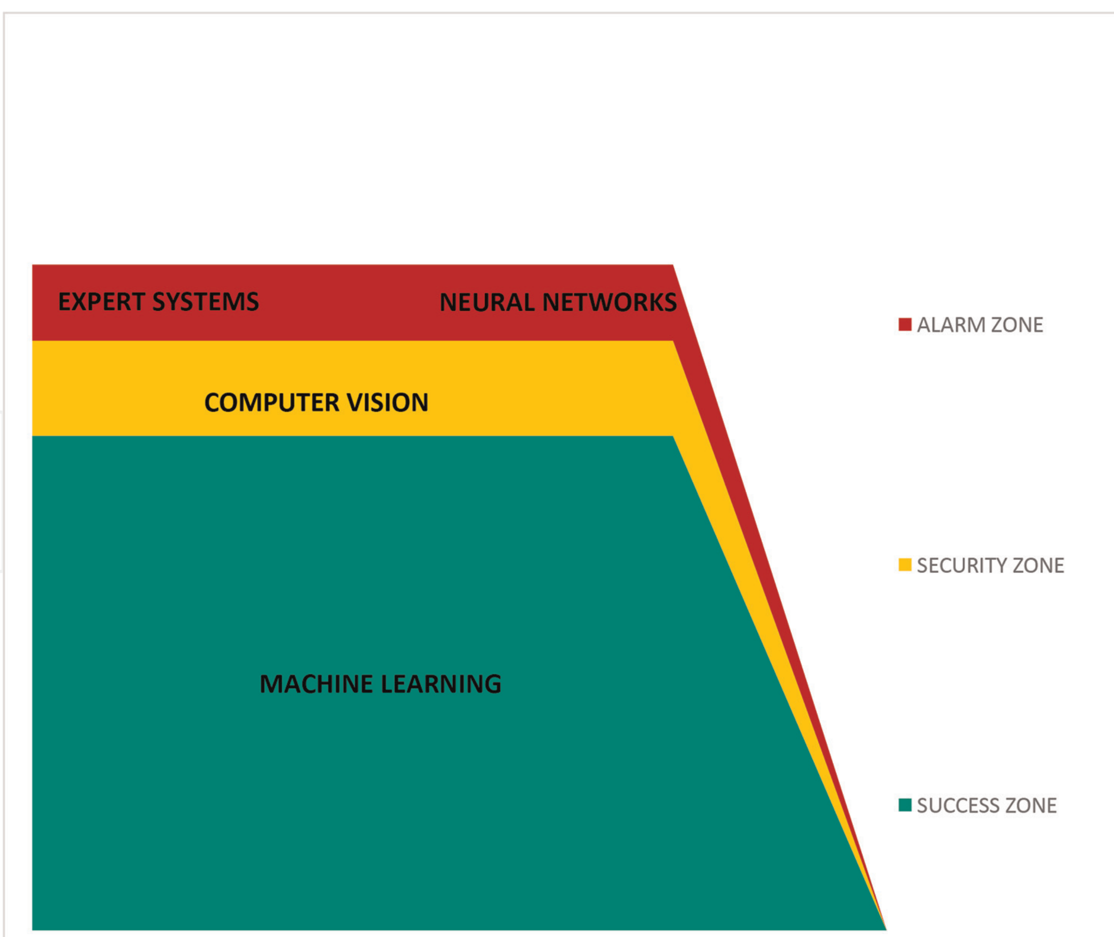

Figure 3.
Simulation graphical representation modified endemic index of areas of development of artificial intelligence applications according to trend.

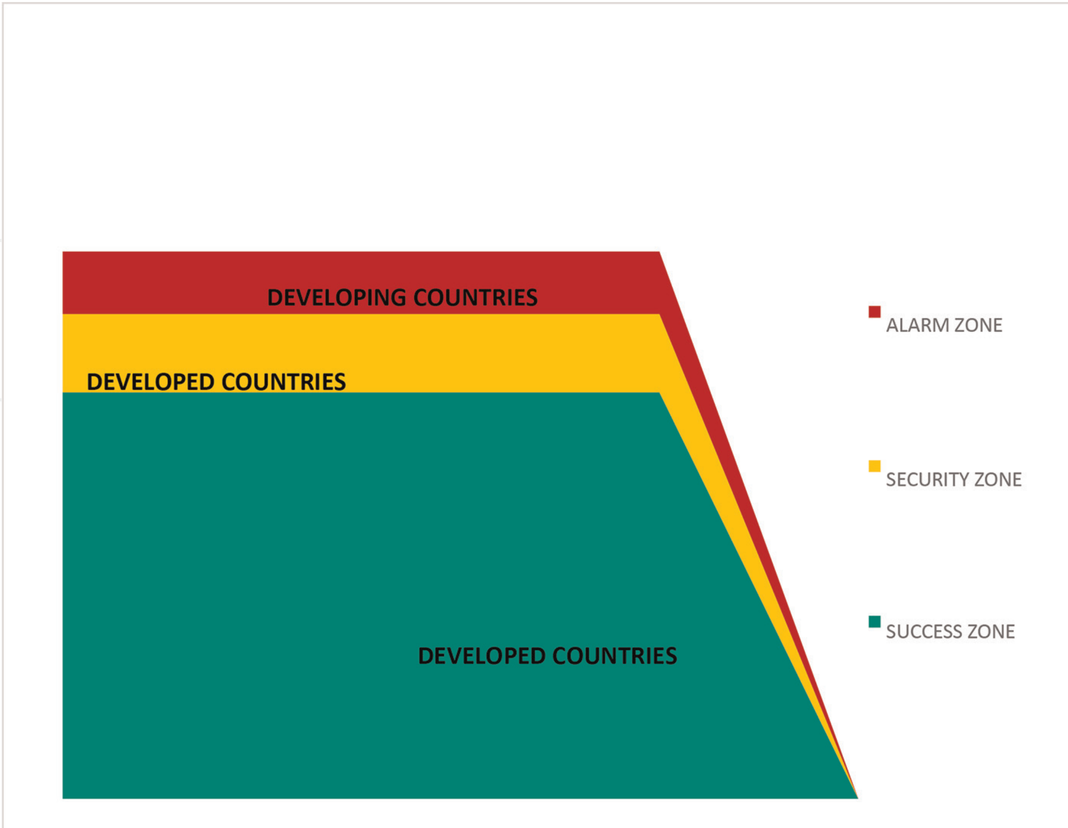

Figure 4.
The trend of artificial intelligence in developed countries VS developing countries.

made in diagnostic areas through the use of advanced and large-scale optics in oncology (**Figure 5**).

During the review of the content of each of the articles, located in the three simulated areas of the endemic channel, it was found that, in each of the medical specialties, where the different areas of artificial intelligence were developed and strategically applied, clinical decisions were made that allowed timely intervention in real-time, according to the needs required in each of them (**Figure 6**).

In all these areas, decisions were made after applying each of these in the different areas of medicine and health. It allowed for generating an impact in the intervention of chronic and transmissible diseases and treatments for each one of them.

13. Limitations

Many of the languages were also limiting for the review of the articles.

14. Discussion

There are many technological applications being made focused on the area of medicine, but not all of them are structured under artificial intelligence and expert systems. This led to evaluate current healthcare technologies in terms of artificial intelligence and expert systems.

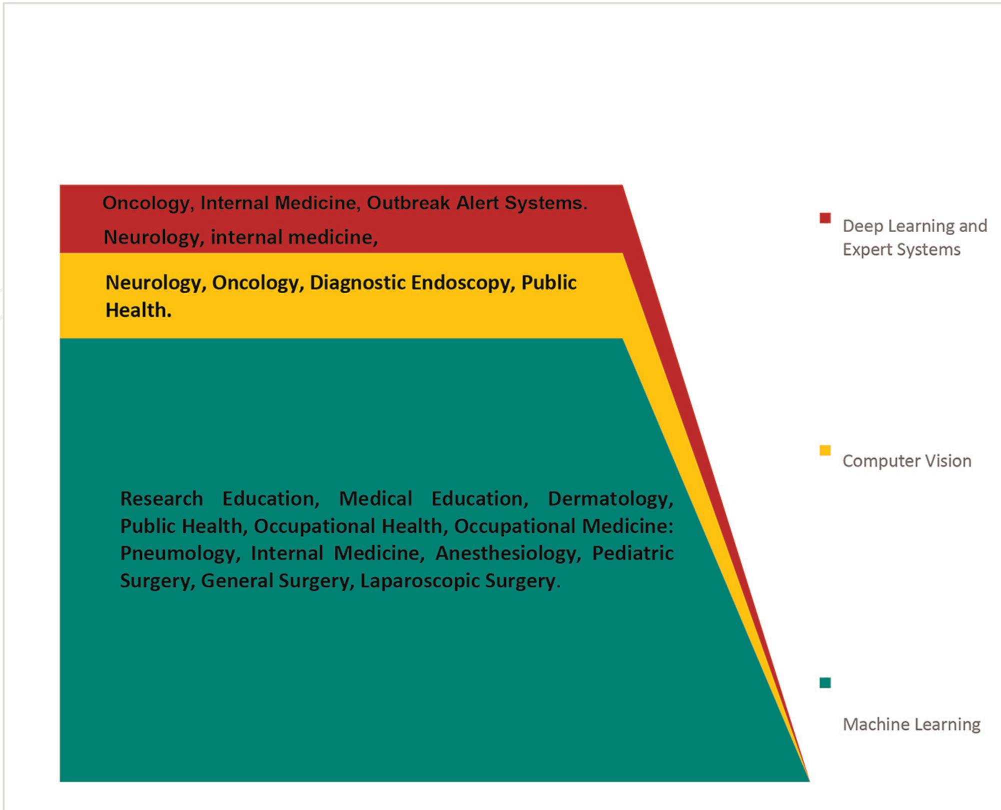

Figure 5.
Development of artificial intelligence application by medical specialty.

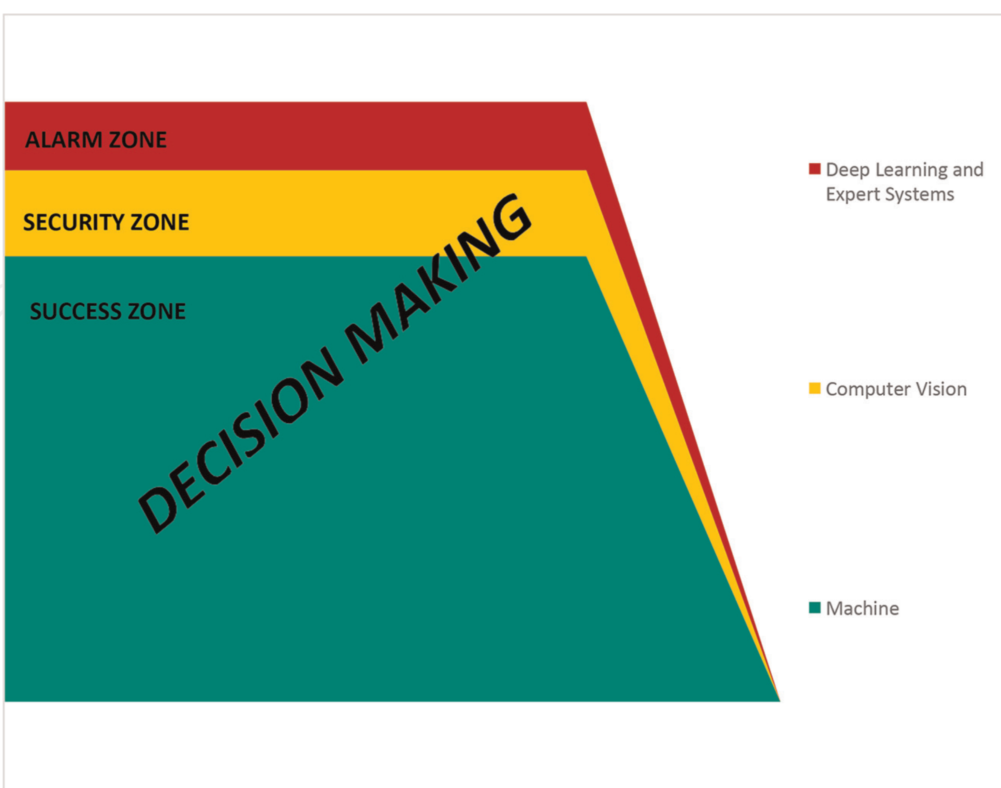

Figure 6.
Decision making by artificial intelligence specialty.

Important findings were obtained with respect to the interventions that have been applied in the clinical part.

Among the most relevant findings, it was recognized that the areas of artificial intelligence where different medical applications were developed were automatic reasoning, computer vision, expert systems, and deep learning with neural networks.

The articles identified as highly concordant were in English, whose applications were implemented in developed countries. This demonstrates the great void of projects and studies on technologies in developing countries, where there is little economic investment in technology and research.

In addition, the epidemiological studies that apply to each of the areas of artificial intelligence were identified, represented by observational, descriptive, analytical, predictive, and experimental studies.

When comparing this article with another research conducted on artificial intelligence in communicable diseases, we can observe that the total number of articles found according to the degree of agreement was 70, compared to 146 in this study; 16 studies were highly concordant compared to 28 in this research. The trend by areas of artificial intelligence focused mainly on automatic reasoning, computer vision, expert systems, and neural networks; in this study, the same result was obtained according to the approach.

In both studies, it could be observed that the area of neural networks is the least developed, the most published and very concordant studies were in the English language in developed countries and in the Medline database, which demonstrates the economic, educational, and research investment that these countries have made in comparison with developing countries.

In addition, it reflects the transformation and technological advances that these countries have made in different areas. The areas of health where there was greater development were public health and epidemiology in infectious diseases, unlike this study, which was in the area of internal medicine.

On the other hand, it made it possible to identify which clinical issues have been evaluated and do not require further research, as well as which texts or topics do not require further research. It also allowed professionals to keep up to date on current trending topics.

We were able to assess the consistency of studies and explore the main sources of variability in studies with apparently beneficial results. Different predictive models of morbidity were identified.

The quality assessment of the body of evidence obtained was performed by two reviewers or peers independently, and the differences in the results of the evaluation of each aspect were discussed until a consensus was reached. The differences between the peers between each of the filters were minimal.

15. Conclusion

It is interesting to observe how medical and technological sciences have been harmonized with the only purpose of finding solutions to daily problems in the care of patients and in search of improving their health condition.

The results of this systematic review of the literature will serve to have a qualitative and quantitative balance of these medical interventions, allowing to an evaluation of their benefits.

Decisions on the forms of medical intervention should be based on the evaluation of the balance between the benefit and the risks or harm they generate; this evaluation will make it possible to obtain relevant and valid information that will allow the search for different forms of intervention.

The search strategy was based on a relational model and an entity-relationship model, in addition to a model for evaluating the thematic quality of the articles found, which made it possible to establish strategies to minimize biases and avoid making systematic errors when selecting or evaluating the relevant literature.

On this occasion, a systematic review of the literature was carried out, not based on clinical or experimental studies, but focused on reviewing and evaluating health technologies, specifically artificial intelligence and expert systems applied to medicine, medical specialties, and surgical procedures.

The contribution that artificial intelligence is making to medical science, research, and the population's health has been fundamental in the advance of public health interventions and in the approach to diseases. However, it is a cause for concern since technology is advancing faster than the regulatory, ethical, and legal framework; and to what extent these new technologies can benefit or harm humanity.

Conflicts of interest

There are no conflicts of interest.

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