(IJRMST) 2024, Vol. No. 17, Jan-Jun **e-ISSN: 2455-5134 p-ISSN: 2455-9059**

Developing An Artificial Intelligence Based Chatbot For And Early And Effective Prediction Of Various Diseases

Saksham Agarwal

Montfort Sr. Sec. School, Ashok Vihar, Delhi

DOI:10.37648/ijrmst.v17i01.011

[1]*Received: 01 May 2024; Accepted: 21 June 2024; Published: 26 June 2024*

ABSTRACT

Artificial Intelligence (AI) and chatbot technology have emerged as promising solutions for enhancing healthcare services. AI chatbots, with their ability to mimic human-like interactions, are revolutionizing tasks such as patient triaging and medical advice. This review focuses on the use of AI chatbots in disease prediction, exploring their effectiveness and potential for early intervention and treatment. The aim of this systematic literature review is to analyze studies related to AI chatbot technology in disease prediction. A total of 24 selected journals were systematically reviewed based on predefined inclusion and exclusion criteria. The review protocol included examining studies published across various years, with a focus on articles from 2020. The findings underscore the significant potential of AI chatbots in predicting diseases and aiding healthcare professionals in making informed decisions. By harnessing machine learning algorithms and techniques, AI chatbots can elevate the accuracy and speed of disease diagnosis. The urgency and importance of continued research and development are clear, as it is crucial to refine AI chatbots' capabilities and revolutionize healthcare delivery for improved patient outcomes and disease management.

INTRODUCTION

Artificial Intelligence (AI) involves creating intelligent agents that can perceive their surroundings and use that data to achieve specific objectives. When a machine mimics cognitive functions associated with human minds, such as problem-solving and learning, it utilizes artificial intelligence. By harnessing the power of AI, computers can emulate human thinking and behaviour to a remarkable degree [1,2].

A chatbot is a software service or program designed to communicate with users via text-based conversations. It can substitute for human interaction, engaging in conversations through messaging applications or other services by responding to user inputs sentence-by-sentence. This technology is designed to simulate natural language conversation, offering users a conversational experience. Chatbots understand, learn, and interact like humans, enabled by artificial intelligence. AI chatbot technology has emerged as a promising solution to improve various industries, including healthcare. Delivering high-quality healthcare services is crucial for improving patient outcomes and reducing healthcare system burdens. With the increasing demand for healthcare services, exploring new ways to provide efficient and effective care has become essential [3,4].

In recent years, there has been growing interest in using AI chatbots in healthcare settings. AI chatbots can assist with tasks such as triaging patients, providing medical advice, and answering questions about medications and treatment options [5,6]. Additionally, AI chatbots have shown potential in predicting diseases, which is the focus of this literature review.

The outcomes of this study will contribute to the current knowledge base regarding the efficacy of AI chatbots in healthcare environments, particularly their role in predicting diseases. This literature review will provide insights into the current state of AI chatbot technology in healthcare and its potential for improving the quality of healthcare services by predicting diseases early and allowing for timely interventions and treatments.

[1] *How to cite the article:* Agarwal S. (June 2024); Developing An Artificial Intelligence Based Chatbot For And Early And Effective Prediction Of Various Diseases; *International Journal of Research in Medical Sciences and Technology;* Vol 17, 76-83, DOI: http://doi.org/10.37648/ijrmst.v17i01.011

This research aims to conduct a systematic literature review on using AI chatbot technology in predicting diseases. The review will analyze studies and research articles on AI chatbot technology and its effectiveness in disease prediction. This includes understanding the methods, algorithms, and data used to develop and validate these chatbots, as well as the accuracy and reliability of their predictions.

METHODOLOGY

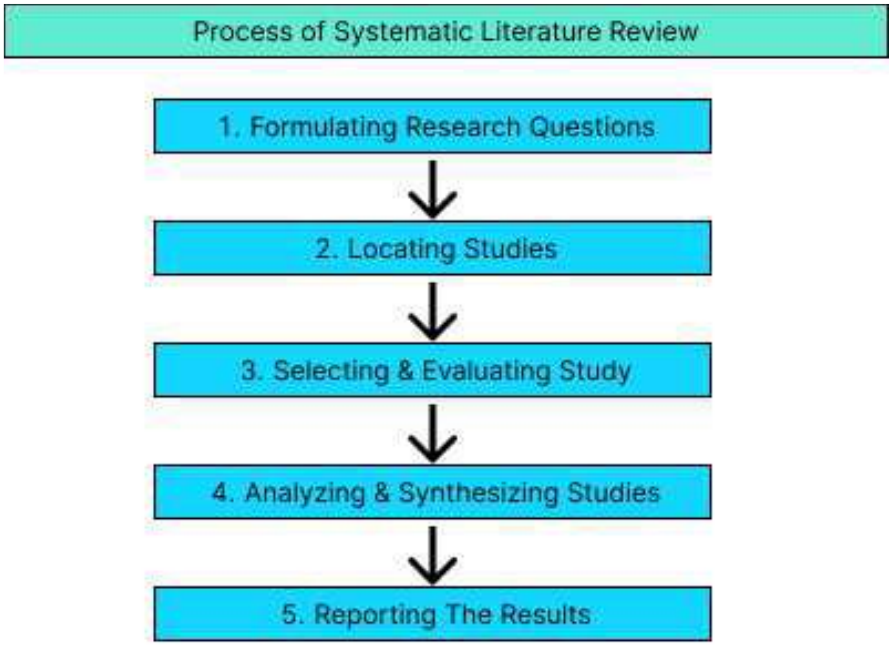

Fig. 1. The process of Systematic Literature Review [34]

A. Formulating Research Questions

As previously mentioned in our introduction, our research aims to analyze studies and research articles related to artificial intelligence chatbot technology and its effectiveness in predicting diseases. We have meticulously crafted four key questions that are pivotal in achieving this purpose. These questions are not just a means to an end, but they are the very essence of our research, guiding us towards a deeper understanding of AI chatbot technology in disease prediction.

1. Effectiveness in Healthcare: Does chatbot technology improve the effectiveness of the healthcare system?

2. Algorithm Performance: What algorithms can be utilized in developing a functional medical chatbot, and which perform best?

3. Accuracy Enhancement: What methods can be explored to improve the accuracy of medical chatbots, particularly in diagnosing illnesses?

4. Challenges and Solutions: What challenges do medical chatbots face, and what solutions can be formulated to address these issues?

B. Study Location

The literature for this research was gathered using Google Scholar and ResearchGate. The search terms used were “medical chatbot,” “healthcare chatbot,” and “healthcare chatbot diagnosis.” We obtained 70,300 papers from Google Scholar and 300 papers from ResearchGate using these terms. The breakdown of the results is as follows:

- “Medical chatbot”: 29,900 papers (Google Scholar) and 100 papers (ResearchGate)

- “Healthcare chatbot”: 25,800 papers (Google Scholar) and 100 papers (ResearchGate)

- “Healthcare chatbot diagnosis”: 14,600 papers (Google Scholar) and 100 papers (ResearchGate)

From these extensive literature sets, we embarked on a meticulous selection process. We carefully reviewed each paper, considering its relevance, quality, and alignment with our research goals. After this rigorous process, we narrowed down the selection to 40 papers that met our stringent criteria.

C. Inclusion and Exclusion Criteria

When selecting papers for our research, we applied specific criteria to determine their relevance and suitability. These criteria helped us decide whether a paper was appropriate for use in our study and whether it fell within the scope of our research.

Table I. Inclusion and exclusion table for this paper

No.	Inclusions	Exclusions
1.	International Papers	Article media, etc
2.	Paper’s year publications between 2018 - 2023	Paper’s year publications before 2018
3.	Paper is written in English language	Paper is written in another language other than English
4.	Paper’s topic must be about chatbot’s usage in healthcare system	Paper’s topic doesn’t revolve chatbot and it’s usage in healthcare system

From Table 1, we identified several criteria for selecting the journals to include in our research:

1. International Publications: Only international papers are included. Any paper that is not an international publication is excluded.

2. Publication Date: Papers must have been published between 2018 and 2023. Any paper published before 2018 is excluded.

3. Language: Papers must be written in English. Any paper not written in English is excluded.

4. Relevant Topic: Papers must focus on chatbots and their usage in supporting healthcare systems. Papers on other topics are excluded as they do not fall within the scope of our research.

By applying these criteria and following the process outlined in Figure 1, we narrowed down the selection from 40 papers to 30 papers.

Our research was conducted with meticulous attention to detail, using specific inclusion and exclusion criteria. These criteria included the requirement that journals must be published between 2018 and 2023 and written in English, among others. By rigorously applying these criteria, we were able to identify 30 papers that were highly relevant to our study.

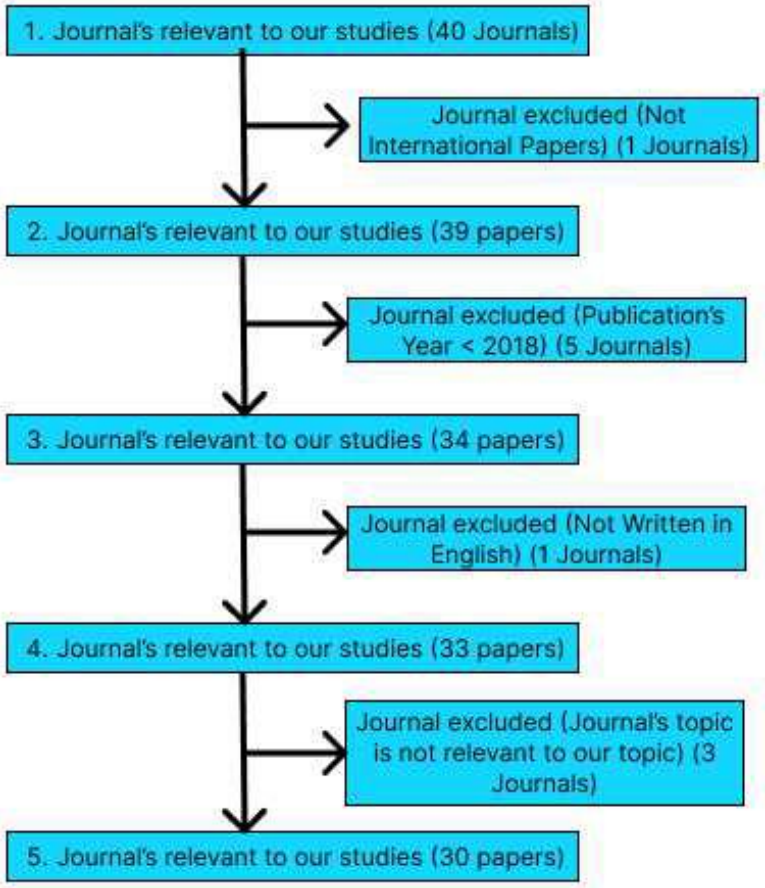

Fig. 2. The process of selecting studies by inclusion and exclusion criteria

D. Analyzing & Synthesizing Studies

Number based on references	Method
[7]	Gather data by qualitative interviewing healthcare experts.
[8]	Thematic analysis for the semistructured interviews and binary regression for the analysis of the quantitative survey data.
[9]	Systematic Review
[10]	NLP
[11]	User survey after interacting with SELMA.
[12]	Literature survey
[13]	NLU
[14]	NLU and ensemble Learning to compare the performance of various machine learning algorithms as standalone classifiers and then combine them in a majority voting ensemble.
[15]	AIML
[16]	Naïve Bayesian networks
[17][18] [19]	SVM, Naïve Bayes & Random Forest
[20]	Naïve Bayes, KNN, Logistic Regression & Decision Tree
[21]	Support Vector Machine (SVM) algorithm, KNN and Naïve Bayes ALgorithm Natural Language Processing (NLP)
[22][23]	Support Vector Machine (SVM) algorithm, Natural Language Processing (NLP), and word order similarity.
[24]	Machine Learning Algorithm: Random Forest and XGBoost predicting diseases based on user inputs
[25]	Literature Reviews, TFIDF Algorithm
[26]	N-gram and term frequency and inverse document frequency (TF-IDF).
[27]	Literature Review

Table II presents the methods used by the authors in their papers, including but not limited to machine learning, natural language processing, and data mining. This table is particularly intriguing as it highlights the variety of methods employed in creating chatbots for disease prediction, showcasing the diverse and innovative approaches authors used to gather data for their research.

RESULTS & DISCUSSION

Table III. Number of papers to answer each research question

No. of research question	Frequency	Author(s)
1	6	Reis (2020), Nadarzynski (2019), Xu (2021), Khilji (2020), Hauser-Ulrich (2020), Divya (2018)
2	9	Kaur (2022), Bali (2019), Jayashree (2020), Visumathi (2023), Jovovic (2023), Gomathy (2021), Tamizharasi (2020), Dharwadkar (2018), Chattopadhyay (2022)
3	5	Jameel (2021), Kavitha (2019), Bhirud (2019), Ayanouz (2020), Siddique (2021)
4	4	Laumer (2019), Palanica (2019), Abd-Alraza (2020), Kowatsch (2018)

A. Literature Review Results

Research Question 1: Enhancing Healthcare Effectiveness

Chatbot technology can significantly improve healthcare effectiveness by providing support and health-related information directly to patients [7]. Integrating chatbots into healthcare systems enhances communication, user experience, and diagnostic accuracy, improving healthcare service delivery [8][9]. Moreover, chatbots streamline disease diagnosis, ensuring timely treatment even for patients with limited access to medical facilities [10]. Advanced chatbots utilizing machine learning (ML) algorithms can aid healthcare providers in personalizing therapies based on individual patient conditions [11][12].

Research Question 2: Machine Learning Algorithms

Various machine-learning algorithms are employed in developing medical chatbots. For instance, Kaur et al. (2022) used the RASA algorithm for COVID-19 diagnosis and Support Vector Machine (SVM) for heart disease detection [13]. Bali et al. (2019) utilized ensemble learning in their chatbot 'Diabot' for diagnosing diabetes [14]. Studies by Jovovic et al. (2023) and Gomathy et al. (2021) identified Random Forest as highly effective in disease prediction, achieving accuracies of 87% and 98.95%, respectively [17][18]. Other algorithms, such as SVM and XGBoost, were also recommended for their performance in disease diagnosis [19][21].

Research Question 3: Improving Speed and Accuracy

The TF-IDF algorithm enhances chatbot diagnostic accuracy by improving its understanding of patient inputs [22][23]. This approach saves doctors' time and facilitates quicker diagnosis. Additionally, Natural Language Understanding (NLU) and Natural Language Processing (NLP) techniques further improve chatbot capabilities, enabling more personalized and effective patient interactions [26].

Research Question 4: Challenges in Implementation

Implementing chatbot technology in healthcare faces challenges related to patient trust and acceptance [27]. While healthcare professionals support chatbot integration, patient adoption varies due to concerns about standardization and technical language used in interfaces [28][29]. Improving user experience through language selection and adopting a more human-like persona can mitigate these challenges and enhance patient trust in chatbot-assisted healthcare services [30].

B. Discussion

This systematic literature review examined AI chatbot technology for disease prediction across 24 journals. Most studies, particularly seven from 2020, highlight AI chatbots' potential to predict diseases effectively and support healthcare decision-making. AI chatbots demonstrate efficacy across diverse healthcare domains, including mental health and chronic disease management, by analyzing user inputs and providing tailored support.

Machine learning algorithms, notably Random Forest, emerged as highly effective for disease prediction and diagnosis. Enhancing the speed and accuracy of disease diagnosis, TF-IDF algorithms improve chatbot performance in understanding patient queries and delivering timely responses. Moreover, advancements in NLU and NLP technologies enable chatbots to engage in more intelligent and personalized patient interactions.

Key challenges identified include patient trust and hesitation, often due to interface standardization issues and technical language barriers. Addressing these challenges through improved user interface design and communication strategies can foster greater patient acceptance and utilization of chatbot-based healthcare services.

CONCLUSION

In conclusion, AI chatbot technology holds immense promise for disease prediction. Continued research and development efforts are crucial to overcoming challenges and refining AI chatbots' capabilities. With ongoing advancements, AI chatbots can revolutionize healthcare delivery, improve patient outcomes, and support more effective disease management and public health interventions.

REFERENCES

1. A. Lili, J . K auttonen and A . Ari, Expert Work Automation in Healthcare: The Case of a Retrieval-Based Medical Chatbot, p. 13, 2022, E-Signals Research.
2. S. Muchhala, A. Jain and S. Rai, Health-Bot (Healthcare Chatbot), pp. 153 - 155, 2020, TCET EC AI ML 2020.
3. B. Kevin, B. Vikin and M. C. Nair, building a chatbot for healthcare using nlp, p. 8, 2023, DOI: 10.36227/techrxiv.22578472.
4. Y. You and X. Gui, "Self-Diagnosis through AI-enabled Chatbot-based Symptom Checkers: User Experiences and Design Considerations," Annual Symposium proceedings. AMIA Symposium, vol. 2020, pp. 1354–1363. PMID: 33936512.
5. C. Linder, The Effects of a Healthcare Chatbots' Language and Persona on User Trust, Satisfaction, and Chatbot Effectiveness. Clemson University ProQuest Dissertations Publishing, 2020, 27835773.
6. S. Fernandes, R. Gawas, P. Alvares, M. Fernandes, D. Kale and S. Aswale, Doctor Chatbot: Heart Disease Prediction System, vol. 9, no. 5, pp. 89 - 99, 2020, Information Technology & Electrical Engineering.
7. L. Reis, C. Maier, J. Mattke, T. Weitzel, Chatbots In Healthcare: Status Quo, Application Scenarios For Physicians And Patients And Future Directions. ECIS 2020 Research Papers. 163, 2020\
8. T. Nadarzynski, O. Miles, A. Cowie, and D. Ridge, "Acceptability of artificial intelligence (AI)-led chatbot services in healthcare: A mixed methods study," Digital Health Journal, vol. 5, no. 1,
9. L. Xu, L. Sanders, K. Li, and J. C. L. Chow, "Chatbot for Health Care and Oncology Applications Using Artificial Intelligence and Machine Learning: Systematic Review" JMIR Cancer, vol. 7, no. 4, pp. e27850, 2021, DOI:10.2196/27850.
10. A. F. U. R. Khilji, S. R. Laskar, P. Pakray, R. A. Kadir, M. S. Lydia and S. Bandyopadhyay, HealFavor: Dataset and A Prototype System for Healthcare ChatBot, p. 4, 2020, 2020 International Conference on Data Science, Artificial Intelligence, and Business Analytics (DATABIA), DOI: 10.1109/DATABIA50434.2020.9190281.
11. S. Hauser-Ulrich, H. Künzli, D. Meier-Peterhans, T. Kowatsch, A Smartphone-Based Health Care Chatbot to Promote Self-Management of Chronic Pain (SELMA): Pilot Randomized Controlled Trial. JMIR Mhealth Uhealth 2020;8(4):e15806. doi: 10.2196/15806.
12. I. Divya, S. Ishwarya, Priyasankari, and S. Kalpana D evi, " A Self- Diagnosis Medical Chatbot Using Artificial Intelligence," Journal of Web Development and Web Designing, vol. 3, no. 1, pp. 1-7, 2018, oai:ojs.matjournals.in:article/2334.
13. V. Kaur, B. Pokharel, Y. Pokharel, M. Makam, B. Timilsina and G. K. C, An Interactive AI-Powered Web Healthcare System, p. 5, 2022, 2022 Second International Conference on Computer Science, Engineering and Applications (ICCSEA), DOI: 10.1109/ICCSEA54677.2022.9936169.
14. M. Bali, S. Mohanty, S. Chatterjee, M. Sarma, and R. Puravankara, "Diabot: A Predictive Medical Chatbot using Ensemble Learning," International Journal of Recent Technology and Engineering, vol. 8, no. 2, pp. 6334-6340, 2019, DOI:10.35940/ijrte.B2196.078219.

15. J. K, M. K. A, P. R and P. S. P, The Smart Health Care Prediction using Chatbot, vol. 9, no. 2, pp. 75 - 78, 2020, International Journal of Recent Technology and Engineering (IJRTE), DOI: 10.35940/ijrte.A3007.079220.
16. V. J , T. D . V . R. R eddy, V . Abhinandhan and P . A. Kumar, Multi- Disease Prediction Using Machine Learning Algorithm, vol. 11, no. IV, pp. 447 - 453, 2023, International Journal For Research in Applied Science and Engineering Technology, DOI: 10.22214/ijraset.2023.50128.
17. Jovovic, D. Babic, T. Popovic, S. Cakic and I. Katnic, Disease Prediction Using Machine LearningAlgorithms, p. 4, 2023, 27th International Conference on Information Technology (IT), DOI: 10.1109/IT57431.2023.10078464.
18. I. Gurnani, Vincent, F. S. Tandian and M. S. Anggreainy, "Predicting Company Bankruptcy Using Random Forest Method," 2021 2nd International Conference on Artificial Intelligence and Data Sciences (AiDAS), IPOH, Malaysia, 2021, pp. 1-5, doi: 10.1109/AiDAS53897.2021.9574384.
19. M. S. Anggreainy, N. Soedarsono and B. H. Widjaja, "STR-DNA Matching and Family Relation Using Bayesian Inference," 2022 International Conference on ICT for Smart Society (ICISS), Bandung, Indonesia, 2022, pp. 1-4, doi: 10.1109/ICISS55894.2022.9915180.
20. C. K. Gomathy and A. R. Naidu, THE PREDICTION OF DISEASE USING MACHINE LEARNING, vol. 5, no. 10, p. 7, 2021, International Journal of Scientific Research in Engineering and Management (IJSREM). S
21. B. Tamizharasi, J. Livingston, and S. Rajkumar, "Building a Medical Chatbot using Support Vector Machine Learning Algorithm," Journal of Physics: Conference Series, vol. 1716, pp. 1-7, 2021, DOI:10.1088/1742-6596/1716/1/012059.
22. R. Dharwadkar, N. A. Deshpande, A Medical ChatBot. International Journal of Computer Trends and Technology (IJCTT) – Volume 60 Issue 1, 2018.
23. S. Chattopadhyay and S. Chattopadhyay, "A Deep Learning Enabled Chatbot Approach for Self-Diagnosis," Journal for Research in Applied Science and Engineering Technolog, vol. 10, no. 12, pp. 1810-1818, 2022, DOI: https://doi.org/10.22214/ijraset.2022.48322.
24. Leonard Gunawan, Maria Susan Anggreainy, Louis Wihan, Santy, Gihon Yonathan Lesmana, Sabin Yusuf,. Support vector machine based emotional analysis of restaurant reviews. Procedia Computer Science,Volume 216,2023, Pages 479-484, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2022.12.160.
25. U. Jameel, H. Khan, and A. Anwar, "Doctor Recommendation Chatbot: A research study" Journal Of Applied Artificial Intelligence, vol. 2, no. 1, pp. 1-8, 2021, DOI:10.48185/jaai.v2i1.310.
26. B. R. Kavitha, C. R. Murthy, Chatbot for healthcare system using Artificial Intelligence. International Journal of Advance Research, Ideas and Innovations in Technology (Vol. 5, Iss. 3), 2019, 1304-1307
27. N. Bhirud, S. Tataale, S. Randive, and S. Nahar, "A Literature Review On Chatbots In Healthcare Domain" INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH, vol. 8, no. 7, pp. 225-231, 2019, IJSTR-0719-20726.
28. S. Ayanouz and A. B. Anouar, "A Smart Chatbot Architecture based NLP and Machine Learning for Health Care Assistance," NISS2020: Proceedings of the 3rd International Conference on Networking, Information Systems & Security, Art. No. 78, pp. 1-7, 2020, DOI:10.1145/3386723.3387897.
29. S. Siddique, J. C. L. Chow, Machine Learning in Healthcare Communication. Encyclopedia 2021, 1(1), 220-239; 2021, DOI: 10.3390/1010021.
30. S. Laumer, C. Maier, Gubler, F, Chatbot Acceptance in Healthcare: Explaining User Adoption of Conventional Agents for Disease Diagnosis, 2019
31. A. Palanica, P. Flaschner, A. Thommandram, M. Li, Y. Fossat, Physicians' Perceptions of Chatbots in Health Care: Cross-Sectional Web-Based Survey. J Med Internet Res 2019;21(4):e12887. DOI: 10.2196/12887.
32. A. Abdulrazaq, Z. Safi, M. Alajlani, J. Warren, M. Househ, and K. Denecke, Technical Metrics Used to Evaluate Health Care Chatbots: Scoping Review J Med Internet Res 2020;22(6):e18301. DOI:10.2196/18301.
33. T. Kowatsch, M. Nißen, D. Rüegger, M. Stieger, C. Flückiger, M. Allemand, F. von Wangenheim, The Impact Of Interpersonal Closeness Cues In Text-Based Healthcare Chatbots On Attachment Bond And The Desire To Continue Interacting: An Experimental Design. Twenty-Sixth European Conference on Information Systems (ECIS2018), Portsmouth, UK, 2018.
34. I. Kilubi, "The strategies of supply chain risk management - a synthesis and classification," pp. 1-18, 2016, International Journal of Logistics Research and Applications, DOI: 10.1080/13675567.2016.1150440q.