ISSN: 2581-3404 (Online) IF: 5.68 (SJIF)
IJIRTM, Volume-8, Issue-1, February-2024.

No-Shows Appointment Prediction Using Machine Learning: A Review

Vaishali Shukla[1], Pooja Meena[2], Chetan Agrawal[3]
Dept. of CSE, Radharaman Institute of Technology & Science, Bhopal, India[1, 2, 3]
Vaishalishuklab1@gmail.com[1], meena.pooja1@gmail.com[2], chetan.agrawal12@gmail.com[3]

Abstract: *Clinics and hospitals globally are losing substantial profits due to patient no-shows. This challenge is faced by any healthcare facility allowing advance appointment bookings, as patients may not show up or cancel too late. To mitigate this, many hospitals use costly reminder systems and overbooking strategies, where multiple patients are booked for the same slot. These methods, however, do not fully address the economic and social impacts of high no-show rates. To tackle this issue, the paper presented a review on techniques used for appointment scheduling and intuitive management systems that includes features for automated handling of high-risk appointments using case-specific outcome predictions, thereby aiming to reduce idle time and overtime for medical staff. The paper also shows the role of machine learning for maintaining efficient handling of such system.*

Keywords:- No-Shows, Missed-Appointment, Machine Learning.

Introduction

The issue of patients not attending scheduled medical appointments, examinations, or surgeries, known as "no-shows," is a significant problem in healthcare. This behavior leads to substantial impacts on revenues, costs, and resource utilization in health centers [1]. According to study, a hospital reported number of no-show appointments per day, resulting in millions of cost. People with the disease miss consultations for a variety of reasons. They may very well have forgotten, experienced road transport difficulties, or been unable to leave work. Missed appointments are caused by negative emotional responses or anxiety that comes with going to the doctor for some patients [2]. Some service users also feel emotionally verbally abused by the medical system, whether it's due to staff, waiting lists, or the believing that about there opinions and emotional responses are ignored. No-show rates can also be caused by a lack of knowledge and understanding of how the work schedules system actually works. Some respondents admitted that failing to grasp an appointment benefits the health centre by reducing wait times for other patients or allowing the doctor to capture up on the work or take regular breaks [3]. Patients are unaware of the impact that communication failures have on the health centre as well as many other service users. A reconnection fee that cannot be called back prevents another physician from receiving treatment. Initial consultation behaviours are a wide - spread, global issue, despite the fact that substantiated rates of doctors appointments

vary by country. The medical world is becoming increasingly interested in uncovering and comprehending the issues surrounding no-show behaviour.

Given the diversity of contexts and particularities of healthcare provision and structures, it's unlikely that a consensus can be reached on the factors that statistical significant impact no-show behaviour [4]. It is able to determine the factors that contribute that have been most commonly found to be significant and there own impact on no-show by combining studies that review on a range of diagnostic specializations and land masses and use methodological approaches for data processing.

Furthermore, despite the fact that a thorough production of the country in this field would be extremely beneficial for researchers, professionals, and doctor's office university administrators, no updated systematic literature review (SLR) appears to exist to our understanding. Therefore, this paper presents a comprehensive review of no-show assignments and the variables that impact them in this document.

II. Literature Review

Dantas et al. [1] conducted a systematic literature review (SLR) on no-shows in appointment booking, analyzing factors influencing no-show rates and comparing with previous research. Their analysis covered a wide range of geographic regions and patient demographics.

Nuti et al. [2] found that no-show patients have higher rates of acute care utilization, indicating the need for proactive schedule changes for these patients.

Defife et al. [3] explored clinical process factors contributing to patient no-shows in psychoeducational settings, identifying key strategies used by clinicians to manage patient attendance. Glowacka et al. [4] used data mining and simulation to identify differences in no-show rates between patient groups, highlighting the benefits of this approach in healthcare settings.

Chandio & Naqvi [5] emphasized the importance of having a clear, consistent process for handling appointments and no-shows, suggesting patient education as a crucial part of this process.

Incze et al. [6] highlighted the financial impact of no-shows on the UK's National Health Service and used data mining to identify predictive factors for no-shows.

Batool et al. [7] utilized machine learning to predict hospital no-shows, achieving high accuracy and demonstrating the effectiveness of various algorithms in improving prediction performance.

Topuz et al. [8] combined the elastic net method with Bayesian Belief Networks to predict patient no-shows, offering new insights into predicting these events in primary care settings.

Khasawneh & Poranki [9] presented new methodologies based on the Opposition-based Self-Adaptive Cohort Intelligence algorithm, showing significant performance in predicting patient no-shows.

Fan et al. [10] aimed to develop predictive models for patient no-shows using machine learning algorithms, demonstrating the potential of data analysis in reducing no-show rates and improving healthcare efficiency.

Dunstan et al. [11] investigated the relationship between patient no-shows and various demographic, social, and historical factors from 2015 to 2018. They employed traditional machine learning algorithms like Random Forest, Logistic Regression, Support Vector Machines, and AdaBoost, as well as algorithms designed to address class imbalance issues, such as RUS Boost, Balanced Random Forest, Balanced Bagging, and Easy Ensemble. This approach was necessary because no-shows often represent a relatively small proportion of total appointments, leading to class imbalances in the data.

Salazar et al. [12] tested these models on a dataset of about 5,000 samples, finding that the Random Forest classifier yielded the best results. This model achieved a high Recall Rate of 0.91 and an ROC curve rate of 0.969, indicating its effectiveness in predicting patient no-shows.

Sun et al. [13] investigated predictors of appointment no-shows among adults with type 2 diabetes during pre-COVID and COVID periods, also comparing in-person and telehealth visits. They found that older age and being White were protective factors against no-shows, with telehealth visits significantly reducing no-show rates during COVID.

Reuter et al. [14] used machine learning algorithms to predict missed healthcare visits during COVID-19, utilizing data from the SHARE COVID-19 surveys. They reported that 15.5% of respondents missed essential healthcare visits due to the pandemic. The study showed that all machine learning models had similar predictive power, with an AUC of around 0.61, indicating moderate prediction accuracy for both men and women.

III. Role of Machine Learning in No-Show Appointment Prediction

Machine learning (ML), a branch of artificial intelligence and computer science, focuses on developing algorithms that improve through practice and accumulated data. ML can be categorized into three types: supervised, unsupervised, and reinforcement learning. The application of ML has been expanding across various fields over the last few decades, including agriculture, industry, sensor technology, fashion, and healthcare.

In healthcare, particularly, ML algorithms have been employed to identify key factors and clinical indicators associated with missed appointments. Despite the significance of patient no-shows in healthcare settings, few studies have utilized ML to thoroughly understand this issue. Challenges in building robust predictive models for patient no-shows have been noted, often due to limitations in the available data features. This gap highlights the need for more comprehensive datasets to enhance the predictive power of ML in addressing patient absence in healthcare.

Machine Learning (ML) plays a pivotal role in reducing avoidable no-show rates in hospitals, focusing on three main areas [11] as presented in fig 1. Therefore, machine learning aids in comprehensively understanding and addressing the multifaceted issue of patient no-shows in healthcare by identifying underlying causes, predicting patient behavior with high accuracy, and evaluating the effectiveness of different intervention strategies.

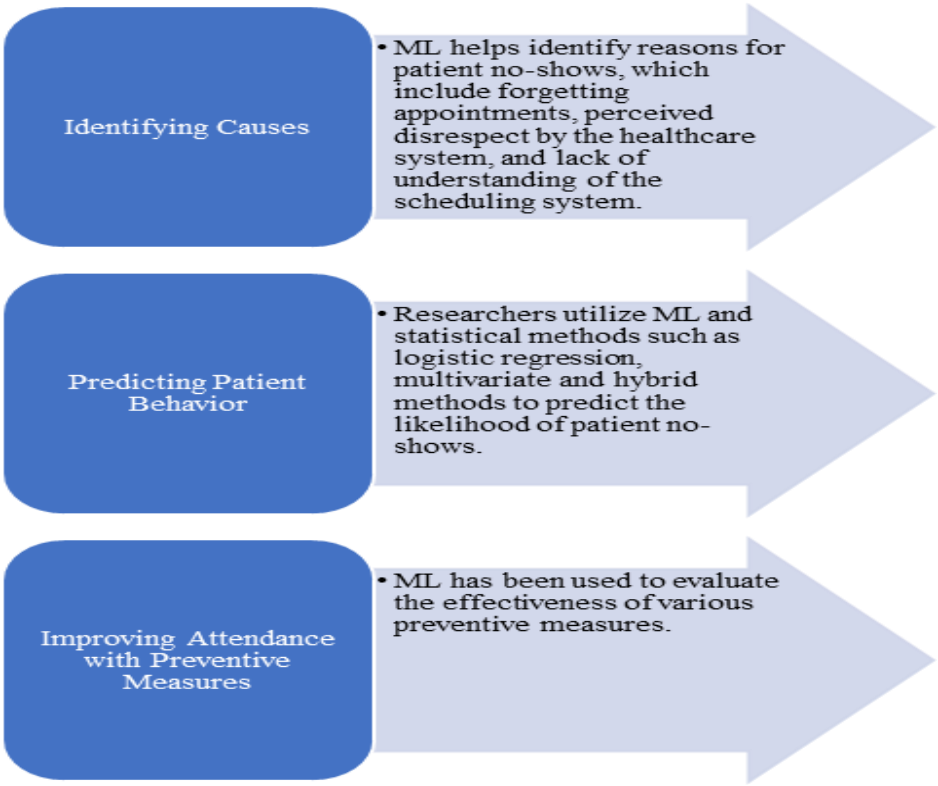

Fig. 1: Role of ML to in No-Show.

IV. Challenges and Future Scope

The current challenges in healthcare research, particularly concerning patient no-shows, present numerous opportunities for future exploration. Key areas include a deeper understanding of the behavioral and socioeconomic factors influencing patient attendance, enhancing the accuracy of prediction models for no-shows using advanced data analytics, and exploring the long-term efficacy and patient outcomes associated with the rise of tele-health. Research should also focus on informing policy reforms and healthcare system improvements, developing personalized patient communication strategies, conducting economic analyses of no-show impacts. These multifaceted research directions can significantly contribute to enhancing healthcare management and patient care efficiency.

V. Conclusion

Because the problem of patient no-show behaviour in online outpatient appointments has become more and more significant, hospitals must be able to predict patient no-show behaviour effectively. This study presents the feasibility of using a large number of online outpatient initial consultation data to develop predictive models for physician no-show behaviour using machine learning techniques. The prediction models help healthcare facilities optimize their outpatient consultation processes by considering possible

physician no-show behaviour and attempting to make flexible and acceptable modifications to promote better effectiveness. The paper presented a comprehensive review to help future researchers in designing more effective no-show prediction system using machine learning tools.

References

[1] Dantas, L. F., Fleck, J. L., Oliveira, F. L. C., & Hamacher, S. (2018). No-shows in appointment scheduling – a systematic literature review. Health Policy, 122(4), 412–421. https://doi.org/10.1016/j.healthpol.2018.02.002

[2] Nuti, L. A., Lawley, M., Turkcan, A., Tian, Z., Zhang, L., Chang, K., Willis, D. R., & Sands, L. P. (2012). No-shows to primary care appointments : subsequent acute care utilization among diabetic patients.

[3] Defife, J. A., Smith, J. M., & Conklin, C. (2013). Psychotherapy Appointment No-Shows : Clinicians ' Approaches. 107–113. https://doi.org/10.1007/s10879-012-9216-6

[4] Glowacka, K. J., Henry, R. M., & May, J. H. (2009). A hybrid data mining / simulation approach for modelling outpatient no-shows in clinic scheduling. 1056–1068. https://doi.org/10.1057/jors.2008.177

[5] Chandio, A., & Naqvi, S. M. (2018). Can "no shows" to Hospital Appointment be Avoided? OPEN ACCESS. January 2021.

[6] Incze, E., Holborn, P., Higgs, G., & Ware, A. (2021). Health and Place Using machine learning tools to investigate factors associated with trends in ' no-shows ' in outpatient appointments. 67(May 2020).

[7] Batool, T., Abuelnoor, M., Boutari, O. El, Aloul, F., & Sagahyroon, A. (2020). Predicting Hospital No-Shows Using Machine Learning. 142–148.

[8] Topuz, K., Uner, H., Oztekin, A., & Yildirim, M. B. (2017). Predicting pediatric clinic no-shows : a decision analytic framework using elastic net and Bayesian belief network. Annals of Operations Research. https://doi.org/10.1007/s10479-017-2489-0

[9] Khasawneh, T., & Poranki, S. (2019). Jo urn a. Applied Soft Computing Journal, 105866. https://doi.org/10.1016/j.asoc.2019.105866

[10] Fan, G., Deng, Z., Ye, Q., & Wang, B. (2021). Machine learning-based prediction models for patients no-show in online outpatient appointments. Data Science and Management, 2(April), 45–52. https://doi.org/10.1016/j.dsm.2021.06.002

[11] Dunstan, J., et al. "Predicting no-show appointments in a pediatric hospital in Chile using machine learning." Health Care Management Science (2023): 1-17.

[12] Salazar, Luiz Henrique A., et al. "Application of machine learning techniques to predict a patient's no-show in the healthcare sector." Future Internet 14.1 (2021): 3.

[13] Sun, Chun-An, et al. "Predictors of Follow-Up Appointment No-Shows Before and During COVID Among Adults with Type 2 Diabetes." Telemedicine and e-Health 29.6 (2023): 851-865.

[14] Reuter, Anna, et al. "Predicting missed health care visits during the COVID-19 pandemic using machine learning methods: evidence from 55,500 individuals from 28 European countries." BMC Health Services Research 23.1 (2023): 1-12.

[15] Deepak Kumar Rathore, Praveen Kumar Mannepalli, "Diseases Prediction and Classification Using Machine Learning Techniques", AIP Conference Proceedings 2424, 070001 (2022); https://doi.org/10.1063/5.0076768.

[16] R Dubey, "An empirical study of intrusion detection system using feature reduction based on evolutionary algorithms and swarm intelligence methods", International Journal of Applied Engineering Research 12 (19), 2017. pp. 8884-8889.