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Assessing the Predictive Capability of a Machine Learning Model

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ABSTRACT: *The purpose of this study was to evaluate the effectiveness of an integrated machine learning system that has been put into place to help professionals predict how patients will respond to steroid treatment for glaucoma. The research employed a quantitative research methodology, utilizing descriptive statistics. Taro Yamane formula was applied in finding a suitable population size. Our study employed linear regression analysis to establish the correlation between the predictors, i.e the novel predicting system, and the dependent variable, which pertains to the effectiveness of forecasting a patient's reaction to steroid treatment. The analysis showed that implementing a novel prediction technique would have a notable impact and efficiency in determining a persons status in pre-trabeculectomy evaluation. The p-value (0.000), which is less than the predefined significance level (Alpha) of 0.05—more specifically, 0.000<0.05—indicates the evidence for a significant finding. The calculated t-value (33.196) exceeds the critical t-value (1.960). Consequently, the correlation coefficient (R) of 0.920 demonstrates a highly robust positive effect.*

KEYWORDS: machine learning, trabeculectomy, glaucoma treatment

INTRODUCTION

Predictive research aims to forecast forthcoming events or outcomes by analyzing patterns within a collection of variables. This approach has gained significant traction in medical research (Idowu et al., 2015). Precise predictive models can provide patients and physicians with valuable insights into the prospective trajectory of a medical condition or the likelihood of its occurrence, therefore aiding in determining appropriate actions about screening and/or therapy.

According to Martin (2022), substantial advancements have been achieved by humanity through the creation and refinement of progressively more potent and intricate instruments. During the era of the Industrial Revolution, a significant quantity of tools were developed in the form of machinery, which facilitated the automation of jobs necessitating manual labor. In the contemporary era of technology, there is a growing trend toward developing computer-based solutions that aim to automate cognitive functions.

The post system was evaluated by assessing the new system's performance and the previous approach it aimed to enhance. Consequently, a comprehensive assessment of the system's performance was conducted to determine users' perspectives on the performance of the deployed application. The analysis was conducted by selecting 80 participants, specifically eye surgeons and carers with expertise within the relevant sector.

Problem Statement

Steroid-induced glaucoma poses a significant risk of vision loss and is a disorder that presents several obstacles to the existing healthcare system. It is faced with a lot of challenges, which include

1. Being unable to recognize patients who show a positive response to steroid treatment before a trabeculectomy because of increased intraocular pressure. The topic under investigation has been characterized by ambiguity, resulting in a notable void in scholarly literature. The existing body of literature has examined the impact of steroids following trabeculectomy in individuals with glaucoma, as evidenced by the study conducted by Augusto et al. (2021). However, there needs to be more research investigating the predictive factors before the trabeculectomy treatment.

2. Inadequate standardized, automated technology to predict patients' responses to steroids before trabeculectomy surgery.

Objectives

This study aims to examine and assess the perspectives of experts regarding the performance and efficacy of the recently implemented predictive system.

Research Questions and Hypotheses

Has the effectiveness of the recently created integrated prediction system (IPS) been verified for the assessment of pre-trabeculectomy surgery?

Ho1: The null hypothesis posits that the integrated prediction system (IPS) does not statistically impact the accuracy of forecasting a persons reaction in using steroid in the pre-assessment evaluation.

Ho2: Utilization of the deployed application provides a substantial impact on the efficacy of forecasting patients' responses to steroid treatment in the pre-trabeculectomy assessment.

LITERATURE REVIEW

Nuzzi et al. (2021) described artificial intelligence (AI) in their study, describing it as a subfield within computer science that focuses on creating and refining algorithms aimed at emulating human intelligence. Tse et al. (2022) conducted a study in which they explored the potential impact

of Artificial Intelligence (AI) on clinical tests, particularly Objective Structured Clinical tests (OSCEs). Although OSCEs have inherent limitations, integrating new technologies such as artificial intelligence (AI) could potentially increase the assessment and preparation of future clinicians. According to the research conducted by McGrath et al. (2019), it is argued that the second wave of Artificial Intelligence (AI) has the potential to significantly transform our lives, presenting both exciting opportunities and formidable challenges. Moreover, Tse et al. (2022) suggest that the integration of artificial intelligence (AI) into the medical domain is an inevitable phenomenon that has the potential to profoundly transform the existing paradigm, with both positive and negative implications.

Nuzzi et al. (2021) conducted a comprehensive review to present a descriptive overview of the current and therapeutically significant applications of artificial intelligence (AI) in several domains of ophthalmology. The concept of three-dimensionality was seen as a means to facilitate the comparison of one or more formulas, enabling the assessment of regions of clinical concurrence and discordance among various formulas. Siddiqui et al. (2020). According to Qian et al. (2021), using Artificial Intelligence (AI) in medical and other disciplines has demonstrated extensive potential. It has prompted the emergence of deep learning models. Deep learning applications are wide-ranging, encompassing several fields, such as the forecasting of seismic aftershocks (Devries et al., 2018) and the progress of drug development (Chen et al., 2018). In healthcare, medical imaging techniques have been employed to determine the precise timing of stroke occurrences, evaluate the presence of cancerous lesions, and examine the spread of metastases. Esteva et al. (2017) and Trebeschi et al. (2017) have identified various other conditions. The applications of ophthalmology contribute to the identification and diagnosis of glaucoma. Asaoka et al. (2019) and Asaoka et al. (2016) have conducted studies on the topics of diabetic retinopathy (DR), age-related macular degeneration, and retinopathy of prematurity.

Linear regression is commonly employed to determin a dependent variable (y). Therefore, this model is a statistical technique that analyzes the relationship between a dependent variable and a specified independent variable (x). The present methodology reveals a linear correlation between the independent variable, x, and the dependent variable, y. Bhadana, et al. (2021). This paper introduces a very reliable prediction technique derived from an applied statictics initially put forward by Vapnik then discussed holistically by Vaid et al. (2020). In their recent publication, Devanaboina et al. (2021) presented a study that centers on applying machine learning techniques, specifically the Convolutional Neural Network algorithm implemented with Tensorflow, for cataract diagnosis. The prediction of illness and the subsequent development of combination medication therapies or reactions has long been a complex and demanding field of study. However, as George et al. (2021) noted, using computational models to tailor drug response prediction has a significant potential to increase the likelihood of successful patient recovery.

Sampling Technique and Methodology

This study employed both probability and non-probability sampling techniques. The purposive sampling methodology was utilized in this study since the people who responded to the questionnaire was basically on their readiness and eager to give information to the researcher and was chosen on that ground. This approach was chosen from the broader category of non-probability sampling methods. Quota sampling, a type of probability sampling, was utilized to determine the sample size of each department within the hospital, specifically the optometrist and ophthalmologists' departments. The staff strength ratios within these departments played a role in achieving this. As a result, the ratio of hospital staff strength to the study's entire population determined the allocation of respondents sampled in each department. Various statistical methods were employed to analyze the data gathered for the present investigation. The hypotheses presented were subjected to regression analysis with a significance threshold of 0.05. The Statistical Package for Social Sciences (SPSS) version 20 was applied uniformly.

Presentation of Sample

Table 1 Questionnaire Sharing

Sharing	Quantity	%
No. Shared	107	100%
No. filled	80	75%
No. not filled	27	25%

Findings

Table 2 Measures of Variability

	(Avg)	(Avg Of Variability)	N
Integrated New model	4.2030	.96886	80
Efficiency	3.9752	1.07175	80

Table 3 Anaylysis Interpretation[b]

Design	Correlation (R)	Coefficient of determination (R^2)	Model Accuracy (Adjusted R^2)	Error of estimation (Std.error)	Durbin-Watson

1	.920[a]	.846	.846		.38068	.923

a. Independent variables: New deployed system
b. Observed sample: Efficiency of patients responses

Table 4 Analysis of Variance

Design		Summation of Squares	Degree of freedom	Mean Square	F-value	Stat sig.
1	Regression	159.695	1	159.695	1101.967	.000[b]
	Residual	28.984	78	.145		
	Total	188.678	79			

a. Observed sample: Efficiency of patients responses
b. Independent variables: New deployed system

Table 5 Correlation of Coefficient[a]

Design		Raw Coefficient B	Error of estimation	Beta weights	t-value	Stat Sig.
1	(Fixed function)	.897	.103		8.696	.000
	New predicting system	.832	.025	.920	33.196	.000

a. Observed sample: Efficiency of patients responses

Table 6 Fitting Deviation[a]

	Min	Max	Avg	Avg of Variablity	No
Expected paramenters	1.7285	5.0552	4.2030	.89135	80
Remainder value	-.72852	.77644	.00000	.37973	80
Std. expected parameter	-2.776	.956	.000	1.000	80
Std. Remainder value	-1.914	2.040	.000	.998	80

a. Observed sample: Efficiency of patients responses

DISCUSSION OF FINDINGS

The correlation (R) value in analysis interpretation and summary showed table (3) above indicates a coefficient of determination of 0.920, suggesting a robust positive effect. The R2 coefficient of determination calculates the proportion of the dependent variable's overall variability and the ability to predict patients' responses to steroids that the independent variable, or the new prediction method, can account for. The findings indicate that the new predictive approach accounts for 85% of the variability in accurately forecasting a patient's reaction to steroid treatment. This exhibits an identical level of elevation. The regression model demonstrates statistical significance with a p-value of 0.000, indicating a strong match for predicting the outcome variables. Additionally, the t value of 33.196 further supports the overall regression model's efficacy.

Given that the p-value (0.000) is less than the predetermined significance level (Alpha = 0.05), specifically 0.000<0.05, and the calculated t-value (33.196) exceeds the critical t-value (1.960), it is thus appropriate to decline the use of the **Ho1** and accept the **Ho2**. This outcome suggests, a newly implemented prediction application significantly impacts on efficiency of determining patients response to steoid in trabeculectomy pre-assesment.

CONCLUSION

Survey findings in analyzing the implementation and the post-evaluation of the predicting system indicate a notable impact on the efficacy of predicting a patient's reaction to steroid treatment during pre-trabeculectomy examination. The study additionally showed that implementing a novel steroid prediction response system was undertaken to assist physicians in forecasting and categorizing their patients' conditions before a trabeculectomy treatment. This implies that ophthalmologists can consult the new system and gather supplementary evidence before reaching a conclusive determination regarding their patients. Consequently, the study suggests implementing a prediction system that is culturally appropriate for utilization by healthcare professionals in government and public healthcare facilities.

References.

Asaoka, M., Murata, H., Hirasawa, K., Fujino, Y., Matsuura, M., & Miki, A. (2019). Using Deep learning to accurately dignose early-onset glaucoma from macular optical coherence tomography images. *AM J Ophthamol*(45), 136-198.

Asaoka, R., Murata , H., Iwase, A., & Araie, M. (2016). Detecting preperimetricglaucoma with standard automated perimetry using a deep learning classifier. *Ophthalmology, 123*(80).

Augusto, P., Denise, F., Tiago, S., Prata, C., & Barbosa, G. (2021, Feburary).) Effect of steroid eyedrops after trabeculectomy in glaucoma patients: a keratograph analysis. *Arquivos Brasileiros de oftalmologia*, 0004-2749. doi:10.5935/0004-2749.20210050

Bhadana, V., Jalal, S., & Pathak, P. (2021). A comparative study of machine learning models for COVID-19 prediction in India. *IEEE Xplore,, 3*(1), 1-7.

Chen, H., Engkvist, O., Wang, O., Olivecrona, M., & Blaschke, T. (2018). The rise of deep learning in drug discovery. *Drug Discov Today, 1241*(50), 23

Devanaboina, R., Badri, S., Depa, M., & Bhutada, S. (2021). Ocular Eye Disease Prediction Using Machine Learning. . *Internation Journal of creative research thoughts (IJCRT),*, 2320-2882.

Devries, S., Viegas, F., Wattenberg, M., & Meade, B. (2018). Deep learning of aftershock patterns following large earthquakes. *Nature, 632*(4), 560

Esteva, A., Kuprel, B., Novoa, R., Ko, J., Swetter, S., & Blau, H. (2017). Dermatologist-level classification of skin cancer with deep neural networks. . *Nature., 115*(8), 542.

George, A., Ladislave, R., Zhaleh, S., Petr, S., Benjamin, H., & Anna, G. (2020). Machine learning approaches to drug response prediction: challenges and recent progress. . *npj Precision Oncology, 19*, 225. doi:10.1038/s41698-020-0122-1

Idowu, A., Aladekomo, A., Williams, O., & Balogun, J. (2015). Predictive model for likelihood of Sickle cell aneamia (SCA) among pediatric patients using fuzzy logic. . *Transactions in networks and communications, 31*(1), 31-44.

Martin, M. (2022, Feburary 3). *What is an intelligent system?* Retrieved March 2022, from researchgate: https://www.researchgate.net/publication/344334868

McGrath, H., Flanagan, C., Zeng, L., & Lei, Y. (2019). Future of Artificial Intelligence in Anesthetics and Pain Management. . *Journal of Biosciences and Medicines,, 7*, 111-118. doi:10.4236/jbm.2019.711010

Nuzzi, R., Boscia, G., Marolo, P., & Ricardi, F. (2021). The Impact of Artificial Intelligence and Deep Learning in Eye Diseases: A Review. *Frontier in Medcine*, 123-125. doi: 10.3389/fmed.2021.710329

Qian, H., Dong, B., Yuan, J., Yin, F., Wang, Z., Wang, H., . . . Ning, B. (2021).) Pre-Consultation System Based on the Artificial Intelligence Has a Better Diagnostic Performance Than the Physicians in the Outpatient Department of Pediatrics. Front. Med. . *Front. Med*, 8. doi:doi: 10.3389/fmed.2021.695185

Siddiqui, A., Ladas, J., & Lee, J. (2020). Artificial intelligence in cornea, refractive, and cataract surgery. . *Curr Opin Ophthalmol, 31*, 253-60. doi:10.1097/ICU.0000000000000673

Trebeschi, S., Van, G., Lambreght, D., Lahave, M., Parmar, C., & Bakers, F. (2017). Deep learning for fully-automated localization and segmentation of rectal cancer on multiparametric MR. . *Sci Rep, 7*, 5301.

Tse, K., & Cheng, M. (2021, march 02). *dovepress*. Retrieved February 14, 2022, from dovepress.com: https://www.dovepress.com/

Vaid, A., Somani, S., Russak, A., De-Freitas, J., Chauchry, F., Paranjpe, J., & Glicksberg, B. (2020). Machine learning to predict mortality and critical events in covid-19 positive New York city patients: a cohort study. . *Journal of Medical Internet Research,, 49*(6), 1918-1929.