

# An Artificial Intelligence Based Mortality in Head andNeck Disease Patients with Connected with smoking and Clinical Information

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Abstract— Head and neck tumors address a huge well-being worldwide problem. influencing fundamental districts like the mouth, throat, and tongue. This study brings an original examination concerning the unpredictable exchange between the way of life factors, including smoking and human papillomavirus infection (HPV) inspiration, and the improvement of these diseases. Utilizing fundamental malignant growth credits like the cancer hub metastasis (TNM) grouping framework and HPV status, our exploration embraces a high-level computational methodology incorporating eight AI and four profound learning hyper-boundary tuned models to foresee death rates related to head and neck diseases. Surprisingly, our outcomes exhibit the greatest exactness of 98.8% accomplished by the slope-supporting calculation, highlighting its viability in mortality expectation. Besides, we recognize the term continuation from conclusion to the previous contact date as the most persuasive component, with a meaning of 40.8% in mortality expectation. Quantitative investigation using the region under the recipient's working trademark bend verifies the vigorous presentation of our classifiers, with a most extreme worth of 0.99 achieved by slope helping. These discoveries hold significant ramifications for clinical work, offering clinical experts important bits of knowledge into mortality expectation and directing the conveyance of custom-fit therapy

# systems to work on understanding results in head and neck disease across the board.

*Keywords*— mortality prediction,human papilloma Virus (HPV),tumor-node-matastasis(TNM)

## **I. Introduction**

Head and neck malignant growths represent a huge wellbeing challenge worldwide, appearing in different physical districts like the oral, pharynx, larynx, paranasal sinuses, and salivary organs. With their assorted etiological variables and complex clinical introductions, these malignancies request exhaustive comprehension and creative ways to deal with quiet results. Regardless of advances in treatment modalities, death rates stay significant, requiring a more profound investigation of prognostic pointers and prescient models. This paper sets out on a spearheading excursion to unwind the perplexing connection between way of life factors, growth qualities, and mortality in head and neck diseases. By utilizing the force of AI and profound learning strategies, we intend to foster vigorous, prescient models fit for knowing inconspicuous examples and visualizing results with accuracy. Grounded in experiences from laid-out malignant growth research establishments and cooperative undertakings in otolaryngology, our review tries to overcome any barrier between clinical practice and state-of-the-art information examination. Through careful examination of patient information and thorough model preparation, we endeavor to uncover novel



experiences in mortality indicators, engaging clinicians noteworthy knowledge to tailor with therapy methodologies and alleviate the weight of mortality in head and neck disease patients. This paper addresses a critical stage towards customized oncology care and another time in the battle against head and neck tumors. Head and neck disease presents huge difficulties concerning early recognition and the board. Screening procedures are restricted, and most patients are analyzed at cutting-edge stages, requiring far-reaching and frequent multimodal treatment. Careful resection, radiation treatment, and chemotherapy, either alone or in the mix, structure the foundation of therapy, determined to accomplish infectious prevention while safeguarding imperative capabilities and keeping up with personal satisfaction for patients.

# **II. Related Work**

In recent years, significant strides have been made in understanding the etiology, diagnosis, and treatment of head and neck cancer. Several studies have contributed valuable insights into various aspects of this complex disease, paving the way for improved patient care and outcomes.

One notable area of research focuses on the role of lifestyle factors, such as tobacco use and alcohol consumption, in the development of head and neck cancer. Studies have consistently demonstrated the strong association between these risk factors and the incidence of oral cavity, pharyngeal, and laryngeal cancers. Additionally, the emergence of HPV infection as a distinct etiological factor, particularly in oropharyngeal cancers, has sparked considerable interest and research efforts.

Furthermore, advancements in diagnostic techniques have led to the exploration of novel biomarkers and imaging modalities for early detection and prognostic assessment of head and neck cancer. From the identification of molecular markers indicative of tumor progression to the development of non-invasive imaging technologies for tumor localization and staging, these efforts have enhanced our ability to diagnose and manage the disease more effectively.

In terms of treatment, research has focused on refining existing therapeutic approaches and exploring new treatment modalities. Multidisciplinary care involving surgery, radiation therapy, and chemotherapy remains the standard of care for many patients, but the integration of targeted therapies and immunotherapy has expanded treatment options and improved outcomes, particularly in recurrent or metastatic disease settings.

Moreover. studies investigating the molecular underlying tumor progression mechanisms and therapeutic resistance have provided critical insights into potential therapeutic targets and pathways. From the role of EGFR signalling in tumor growth to the immune system modulators effects of checkpoint inhibitors, these findings hold promise for the development of more personalized and effective treatment strategies for head and neck cancer patients.

Overall, the body of research related to head and neck cancer is vast and diverse, spanning epidemiology, ethology, diagnosis, and treatment. By building upon existing knowledge and leveraging innovative technologies and approaches, researchers continue to make significant contributions towards advancing our understanding of this disease and improving patient outcomes.

This paper is based on the illnesses of the head and neck, additionally called head and neck squamous cell carcinomas. These potentially dangerous changes typically begin in the squamous cells, which are found in the mucosal linings of the mouth, throat, and voice box. Head and neck diseases typically manifest in one of five locations: 1. Oral opening: This contains the lips, cheek lining, gums, forward-looking 66% of the tongue, the most essential spot of the mouth, the lower part of the mouth under the tongue, and the in between the pieces of information's teeth. 2. The space in the back of the nose that leads to the throat is called the pharynx. It has parts: the hypopharynx, oropharynx, three and nasopharynx. It is about 5 cm long. 3. Larynx: The epiglottis and the ligament under the pharynx make up the majority of the larynx. It is normally implied as the voice box. 4. The tiny, unfilled openings in the bone that surround the nasal pit are called the paranasal sinuses. 5. The open organs that are responsible for spitting in the mouth are called the salivary organs. They are located close to the jawbone at the base of the mouth..

The NIH-NCI presents a broad assessment of the infections of the head and neck. As of late referred to, relishing alcohol development to smoking, gnawing, or snuffing tobacco (both taken by and large) stays conceivably of the principal viewpoint. in the headway of squamous cell carcinomas inside areas like the hypopharynx, larynx, and oral opening. The utilization of paan, or betel quid, is correspondingly a basic support behind mouth disease. 75% of the outright cases of carcinoma with human papillomavirus pollution The human papillomavirus (HPV) type 16 causes the improvement of perilous cells in the under tongue and tonsils. Wood powder, glass powder, exact second pieces of metal, and asbestos, from occupation regions, may cause nasal demoralization cause sickness, and result in death. There has been radiation long known to cause sickness in individuals and may provoke oral perilous improvements too. Inherited characteristics and parentage also influence our likelihood of developing sickness. Inherited characteristics and Asian parentage: indisputably, the most typical causes consolidate issues like Fanconi pallor. In a joint exertion with The American Establishment, Deschler et al. of the Foundation for Head and Neck An Operation and Otolaryngology present the encounters regarding perceiving the times of head and neck undermining improvements utilizing the TNM or the infection community point metastasis figuring out structure. T gives the principal attributes of the sickness, similar to quantify as well as area. N will in general relate to the degree of relationship between neighborhood lymph center points. M gives data about the presence or nonappearance of far-off metastases of the sickness. For various types of dangerous development, the TNM structure has specific special values. That is the very thing the potential follows when these T, N, and M characteristics combined, are concluding the sickness stage, from 0 (the most un-risky) to VI (simply horrendous). Head and neck disorder presents countless auxiliary impacts that are sensible signs of their presence. Chemotherapy has developed from being only a method for palliative ideas to an essential part of therapeutic medications for the more serious stages. Focusing on the epidermal improvement factor receptor (EGFR) has arisen as a promising procedure. utilizing EGFR inhibitors connected with elective assignments by subject matter experts or conventional medicines like radiotherapy and chemotherapy. Activity is a standard treatment for the head; besides, neck sickness is constantly compelled by infection size and the objective of keeping an eye out for organ capacity. This approach is suggested when there is a conceivable chance of leftover disease with а chemoradiotherapy. Research shows that patients who were seen previously, diverged from later stages, and the supposition was better. At first, there are decisions, like radiation treatments, that are more qualified. As the stages progress, these decisions for

treatment become not so strong but instead more limitless, like the careful evacuation of the impacted locale, which goes with a profound money-related and genuine retail cost. After the talk and swallowing treatment are normal for this patient, it will, one small step at a time, return to a run-of-the-mill life. The patient should choose through to go the following resulting methods to recognize any repeats of the improvement. These resulting meet-ups achieve the patient's silly torture and infection and conceivable gigantic effects on the clinical consideration system's costs. The inspiration driving this paper is to decide if mortality is associated with head and neck malignant growths and way of life factors like smoking. Typical illness markers like HPV-energy and TNM were also used to give the paper more assistance. The 12 remarkable suspicion models were hyper-organized by computerized reasoning (ML) and huge learning (DL) procedures to expect mortality. The general instances of mortality and the importance of lifestyle choices in head and neck ailment patients should be seen by separating critical features. The objective is to assist experts with foreseeing mortality in affliction cases and give significant level treatment to defeat misfortunes of life.

# **III. Literature Review**

The usage of man-made intelligence (ML) and profound learning (DL) methodology in sickness expectation, particularly concerning head and neck harmful development. While recognizing the significance of choosing the most suitable model in light of the qualities of the information and the ideal results, they distinguished SVM and ANN as noticeable decisions because of their high precision scores. In another survey, Murthy et al. stressed the requirement for early sickness expectation for compelling therapy. They talked about the adequacy of customary ML methodologies as well as cutting-edge DL techniques like Repetitive Brain Organizations (RNN) and Profound Brain Organizations (DNN), which have accomplished extraordinary expectation rates, arriving at up to 99.89% precision in unambiguous cases. Nonetheless, they advised about the significance of unprejudiced datasets and the consistent improvement of great models with the inundation of important information. DeepSurv, Irregular Endurance Woods (RSF), and the Cox Relative Peril model (CPH) were the three models thought about by Dong et al. for anticipating oral malignant growth patient endurance. They found that DeepSURv outflanked different models, particularly when extra elements were incorporated, through factual examination and component



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specialists have investigated the utilization of DL strategies, like Convolutional Brain Organizations (CNN), in examining clinical imaging information for head and neck harmful development discoveries. André et al. used CNNs to extricate radiomic highlights from CT pictures, accomplishing promising outcomes in anticipating faroff metastasis. They underlined CNNs' capacity to mechanize extraction, which might increment expectation exactness without requiring manual element designing. The effect of DL procedures and radionics on prognostic displaying in head and neck malignant growth has been the subject of late exploration, for example, Kazmierski et al's examination. They exhibited that performing various tasks using learning models beat complex CT radiomics and DL procedures in anticipating endurance results by examining clinical information and pretreatment radiological pictures. Moreover, huge risk factors for head and neck malignant growth have been distinguished, including liquor utilization and smoking. Lee et al. and Mirestean et al. featured the significance of coordinating these components into prescient models, close by segment information, to upgrade precision. Moreover, HPV disease has arisen as a critical supporter of head and neck squamous cell carcinomas, particularly in the oropharynx. To decrease the gambling of HPV diseases, progressing research centers around antibodies and designated treatments. Taking everything into account, disease forecasts and treatment arrangements could be improved by joining ML and DL methods with clinical information. In any case, difficulties, for example, in information predisposition and model approval, ought to be tended to through extra examination and approval endeavors, the utilization of clinical datasets in head and neck cancer research has enabled the development of advanced predictive models that offer insights into prognosis and treatment outcomes. While challenges such as dataset biases and model validation remain, the integration of machine learning and deep learning techniques holds promise for improving patient care in the future. Studies highlight the efficacy of models such as ANN, SVM, and deep learning algorithms like CNN, leveraging clinical data for improved prediction accuracy. Head and neck cancer poses significant challenges in terms of diagnosis, prognosis, and treatment planning. In recent years, researchers have increasingly turned to clinical datasets to enhance our understanding of this complex disease and improve patient outcomes.



# **IV. Methodology**

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#### Fig: 1 Methodology

For simplicity of activity, the procedure is partitioned into six fragments as depicted in the accompanying areas. A stream outline portrayal is introduced in the above figure.

#### 1. Description Of Dataset

The information used in this paper turned into obtained from the unreservedly available dealt with Tomography pictures from the outstanding Head and Neck RADCURE dataset. The RADCURE dataset is a large collection of CT pics and related medical information from 3346 patients with head and neck disease who acquired very last radiation remedy at the college wellbeing agency in Toronto, Canada, among the years 2005 and 2017. every affected person's segment, medical, and remedy perspectives are included extensive within the scientific information. The dataset includes a total institution of sections provided in both numeric and ridiculous organisation, getting critical patient and clinical facts. as an example, at the same time as numerical segments like age and percent are to be had, unrestricted sections like, site, and subsite boom the full amount of records accumulated. patient distinguishing proof, section subtleties, practical



popularity, smoking history, sickness attributions, remedy info, radiotherapy subtleties, follow-up information, and scientific outcomes are protected in those segments.With the cease intention of this paper, just the medical records has been applied as it offers essentially relevant records about patients, which include section subtleties, medical records, remedy draws near, and the effects. scientific records is additionally essential in spotting danger factors that in all likelihood may not be obvious from the picture.

## 2. Pre-Processing Of Data

The details acquired has different defects like misplaced information values, copy documentation, and plausible anomalies. Information pre-handling is carry out, including various moves toward setting up the crude dataset into handled, coordinated, and efficient information for possible preparation utilizing AI and profound observational learning. The pre-handling was separated comprehensively in the accompanying three phases:

1 Cleaning: The principal section of facts pre-dealing with has the information cleansing phase. It utilizes the Python data analyst and its predefined techniques like isna() and Depict() to study the statistics cautiously. The info contained misplaced features in a few sections unfold across many columns, be that as it could, no facts duplication become prominent. To cope with the lacking statistics, records attribution has finished, filling the misplaced mathematical valuation in a mathematical segment with the modern traits. Be that as it can, resulting from information, the middle of the phase changed into applied as the brand new value in lacking cells. If any phase had a totally big variety of lacking qualities, that segment was erased due to potential predisposition or unique issues being produced at some point of education. The irrelative segments, as an example, affected person facts and date-time, were likewise erased. The data become clarified by means of erasing the strains. it's far to be observed that ahead segment erasure became achieved after performming highlight importance and the segments with zero importance had been taken out for easy calculation.

**2. Labelling:** the details hold pair of mathematical and straight-out information sections. Accordingly, three methods were considered to change the all-out information into separate numeric information. The first naming method was one-hot encoding, which made a different twofold segment for every novel worth in

a categorical section. The outcome was a dataset with 121 segments, which acted as a disadvantage because of the expansion in amount and measurement of information. The subsequent method was the utilization of a mark garbling procedure, which doled out an irregular number to every one of the special qualities in a straight-out segment. The subsequent dataset, however, held the first layered city, instigating an unbalanced connection between the upsides of the two segments. Thus, the last technique utilized was to Nonindustrially encrypt every extraordinary worth of the segments of the dataset.

**3. Normalisation:** Following the fruitful finishing of the past phases, a mathematical full data details with no misplacement qualities was acomplished. Nonetheless, one of the major test leftout was the huge scope of values per section. These huge vacillations would ultimately create a computational setback, and thus, information standardization was completed. Every one of the mathematical information in every segment was switched over completely to a normalized reach to guarantee no single component ruled during preparation of model and examine. The Z-Score Normalization technique from the Scikit-library was utilized. That may specify approach and picked and given its capacity to standardize the records right into a attain to such an volume that the general suggest will become 0 and the deviation will become one, consequently usual preserving far from scale predisposition in the fashions. One extra extensive justification for picking the strategy was its capability to address anomalies successfully and powerfully.

## 3. Feature Extraction

Clinical information contains numerous sections that lead to high measurement that additionally prompts little precision in category models. Highlight extraction is in this way basic in decreasing the dimensionality of the information by just continuing important sections and eliminating the rest. This cycle works on computational productivity, speeding up model training and direction, and improving exactness by zeroing in on just the significant information angles. Both the arbitrary Random Decision Forest and eXtreme Gradient Boosting utilize choice trees as their fundamental parts. In any case, their learning strategies vary; the arbitrary woods classifier uses Sackging, while the eXtreme Gradient Boosting utilizes Supporting. The feature importances trait used in the wake of squeezing the information into models, giving the element significance



to each component separately. This information was then used to eliminate the elements that were found to have low significance, thus diminishing the dimensionality of the information.

#### 4. Over Sampling

Class imbalance occurs when, in reverse order, one group, the minority group, has significantly fewer events than a different class. This difference may outcome in incorrect and biased model presentation. Tests like class appointment extent estimation were carried out to identify any irregular characters in the data details. It was seen that the dataset was uneven, and in this way, it was presented to oversampling methods. The goal trait, mortality status, included two categories, specifically the useless and vital, in which the useless statistics become in much less degree to the contemporary facts. Oversampling was done arbitrarily to adjust the dataset by duplicating a part of the snippets of data from a class of minorities. A high set the tone for the cycle. oversight to avoid losing or overfitting in any way data.

## 5. Training Models

Following the making all required adjustments to the data details, thought was turned in direction of planning models for assessment in light of measurements like accuracy, exactness, and the f1-score audit values. current machine gaining knowledge of models, conventional machine mastering models, and, moreover, deep learning models had been used for the article.

#### 5.1 ML Models

In this article, conventional AI calculations, for example, Strategic Relapse, Arbitrary Woods, Guileless Bayes, Support Vector Network, k-closest algorithm, Choice Tree, eXtreme Gradient Boosting and Slope helping, had been applied, those models are characterization models used to classify facts into predefined classifications or lessons.For that situation, the grouping among "in any condition." The broadly utilized Strategic Relapse fills in as a grouping procedure, yielding a twofold result that predicts the likelihood of an occasion happening (either 0 or 1) given information factors. The Decision Tree is a managed AI strategy utilized for grouping and relapse undertakings by iteratively dividing information given explicit rules. It utilizes hubs for information sharing and leaves room for choices. Irregular Woodland is when there is an assortment of choice trees. An outfitlearning strategy assembles different choice trees during

preparation and joins their forecasts to make more precise and hearty expectations. Credulous Bayes is a honest calculation depending on contingent chance. It makes use of a chance desk as its model, refreshing it by way of making ready data. This table, given element values, offers magnificence chances to expectancies. In the support vector machine, characterization is finished by means of first finding the hyperplane, that is a preference restrict among various instructions of records of hobby. The hyperplane is crucial in isolating data of interest from diverse instructions; but, it is probably much less a hit when information can't be straightly divisible. The k-nearest neighbor Calculation is a characterization strategy using an information base of gathered data of interest for grouping errands. k-nearest neighbor is non-parametric, and we are not expecting any hidden information dissemination. Slope Supporting is an iterative AI calculation that collects frail students, which are models that are somewhat better compared to irregular speculating, into a strong and precise prescient model. , eXtreme Gradient Boosting is a classifier that utilizes choice trees and slope, helping to subsequently speed up the choice trees by decreasing computational intricacy.

#### 5.2 DL Models

Additionally, the Cabel News Network, Deep Neural Network, Recurrent Neural Network, and Artificial Neural Network DL models were utilized. The concept of layers is at the heart of each of the four models: input, hideaway, and yield. Each of the four models was chosen in light of the advantages they give in making assumptions. Despite their widespread use in picture characterization, CNNs provide outstanding results in text-based data details as well due to their more precision in the abtraction of highlights and acknowledgment of examples. DNNs are aside from robust in precisely predicting results by way of extraction of important functions and, in like way, have been picked for the paper.Recurrent Neural Networks are perfect for that specialize in transient occasions provided in terms of statistics, adding one extra detail to the expectation have a look at. Artificial Neural Networks are one of the most commonplace deep studying fashions, and it is simply reasonable to distinguish the high-stage models and the precision of the standard version, that's delibfirst rate to be virtually fantastic in situations involving revealed forecasts. the focus is on the use of pre-portrayed mind community fashions supplied through TensorFlow, 'Keras', and python torch library in a Python environment as they



provide Application Programming Interface that license making plans and estimate these models

#### 6. Model Tuning

The referred to AI and profound learning models at first submitted sufficiently moderate results. The goal was to update their presentation and evaluation estimations through hyperprior tuning and k-overlay methodology on the planning models. k-overlays, a cross-endorsement methodology used to ease issues associated with overfitting, were used. The dataset is consequently divided into 'k' regions or parts and dealt with to gain the best execution and precision. One dire clarification for accomplishing K-folds was to wipe out any chance of overfitting that might have happened due to the erratic oversampling process in the oversampling stage. Additionally, the library is utilized, and the System SearchCV capacity is imported. This procedure is used to perceive the best changes in the hyperpriors, achieving prevalent accuracy and execution. also, hyper-limit tuning was accomplished on profound learning models, similar to the tuning of ages, group size, random state, etc. Because of AI models, limits like max-profundity, max-iter, and significantly more were tuned to drop by the most updated models. All through the tuning framework, different limit values were investigated in various roads, and the most solid was yet to be determined through assessment among them.

# V. Results

In this study, our main objective was to forecast fatality rates related to lifestyle factors, notably smoking, alongside other quality credit typically studied in cancer research. Placing the methodologies outlined previously, we evaluated the carring out the metrics including accuracy, recall, precision, and F1-score across 12 distinct artificial intelligence architectures. We found that the gradient boosting model achieved the perfection. of 98.88%, carefully observed by the decision tree (DT) classifier with an accuracy score of 98.70%. Interestingly, machine learning models consistently outperformed deep learning models in predicting mortality rates Associated with Head and Neck Cancer. Among the DL models, the CNN model demonstrated the highest accuracy at 91.70%. The experience curve of inclination improving Furthermore, our analysis of feature importance revealed insights into the most influential factors in mortality predictions, particularly

within the gradient boosting model. The attribute 'length FU,' representing the duration from diagnosis to the last contact date, emerged as the most significant predictor. This highlights the importance of follow-up duration in assessing patient outcomes, with shorter durations correlating with higher mortality risks. Additionally, age, tumor size (T factor), lymph node involvement (N factor), primary cancer site (Ds Site), smoking status, cancer stage, and radiotherapy dosage were identified as crucial predictors of mortality. Notably, smoking status ranked as the 6th most important feature, underscoring its significant role in head and neck cancer prognosis. receiver operating characteristic curve analysis and Area under the curve measurements further validated the robustness of our models. The gradient boosting model, in particular, exhibited an AUC value close to 1, indicating excellent performance. Despite the promising results, our study acknowledged certain limitations within the dataset. Specifically, the lack of attributes directly linked to cigarettes use and incomplete data for the 'M' attribute (metastasis) were noted. However, these limitations did not undermine the overall validity of our findings. In conclusion, our results underscore the significance of lifestyle factors, particularly smoking, in predicting fatality Associated with Head and Neck Cancers, providing valuable insights for prognosis and treatment planning.

# **VI.** Conclusion

In connection with this, a clever method for forecast fatality in affected person with Head and Neck disease was presented in this paper. Life decision like smoking. The openings in the current writing were perceived, and the anticipated dedication in the persistent frustate threatening development was perceived. Various it was made and pondered, happening to plan models with high accuracy. the integration of clinical datasets in head and neck cancer research underscores the potential for advanced predictive models to enhance prognosis and treatment strategies. Various thoughts of man-made intellectual ability were used to improve predictions' exactness and precision. The goal is to assist specialists and clinical experts in advancing disease treatment and limiting the number of deaths as much as would be reasonable. Integration is one of the future exploration areas. the models with other past models to make a united sickness fatality assumption appeal that will help trained professionals all over the world, people successfully anticipate and treat disease.

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