Improved Classification and Prediction of Head and Neck Squamous Cell Carcinomas Using a Novel Generative Adversarial Network Model

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Head and neck squamous cell carcinoma (HNSCC) is a cancer that arises from squamous cells in the head and neck region, a type of cell found in the outer layers of skin and lining various mucous membranes. Diagnosis of HNSCC is primarily achieved through radiographic imaging tests, which are examined to provide comprehensive understanding of the disease. Deep learning, a sub-field of machine learning, can be applied to the task of medical imaging analysis and recognizing intricate structures within large datasets. A generative adversarial network (GAN) is a deep learning architecture that implements two sub-models, a generator and a discriminator, and can be utilized for both image synthesis and classification. The purpose of this experiment was to develop a GAN model that could take an input of radiographic images of HNSCC and both diagnose the stages of cancer and predict progression of the carcinomas with high accuracy. CT scans were downloaded from several image datasets and separated appropriately to first train and then validate the accuracy of the model. When radiographic images were used to validate the GAN model over a sufficient number of epochs and a large enough sample size from the validation set, the distribution of model accuracy had a median of approximately 93.95% and an IQR of approximately 0.9%. This demonstrates that the GAN model was able to recurrently achieve an accuracy of more than 93%, an accuracy that is higher than the 90.5% achieved by machine learning architectures that do not utilize multiple sub-models.