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Artificial Intelligence and Oral Cancer in the Gulf Cooperation Council Countries: A Narrative Review

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ABSTRACT

Objectives: Oral squamous cell carcinoma (OSCC) presents a significant global health issue due to its high morbidity and mortality rates, mainly resulting from late-stage diagnoses. Artificial intelligence (AI) technologies, including deep learning algorithms and imaging techniques, offer transformative potential for the early detection and management of OSCC. This review assesses the feasibility, diagnostic performance, and future directions of AI-driven approaches in OSCC care.

Materials and Methods: A review of 23 sources, including articles, books, and websites, was conducted using several databases, such as PubMed, Scopus, PubMed Central (PMC), and Google Scholar. The search strategy included keywords, such as "oral cancer," "artificial intelligence," and "deep learning". The inclusion criteria followed the PECOS framework, focusing on studies related to AI applications in OSCC diagnosis and management. Diagnostic accuracy, sensitivity, and specificity data were extracted and analyzed for clinical relevance.

Results: The review indicated a diagnostic accuracy of 92.2% for malignancy, with sensitivity and specificity reaching 100%. Advanced AI tools, including deep learning algorithms and imaging techniques, were used to analyze histopathological and photographic data. However, differences in datasets and methodologies limited direct comparison across studies, emphasizing the need for standardization. The findings highlight the importance of standardized datasets and validation protocols to improve the reliability and scalability of AI in OSCC detection. Emerging techniques, such as multi-task learning and ensemble models, show promise for enhancing diagnostic precision.

Conclusions: Incorporating AI into interdisciplinary care models can further facilitate early diagnosis and optimize patient outcomes. AI-driven technologies have the potential to revolutionize OSCC detection by improving diagnostic accuracy and enabling early intervention. In the GCC countries, the application of AI in healthcare is on the rise, highlighting regional advancements in technology-driven patient care. Ongoing research and development are crucial to refining AI applications, ensuring effective integration into clinical practice, and significantly improving patient outcomes.

Keywords: Artificial intelligence, Oral squamous cell carcinoma, Deep learning, Early detection, Gulf Cooperation Council (GCC).

1. Introduction

Oral cancer (OC) is a prevalent form of head and neck cancer associated with high morbidity and mortality rates. Late-stage diagnosis significantly impacts the five-year survival rate negatively. It arises from the unregulated proliferation of malignant cells that infiltrate adjacent tissues. Oral squamous cell carcinoma (OSCC) is notably fatal, exhibiting a mortality rate of 55% (1). Early detection and timely treatment, supported by specialist evaluation and imaging technologies, are essential for enhancing patient outcomes. Identifying OSCC and its precursors, known as oral potentially malignant disorders (OPMDs), is crucial for improving prognosis. OPMDs encompass a variety of lesions that have the potential to transform into cancer, with oral epithelial dysplasia (OED) being one of the most significant predictors.

Artificial intelligence (AI) has become a significant asset in oral health, especially diagnostics. Research on AI has focused on applications, such as dental radiographs, early detection tools, and OC screening, particularly in OPMDs. The application of deep learning in the analysis of histopathological images represents a significant advancement, with accuracy rates ranging from 96.6% to 98.4%, comparable to those of specialized clinicians (2). AI has demonstrated efficacy in detecting various cancers, such as breast, lung, and oral cancers, and classifying data for malignancy assessment (3). AI-driven approaches for predicting the risk of OED progression to OSCC and evaluating therapeutic responses are investigated. The literature demonstrates that AI algorithms can enhance the accuracy of cancer predictions by 15% to 20% (3). The diagnostic accuracy of AI for malignancies is 92.2%, with sensitivity and specificity rates reaching 100% (3). These advancements enable AI to analyze oral images from various devices, thereby minimizing physician subjectivity in detecting OPMD and OC.

OC presents significant public health challenges, especially in developing nations with limited access to specialist care. AI has the potential to reduce clinician workload and simplify diagnostic complexity. However, further research is necessary to standardize labeling protocols, validate automated interpretations, and enhance infrastructure to optimize AI applications in OC care. AI also offers solutions for examining cellular structures in histological slides, though its use in epigenomics and ensemble techniques for OSCC prognosis remain underdeveloped (4).

GCC countries have recognized AI as an essential part of medical field innovation, especially in digital healthcare technologies and diagnostic imaging techniques (5,6). While the UAE has been considered a regional guide in using AI for clinical decision-making and cancer screening (5,7), the application of AI in oral cancer diagnosis across the GCC remains in its early developmental phase and needs further validation and clinical integration. This study reviews deep learning algorithms for OSCC prognostication and assesses the feasibility of AI adoption, highlighting its potential to transform OC care in the GCC region.

2. Materials and Methods

Between October 2024 and June 2025, we conducted a focused search to evaluate the diagnostic accuracy of artificial intelligence (AI), including machine learning and deep learning models, in detecting oral lesions and diagnosing oral cancer. In addition to evaluating the effectiveness of AI, its limitations and current applications in detecting oral cancer were examined and investigated within the Gulf Cooperation Council (GCC) region and Arab countries.

2.1 Search Strategy

A comprehensive search of research articles was conducted using databases, such as PubMed, Scopus, PubMed Central (PMC), and Google Scholar, applying the following search terms: (AI OR "Artificial Intelligence" OR "deep learning" OR "machine learning") AND (diagnosis OR detection OR "early detection" OR "early diagnosis") AND ("oral cancer" OR "oral lesions" OR "oral squamous cell carcinoma" OR cancer) AND (GCC OR "Gulf Council Countries"). A total of 68 articles were initially retrieved and were reviewed with caution for quality and relevance. Two reviewers performed the screening independently, and any disagreements regarding irrelevant articles were resolved through team discussions for consistency and accuracy.

2.2 The Criteria for Study Selection

The article selection was based on a meticulous assessment, and only 23 articles matched the inclusion criteria. The primary purpose of these studies centered on the application of AI in oral squamous cell carcinoma (OSCC) detection. The selection process was based on the PECOS framework: Population: Patients previously diagnosed with OC, specifically OSCC. Exposure: Diagnosis using AI-driven models like deep learning and machine learning. Comparison: compared to conventional methods of OSCC diagnosis. Outcomes: Diagnostic criteria accuracy, specificity, and sensitivity were measured. Study Design: Various study types were included, such as systematic reviews and meta-analyses, clinical trials, and observational studies. The studies were eligible for inclusion if they were recently published, written in English, and categorized as systematic reviews/meta-analyses, narrative reviews/ conceptual articles, or book chapters/ books. Articles were excluded if they focused on animal studies, duplicated findings from the same database, lacked an AI-specific cancer detection focus, or were not published in English.

2.3 Study Characteristics

The 23 selected resources were distributed: two systematic reviews and meta-analyses, three narrative or literature reviews, eight diagnostic performance studies, two book chapters or textbooks, and eight conceptual or historical sources. These selected studies reflect the assessment of the potential of AI tools in detecting oral cancer. While prospective or retrospective cohort studies were not included, the review highlighted theoretical and clinical developments in AI-driven diagnosis.

3. Artificial Intelligence and Its History

AI emulates human intelligence processes within computers designed to think, learn, and perform tasks autonomously. These systems replicate various cognitive activities, such as problem-solving, decision-making, and language comprehension. AI systems utilize data, algorithms, and computational resources to identify patterns and execute actions. AI is categorized into two main types: narrow AI, which focuses on specific activities, and general AI, which seeks to manage a broad spectrum of intellectual tasks similar to human capabilities (8).

The history of AI extends to ancient myths and narratives of synthetic entities. Modern AI was officially defined in 1956 at the Dartmouth Conference, where John McCarthy and his colleagues introduced the term "Artificial Intelligence" (9,10). Early AI research concentrated on problem-solving and symbolic reasoning, developing expert systems in the 1970s and 1980s to emulate human proficiency in specific fields (8).

One of the most notable applications during this era was in medical systems, such as MYCIN (developed at Stanford University). This demonstrated how Al could support clinical decision-making, diagnose bacterial infections, and recommend treatments based on logical rules. These early tools laid the foundation for today's diagnostic AI systems, which now rely on vast datasets and advanced machine learning algorithms to assist in disease detection and management. The 1990s witnessed substantial progress with the emergence of machine learning, allowing computers to acquire knowledge from data. In the 2010s, deep learning and neural networks transformed AI, enabling it to comprehend images, voice, and spoken language. AI applications are ubiquitous, spanning healthcare to finance, and are constantly advancing due to improvements in computer power and data accessibility (8).

4. Challenges in Oral Cancer Detection and Diagnosis

OC constitutes a major global health issue, primarily due to frequent delays in detection, which result in advanced stages and diminished survival rates (2). OPMDs pose diagnostic and management challenges for clinicians (4). The conventional dependence on tumor staging for treatment is hindered by inconsistencies in staging and the absence of integration of prognostic markers, which adversely impacts accurate prognostication and personalized treatment strategies (3,11). Diagnosing oral lesions presents challenges owing to the subjective nature of clinical feature analysis, complicating the differentiation between benign lesions, dysplasia, and early-stage cancer (3). To address these diagnostic challenges, deep learning techniques and AI have emerged as promising tools that enhance screening efficacy and diagnostic accuracy (12). Routine preventive clinical examinations and advancements in AI-based diagnostic tools have the potential to mitigate the absence of symptoms in the early stages, challenges in visualizing the oral cavity, and difficulties in differentiating benign from malignant lesions (13). However, integrating these tools into clinical practice requires overcoming validation, regulatory approval, and clinician adoption challenges. AI algorithms, telemedicine technologies, and smartphone-based tools may enhance early detection and treatment planning, thereby reducing delays in diagnosis and access to specialized services (14). Integrative models that combine conventional features with molecular markers have the potential to enhance risk stratification and facilitate individualized treatment planning (15).

5. Application of Artificial Intelligence in Oral Cancer Detection

AI in oral cancer detection provides key advantages in screening, early diagnosis, disease prediction, treatment planning, and prognosis. The vast amount of digitized data from AI can empower clinicians. One notable advantage of convolutional neural networks (CNNs) is their ability to extract image features and generalize across various computer vision problems (2). AI can perform well in estimating the probability of malignancy and improve the positive predictive value that could help predict individuals' risk of developing oral cancer based on their risk factors, systemic medical conditions, and clinicopathological data (1). For the detection and diagnosis of OPMD and oral cancer, AI can function independently of clinician subjectivity, allowing for consistent interpretation of oral images acquired through various devices. AI-based detection offers a novel approach for screening oral, potentially malignant, disorders and facilitating early diagnosis of oral cancer, demonstrating notable advantages in fast response (3). Deep learning models have been shown to accurately quantify tumor-infiltrating lymphocytes, providing high prognostic value for staging and predicting disease progression (4). Additionally, AI models' diagnostic sensitivity and specificity often approach or exceed those of human experts, offering high negative predictive value and aiding clinicians in decision-making (3).

5.1. AI in Imaging and Screening

AI in imaging and screening uses machine learning and deep learning algorithms to analyze medical images and detect features associated with OPMDs and OSCC. These models are particularly suited for image-based tasks. CNNs are designed to process grid-like data, such as photographs or scans, and can automatically and adaptively extract features from input images. This hierarchical feature extraction is instrumental in identifying complex patterns in medical imagery, aiding in accurate cancer detection and analysis (2).

AI-assisted screening has demonstrated strong diagnostic performance. The area under the Summary Receiver Operating Characteristic (SROC) curve was 0.94, indicating excellent diagnostic performance. AI-assisted screening showed a sensitivity of 89.9%, a specificity of 89.2%, and a high negative predictive value of 89.5% (12). One recent study evaluated the performance of a deep learning algorithm for detecting oral cancer from hyper-spectral images of patients with oral cancer. The investigators reported a classification accuracy of 94.5% for differentiating between images of malignant and healthy oral tissues (13). Alabi et al. reported that deep learning methods, such as CNNs applied to CT images and spectral data, achieved sensitivities of up to 99% and accuracies of up to 96.6% in the prognostication of OSCC (16).

5.2 AI in Clinical Photography

Clinical photograph refers to intraoral images using a digital camera or smartphone, followed by computer processing for automatic identification of lesion types (3). Artificial intelligence has the potential to offer innovative diagnostic tools that can facilitate early detection (1). The application of these technologies to the detection of oral cancer from digitized oral photographs holds tremendous promise for revolutionizing the accuracy and timeliness of diagnosis (2). Several studies have demonstrated remarkable results for this task, consistently achieving sensitivity rates exceeding 85% and accuracy rates surpassing 90%, often encompassing around 1000 images (2).

Clinical photograph imaging indicated the highest diagnostic odds ratio (DOR) of 77.772 among all image tools (12). In a recent AI-based model using oral cavity images, the model demonstrated a sensitivity of 93.9% *versus* 83.7%, a negative predictive value of 98.8% *versus* 94.5%, and a specificity of 81.2% *versus* 81.2% for detecting OSCC and leukoplakia (17). The proposed method could detect oral cancer and leukoplakia with higher accuracy and reliability. The AI-based image analysis model showed significantly higher diagnostic accuracy than Liquid-based cytology may serve as a valuable screening tool for the early detection of oral cancer (17).

5.3 Histopathological and Cytological Applications

Deep learning (DL) is an AI-based method using an extended neural network or related architecture with multiple "hidden" layers of simulated neurons to combine simple visual features into complex patterns. DL-based digital pathology is currently being developed to assess

OED and OSCC outcomes (18). Artificial intelligence (AI) has been used to automatically identify clinically relevant regions from oral tissue histological images for oral squamous cell carcinoma diagnosis. Das et al. achieved an average classification accuracy of 96.9% using a deep convolutional neural network (CNN) model to classify OSCC and normal tissue on oral histology images (4). The deep learning network used computer-aided tools to automatically detect and delineate the detected nucleus from oral histological images with 88.87% sensitivity and 82.03% specificity (4).

5.4 Risk Prediction in OPMDs

Risk prediction refers to the ability to determine the likelihood of malignant transformation of OPMDs, such as OED, into OSCC (18). Adeoye et al. demonstrated that time-to-event models successfully predict the malignant transformation of oral leukoplakia and oral lichenoid lesions (15). Machine learning-enhanced multiplex immuno-histo-chemistry workflows examine immune cell patterns and organization within the tumor immune micro-environment to generate outcome predictions in immunotherapy.

StraticyteTM is a machine learning-based prognostic product that uses protein biomarkers and machine learning algorithms to help build a predictive risk assessment for OED transformation into OSCC. The biomarker selected for this product is the S100A7 bioprotein as the predictive marker. A digital image of the specimen is created for AI-assisted analysis, which is then evaluated to identify positively stained ‘regions of interest’ (ROIs). Image features, like cell size, are extracted and used within the identified ROIs to determine the risk score (10).

6. AI Applications in GCC Countries

Certain GCC nations emphasize the integration of AI into healthcare as an essential part of their national development strategies. AI is increasingly employed to augment operational efficiency, enhance diagnostic precision, and utilize predictive analytics for superior health outcomes. In Saudi Arabia, AI and the Internet of Things (IoT) detect chronic conditions and mitigate associated risks. Telemedicine is advancing, as exemplified by the Saudi Telemedicine Unit of Excellence and the UAE's systems for summarizing clinical data and integrating it with apps tailored for patient care (5). AI-driven telemedicine solutions address healthcare disparities by facilitating remote consultations and improving service delivery in underserved regions. AI is incorporated into chronic disease management programs, such as the Saudi Arabia National Diabetes Registry, providing tailored treatment plans and real-time monitoring for disorders like diabetes and cardiovascular diseases (7).

AI is also utilized in endocrinology for diagnosis, prognosis, and data analysis, decreasing costs and addressing rising healthcare demands. Applying AI algorithms for predicting COVID-19 involves time-series data analysis and studying the impact of lifestyle and citizen awareness in GCC countries, including Saudi Arabia, UAE, Oman, Bahrain, and Qatar. Deep learning-based technologies automatically process radiographic images to identify COVID-19-positive patients through advanced deep transfer learning methodologies. AI also analyzes CT scans, enhancing detection accuracy for COVID-19 cases (6).

The successful integration of AI in healthcare significantly depends on the understanding and perception of medical professionals towards its applications. However, concerns regarding data privacy, lack of AI-specific training, and potential job displacement could hinder full adoption and alignment with national development objectives (19).

A hyper-spectral imaging model was constructed using a DCNN to identify head and neck cancer in mice with an accuracy of 91.36%. This was in contrast to pre-trained models, such as Vgg 19 and ResNet 50, which demonstrated "near-human" performance for lesion detection and 98% accuracy in binary classification. A survival prediction model was suggested with 78.1% accuracy, while a multi-layer perceptron with Gaussian mixture measures was used to obtain oral cancer recurrence predictions and achieved 94.18% accuracy. An accuracy of 97% was attained by models based on ResNet50 for the multi-class detection of precancerous lesions on the tongue, outperforming the need for manual feature extraction and the use of patterns discovered from training data for classification. Ensemble approaches have demonstrated promising results, exceeding those obtained with expensive imaging equipment and improving accessibility to diagnostic tools in resource-limited regions (20).

AI technologies have been established to address cancer care problems, particularly clinical decisions, care access, and the efficiency of oncology treatments.

By assessing abnormalities, like tumors, recognizing distinguishable characteristics, and interpreting images from medical devices, machine learning (ML) tools, such as computer-aided detection (CADe) and diagnostic (CADx) systems, help doctors in diagnosing oral cancer. By fusing AI and computer vision technology, these systems interpret diagnostic images, such as X-rays, Magnetic Resonance Imaging (MRI), and Computed Tomography (CT) scans, providing valuable tools for early detection. AI has proven to execute precision oncology and predictive analytics tasks accurately. Drug discovery is further supported by computational tools designed to lower costs using deep neural networks and machine learning. These approaches improve cancer care efficiency and diagnostic accuracy by giving researchers access to valuable resources (21).

7. Ethical and Regulatory Concerns

Implementing AI in OC diagnostics presents significant ethical and regulatory dilemmas. Moral issues, such as privacy and confidentiality breaches, data and model bias, peer dissent, the responsibility gap in decision-making, deterioration of patient-clinician rapport, and threats to patient autonomy, have significantly constrained the widespread adoption of these models in routine clinical practices (16). These concerns highlight the need for trust, transparency, and inclusiveness in AI-assisted clinical decision-making. The challenges in integrating Al into OC diagnostics can be categorized as follows:

7.1 Technical Challenges

The lack of standardization in image acquisition and annotation, small dataset sizes, and limited external validation present significant barriers to clinical implementation. Most smartphone-based diagnostic tools are not yet clinically validated, and their diagnostic performance varies significantly depending on image quality, lighting, and the smartphone model used. Nonetheless, smartphone-based AI diagnostics are highly promising due to their affordability and portability, particularly in low-resource settings with limited specialist access. They offer the potential to enable point-of-care screening and promote early detection. However, their reliability remains a concern until such tools are rigorously validated and standardized (12).

7.2 Ethical Challenges

The lack of diversity in training datasets raises concerns about model generalizability and fairness. Inadequate representation of different ethnicities, lesion types, and clinical settings can lead to biased predictions and unequal outcomes. Ethical concerns limited the potential use of these models in actual practices. These concerns include privacy and confidentiality, data and model bias, peer disagreement, responsibility gap, patient-clinician relationship, and patient autonomy (18).

7.3 Regulatory Challenges

Many AI models for OC detection lack reproducibility, external validation, and adherence to quality assurance protocols. Global regulatory frameworks, such as the FDA’s Digital Health Software Precertification Program and the European Union’s CE marking process, have been introduced to address these gaps. These frameworks provide structure for evaluating AI-driven medical devices’ safety, effectiveness, and accountability (22,23). However, consistent global enforcement and harmonization remain a work in progress. In addition to these challenges, a significant issue lies in creating high-quality training datasets. Many AI studies also lack external validation and reproducibility, hindering real-world application. Developing open-access, biopsy-verified datasets through international collaboration and standardized imaging protocols could help overcome these limitations. Such efforts should be led by academic consortia, public health agencies, and industry stakeholders working in unison to ensure quality, diversity, and accessibility (2).

Despite these limitations, multiple studies have demonstrated the strong diagnostic performance of AI-based systems for OC detection. Sensitivity rates exceeding 85% and accuracy rates over 90% have been reported in models trained on approximately 1,000 oral lesion images. In one study, the diagnostic odds ratio (DOR) and sensitivity of AI applied to clinical photographs reached 77.772 and 0.939, respectively, confirming their potential clinical value. These findings support the continued refinement of AI tools and underscore the need to resolve technical, ethical, and systemic barriers to unlock their full potential in improving patient outcomes (2).

8. Future Directions for AI in Oral Cancer Detection

Future AI and OC detection advancements hold significant promise for addressing existing challenges. Radiomics, a rapidly developing field, utilizes radiographic images and data characterization algorithms to extract intricate features, such as intensity, shape, and surface texture from CT and MRI scans. However, standardization across imaging protocols and data interpretation remains a significant challenge, potentially limiting cross-institutional applicability. These details, often imperceptible to the human eye, provide oncologists with critical insights into tumor metastatic potential, oncogene expression, and treatment response. Furthermore, integrating multiple modalities, including clinical, radiological, histological, and molecular data through innovative data fusion algorithms, could enhance early diagnosis and improve outcome predictions (18).

Despite its promise, autofluorescence imaging faces several challenges for diagnostic purposes. Variations in hardware components, such as light sources, detectors, and filters, can result in inconsistencies in brightness, contrast, and color shifts. These factors affect diagnostic accuracy and emphasize the need for future AI algorithms to address device-related biases, ensuring more reliable and accurate results (12).

Additionally, neural networks have demonstrated potential in lesion classification. For example, ResNet, a high-performing architecture, has been used for image crop classification and later applied to classify entire lesion images. While the achieved accuracy is promising, advancing this technology requires increasing the quantity and quality of annotated images, improving segmentation and classification processes, and refining training metrics (11). Challenges, such as model overfitting and computational resource demands, must also be addressed to ensure scalable clinical applications.

A significant limitation in AI for OC detection lies in the datasets. Current datasets, such as those sourced from Kaggle, are small, lack standardization, and often fail to provide biopsy-based verification, limiting their generalizability. Developing open-access, biopsy-verified datasets through international collaborations and standardized imaging protocols could address these limitations. Addressing these issues through robust data augmentation techniques, such as discrete wavelet transforms, adaptive histogram equalization, and conventional methods, like rotation, flipping, and cropping, can improve image quality and model performance. Moreover, strategies to mitigate false positives and false negatives, such as incorporating follow-up assessments, robust testing, and expert oversight, are essential for ensuring accuracy and reliability. Despite these challenges, the transformative potential of AI in OC detection is clear. Future research must focus on building AI models that utilize larger, standardized, and reliable datasets while ensuring adaptability to diverse imaging conditions. This approach will refine diagnostic tools and enable early detection, ultimately improving patient outcomes (2).

Building on current advancements, enhancing the effectiveness of AI in OC detection requires developing models that integrate diverse datasets and modalities. Incorporating images captured in varied environments and standardizing shooting conditions will improve training data quality and ensure consistency. Future efforts will expand datasets to include data from normal oral mucosa and other lesions, such as those affecting the gingiva and buccal mucosa. Additionally, videos of the oral mucosa will be utilized to capture a broader array of features, further refining the detection model (17,16).

Machine learning and deep learning techniques demonstrate exceptional potential for identifying intricate patterns and biomarkers in complex datasets imperceptible to human observation. These methods aid clinicians in understanding the immune microenvironment of OC, facilitating personalized medicine through tailored immunotherapy selection and enhanced decision-making (4).

Moreover, AI can streamline workflows, improve diagnostic accuracy, and reduce cancer screening costs. Such advancements enable clinicians and patients to focus on meaningful communication and shared decision-making, elevating the overall quality of care. Future research must continue to refine AI-based algorithms and identify optimal imaging approaches for specific clinical applications (3,16).

9. Conclusions

In conclusion, integrating artificial intelligence into the detection and management of oral cancer, particularly oral squamous cell carcinoma and oral potentially malignant disorders, represents a significant advancement in the field of oral diagnostics. The application of AI technologies, including deep learning algorithms and imaging techniques, has demonstrated remarkable accuracy in diagnosing and predicting the progression of these conditions, thereby enhancing early detection and improving patients' outcomes. Despite the promising capabilities of AI, challenges remain, including the need for standardized protocols, validation of AI systems, and addressing ethical and regulatory concerns. Future research should focus on developing more diverse datasets and refining AI models to ensure their applicability across various clinical settings. By overcoming these obstacles, AI has the potential to revolutionize OSCC and OPMD screening, streamline diagnostic processes, and ultimately contribute to better health outcomes in populations, particularly in resource-limited environments.

In the GCC countries, the application of AI in healthcare is on the rise. Governments have invested in AI-driven healthcare solutions to enhance early diagnosis and detection of OC. This initiative aligns with national health strategies, supporting digital transformation in the medical field and improving the comprehensibility of progressive diagnostic tools.

Conflict of Interests

The authors declare that there are no competing interests regarding the publication of this review. No financial or personal relationships exist that could have influenced the work.

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