Student's Journal of Health Research Africa
Vol. 4 No. 12 (2023): December 2023 Issue
https://doi.org/10.51168/sjhrafrica.v4i12.892
Original article

# A SYSTEMIC REVIEW ON THE FUTURE OF OBSTETRICS AND GYNECOLOGY: HARNESSING ARTIFICIAL INTELLIGENCE.

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## ABSTRACT.

There is a burgeoning interest in the utilization of artificial intelligence (AI) within the realm of medical research, which exhibits considerable potential for forthcoming advancements. Obstetrics and gynecology encompass specialized disciplines that are associated with a heightened susceptibility to legal matters and suboptimal clinical outcomes. Multiple challenges exist in these domains, encompassing the comprehension of fetal physiology and the precise prognostication of prenatal and labor monitoring. The field of gynecology encounters intricacies within the realm of molecular biology, particularly in the comprehension of gynecological malignancies.
This review aims to explore the potential applications of AI within the field of obstetrics and gynecology. The present study aims to investigate the potential utility of AI in enhancing comprehension of fundamental principles within various domains, with a particular focus on its potential impact on the healthcare sector. In the realm of obstetrics and gynecology, AI exhibits considerable potential in tackling enduring obstacles and aiding healthcare providers in their decision-making processes.

**Keywords:** Artificial intelligence, Obstetrics, Gynecology, Medical research.
**Submitted: 2023-12-04 Accepted: 2023-12-05**

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## INTRODUCTION.

Obstetrics and gynecology encompass medical disciplines that frequently give rise to legal actions, culminating in significant compensatory disbursements. During the fiscal year of 2017-2018, the National Health Service (NHS) disbursed a total sum of £4,513.2 million as indemnity, primarily allocated towards addressing claims related to obstetric negligence, which accounted for 48% of the total amount. Additionally, a minor proportion of 2% was allocated to address claims about gynecological negligence. The aforementioned specialties constituted a mere 15% of the aggregate claims [1]. Obstetric-related medical errors, such as hypoxia-induced encephalopathy, may result in enduring adverse consequences. The involvement of misinterpretation of fetal monitoring is a contributing factor, with approximately 50% of cases being deemed preventable [2].
Gynecology encounters notable challenges, particularly in the timely diagnosis of gynecological malignancies, which subsequently influences the course of treatment and overall prognosis. Treatment decisions are frequently guided by the International Federation of Gynaecology and Obstetrics (FIGO) classification [3], which, despite its inherent limitations, serves as a valuable tool in clinical practice.
In the realm of women's healthcare, there exists a notable demand for assisted reproductive technologies, such as *in vitro* fertilization (IVF). The identification and resolution of obstacles, such as the process of embryo selection, necessitate the development of interventions aimed at enhancing the overall efficacy and triumph rates within the medical domain. The implementation of advanced genetic engineering techniques in the context of IVF necessitates the acquisition of novel insights to ensure enhanced precision and accuracy.
The utilization of conventional research methodologies, such as clinical trials and systematic reviews, is accompanied by inherent limitations, including financial constraints and temporal considerations. The present situation necessitates the implementation of a novel methodology utilizing artificial intelligence to effectively tackle research inquiries.

## METHODOLOGY.

This literature analysis aims to explore the applications of artificial intelligence (AI) in the field of obstetrics and gynecology, to address challenges and enhance the quality of patient care. This comprehensive review systematically examines and evaluates a multitude of peer-reviewed studies, research articles, and relevant material sourced from esteemed medical publications and databases. A comprehensive literature search was conducted using the databases PubMed, MEDLINE, Scopus, and Google Scholar to identify relevant publications. The search terms encompassed obstetrics, gynecology, AI, machine learning, computer vision, and natural language processing (NLP). To incorporate recent advancements in AI technology, the

scope of the search was limited to scholarly articles published within the timeframe of 2015 to 2023. The prioritization of English studies was undertaken, with a selection made based on the inclusion of titles, abstracts, and complete texts. The incorporation of AI in the field of obstetrics and gynecology encompasses various areas such as fetal monitoring, gynecological malignancies, assisted reproductive technologies, and personalized medicine. The present discourse emphasizes the investigation of AI-related fields, such as machine learning, natural language processing, computer vision, and artificial neural networks. The present study encompassed a comprehensive analysis of pertinent literature reviews, original research investigations, and illustrative case studies. The present methodology offers a comprehensive and exhaustive evaluation of the existing literature about AI in the field of obstetrics and gynecology. It elucidates how AI is enhancing the quality of patient care and facilitating clinical decision-making processes.

## Artificial intelligence: is this the way forward?

Artificial intelligence (AI) encompasses the utilization of intricate algorithms to facilitate cognitive processes in machines, enabling them to engage in activities such as problem-solving and decision-making. The composition encompasses four essential components, namely natural language processing, machine learning (ML), computer vision, and artificial neural networks (ANNs) [4].

Machine learning, a data-driven approach, is employed to forecast forthcoming events, exhibiting superior performance compared to conventional techniques like logistic regression, particularly in the realm of prognosticating occurrences of surgical site infections.

Natural language processing (NLP) facilitates the comprehension of human language by machines, even in instances where the linguistic input is not impeccably lucid. Artificial neural networks, drawing inspiration from the intricate workings of the human brain, are comprised of computational entities referred to as "neurons" [5]. The ability to accurately forecast outcomes, such as mortality in cases of acute pancreatitis, surpasses that of conventional scoring instruments.

Computer vision facilitates the comprehension of visual data, encompassing images and videos, thereby enabling machines to perform tasks such as facial recognition. For example, it possesses the capability to analyze laparoscopic videos with a notable degree of precision to discern and delineate the various stages involved in a medical procedure.

## Artificial intelligence in obstetrics.

Cardiotocography (CTG) is a diagnostic modality utilized to monitor the cardiac activity of the fetus as well as the uterine contractions, with the primary objective of detecting any potential hypoxia-related complications. It constitutes a pivotal determinant in the process of decision-making during childbirth. Nevertheless, it is imperative to acknowledge that CTG does possess certain limitations. The sensitivity of the method under consideration is suboptimal, with an approximate accuracy rate of 60% [6]. Moreover, the prevalence of human errors in the interpretation of CTG readings is notable, primarily attributed to interobserver variability. In essence, the interpretation of CTG may exhibit subjectivity.

The investigation conducted by researchers has delved into the potential utilization of machine learning (ML) in the realm of fetal monitoring and the subsequent process of decision-making. In a study conducted in 2010 [2], investigators employed ML techniques to examine the fetal heart rate variability and various other fetal activities. The aforementioned methodology successfully identified 50% of the instances exhibiting potential complications, while maintaining a minimal occurrence of false positive alerts. The integration of multiple parameters with heart rate variability yielded enhanced predictive capabilities.

In the year 2014 [7], a subsequent investigation employed an extensive CTG dataset to construct a decision tree model, specifically referred to as a random forest classifier. The utilization of a complex model resulted in an enhancement of the sensitivity and specificity of CTG interpretation to 72% and 78%, respectively.

In a study conducted in 2017, the integration of CTG data with additional variables such as maternal age and umbilical artery pH was employed to discern between unassisted vaginal deliveries and cesarean sections. Multiple ML algorithms were employed in this study, and it was observed that deep learning exhibited the most favorable outcomes in terms of sensitivity and specificity. Specifically, deep learning demonstrated a sensitivity of 94% and a specificity of 91%, surpassing the performance of previously utilized methodologies [6].

## Artificial intelligence in gynaecological.

In the realm of gynecological malignancies, the prognostication of clinical outcomes is presently contingent upon the utilization of the FIGO classification system. There is a burgeoning interest in the utilization of novel radiological and molecular markers in the context of personalized treatment.

In recent investigations, the ramifications of gene mutations, such as p53 and KRAS, on the development and progression of endometrial cancer have been examined. Radiological biomarkers, such as extramural vascular invasion, are currently being employed to classify pelvic tumors [8]. However, given the intricate nature of cancer development and progression, the attainment of personalized medicine continues to pose a formidable obstacle.

In response to this matter, there is ongoing development of AI algorithms. In this study, conducted by researchers at Imperial College London, AI was employed to meticulously

examine and analyze various characteristics derived from CT scans and molecular profiling data in the context of ovarian cancer. A radiomic prognostic tool was developed, exhibiting superior performance compared to conventional markers such as CA-125, in the prediction of chemotherapy resistance.

In the context of cervical cancer, a group of medical professionals employed a probabilistic neural network to forecast the 5-year survival rate after radical hysterectomy [9]. AI has been employed by researchers to devise a scoring methodology for cervical intraepithelial neoplasia (CIN) by leveraging HPV biomarkers and colposcopic observations. This approach has yielded notable outcomes, demonstrating elevated levels of sensitivity and specificity in predicting CIN2. The implementation of such a scoring system holds significant potential for enhancing the quality of patient care [10].

## The vision of personalised medicine.

The seminal work by Hanahan and Weinberg established a set of six fundamental principles in the field of cancer biology, which have since become the bedrock of contemporary molecular oncology. Adherence to these principles is of paramount importance in the progression toward individualized therapeutic interventions for every cancer patient.

Personalized medicine, also known as precision medicine, encompasses the utilization of an individual's genetic profile and comprehensive medical background to anticipate their susceptibility to diseases, prognosticate their health outcomes, and anticipate their response to therapeutic interventions. The identification of biomarkers that possess the capacity to prognosticate outcomes and inform therapeutic interventions is of utmost importance. Mutations in the *BRCA1* and *BRCA2* genes have been identified as crucial factors in tailoring treatment strategies for individuals diagnosed with breast cancer [11].

In prospective scenarios, the presence of mutations such as *KRAS* in endometrial cancer and WNT signaling in ovarian, endometrial, and cervical cancer may potentially serve as prognostic indicators for cancer advancement and facilitate the customization of therapeutic interventions for each patient [8].

The contemporary field of medicine is undergoing a paradigm shift, transitioning from a predominantly reactive approach to disease management towards a proactive strategy focused on prevention, individualization, and targeted therapeutic interventions. This necessitates an extensive compilation of data, encompassing pertinent details about proteins, genes, and patient attributes. Artificial intelligence is widely regarded as the principal modality for the analysis of intricate data in the field of cancer oncology, with the ultimate objective of attaining personalized medicine.

## Artificial intelligence in ivf.

The identification of a viable embryo poses a considerable obstacle within the realm of IVF, given its substantial impact on the likelihood of achieving a prosperous gestation. In the year 1997, Kaufmann *et al*. developed an artificial neural network (ANN) model, which demonstrated the capability to forecast the outcome of IVF procedures with an accuracy of 59%. This remarkable predictive ability was achieved by employing a concise set of four input variables, namely, the patient's age, the number of eggs retrieved, the number of embryos transferred, and the utilization of frozen embryos [12].

Nevertheless, the attainment of enhanced precision poses a formidable challenge owing to the numerous enigmatic variables that exert an influential impact on the triumph of IVF. These factors, imperative for the acquisition of knowledge by machine learning algorithms, present a significant obstacle. To enhance prognostic accuracy, researchers are leveraging extensive datasets, such as those generated through computer vision methodologies. Time-lapse imaging of embryos has been employed to collect comprehensive data. In a particular investigation, a notable achievement was made wherein the analysis of 386 time-lapse images of single blastocyst transfers resulted in the attainment of an accuracy rate of 83% in the prediction of live births [13]. In a recent investigation, a comprehensive analysis was conducted on a substantial dataset consisting of 50,392 images derived from 10,148 embryonic specimens. The primary objective of this study was to discern the quality disparity between suboptimal and optimal blastocysts with utmost precision. Remarkably, the findings exhibited an impressive accuracy rate of 97.53% in successfully distinguishing between these two distinct categories [14]. In a recent study, researchers employed pre-treatment data from preceding cycles to prognosticate the likelihood of achieving favorable outcomes in the initial cycle, yielding an accuracy rate of 81% [15].

## DISCUSSION.

Artificial intelligence (AI) has emerged as a prominent subject of interest, garnering significant attention across various medical disciplines. The considerable anticipation surrounding its implementation has led to a surge in funding for AI research, indicative of the growing enthusiasm in this field. AI exhibits considerable potential as a valuable tool within the field of obstetrics and gynecology, offering promising solutions to address various enduring challenges that have persisted over time. The present review ascertains that AI possesses the capability to enhance knowledge and provide aid to clinicians in the process of decision-making across a diverse range of domains within the field of obstetrics and gynecology. The utilization of AI has the potential to enhance the interpretation of CTG and improve our understanding of fetal physiology in the field of

obstetrics. This advancement holds promise in reducing the occurrence of unfavorable outcomes. In the field of gynecology, AI can elucidate the intricacies of the molecular biology underlying gynecological cancer. As a result, it can contribute to the realization of personalized medicine objectives.

## LIMITATIONS.

The narrative evaluation acknowledges certain limitations. First, while using a formal keyword strategy, this article has only reviewed papers that follow a rigorous research technique and are essential for understanding the area. A large part of the integrated studies used experimental data with limited or no clinical application. A few studies had small sample sizes, while others overrepresented data. *In vitro* fertilization (IVF) studies lacked clarity on machinery training and AI architecture. Additionally, medical AI's limits must be acknowledged. Systemic biases and poor data labeling influence outcomes. The ultimate success of artificial intelligence (AI) depends on large datasets, therefore scientific advancements depend on fast data availability.

## SUMMARY.

This review aims to assess the potential impact of artificial intelligence (AI) in the field of obstetrics and gynecology on healthcare delivery. There is a need for improvement in the domains of obstetric neglect and the diagnosis of gynecological cancer. The article suggests that the integration of AI components, such as machine learning and natural language processing, has the potential to bring about transformative changes in the field of healthcare. The present discourse pertains to the constraints associated with fetal monitoring in the field of obstetrics and elucidates the potential of machine learning (ML) techniques in enhancing the precision of such monitoring. This is substantiated by a comprehensive analysis of relevant studies, which demonstrates a notable augmentation in both sensitivity and specificity. The present discourse delves into the involvement of AI in the realm of gynecology, specifically in the utilization of CT scans and molecular profiling to diagnose cancer and tailor treatment plans to suit the unique needs of each patient. The utilization of AI in the context of IVF to discern viable embryos is also underscored. AI has the potential to enhance fetal monitoring and facilitate the diagnosis of gynecological cancers, thereby mitigating adverse outcomes.

AI facilitates the implementation of treatment regimens that are tailored to an individual's genetic and medical history. The process entails the selection of viable embryos. Additionally, the implementation of improved diagnostic techniques and the development of comprehensive treatment plans have the potential to mitigate legal and adverse healthcare outcomes, thereby potentially decreasing associated financial burdens. The utilization of AI in scientific investigations has the potential to yield significant advancements in the field of medicine. In summary, the implementation of AI holds great potential for enhancing the provision of obstetrics and gynecological care, thereby leading to improved patient outcomes. The imperative for further investigation and integration of AI into these domains is paramount.

## RECOMMENDATIONS.

Given the potential of AI to enhance understanding of obstetrics and gynecology, it is recommended that educational institutions incorporate AI-driven modules into medical curricula. This would empower future healthcare professionals with the knowledge and skills needed to leverage AI for improved patient care and outcomes. Encouraging collaborative research endeavors between AI experts and healthcare professionals in obstetrics and gynecology can lead to innovative AI applications. Such partnerships should be fostered to expedite the development and implementation of AI solutions addressing specific challenges in these specialized fields.

## ACKNOWLEDGMENT.

We acknowledge the invaluable contributions of researchers, healthcare providers, and AI experts whose work has paved the way for exploring the potential of artificial intelligence in obstetrics and gynecology. Their dedication to advancing medical research and healthcare practices is instrumental in shaping the future of these disciplines.

## LIST OF ABBREVIATIONS.

| | | |
|---|---|---|
| AI | : | Artificial Intelligence |
| IVF | : | In Vitro Fertilization |
| NHS | : | National Health Service |
| FIGO | : | International Federation of Gynaecology and Obstetrics |
| NLP | : | Natural Language Processing |
| ML | : | Machine Learning |
| ANNs | : | Artificial Neural Networks |
| CTG | : | Cardiotocography |
| CIN | : | Cervical Intraepithelial Neoplasia |

## CONFLICT OF INTEREST:

None

## SOURCE OF FUNDING:

The study had no funding.

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**Publisher details.**

**Publishing Journal: Student's Journal of Health Research Africa.**
**Email: studentsjournal2020@gmail.com or admin@sjhresearchafrica.org**

**(ISSN: 2709-9997)**

**Publisher: SJC Publishers Company Limited**
**Category: Non-Government & Non-profit Organisation**
**Contact: +256775434261(WhatsApp)**
**Email: admin@sjpublisher.org**
**Website: https://sjpublisher.org**
**Location: Wisdom Centre Annex, P.O. BOX. 701432 Entebbe, Uganda, East Africa.**