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Explainable Artificial Intelligence in Gynecology and Obstetrics

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Abstract

Explainable Artificial Intelligence (AI) is having an increasing interest within several industry sectors, including the medical domain, and particularly for gynecology and obstetrics. This article presents some real use-cases within this context that are covered by the literature.

Abbreviations: AI: Artificial Intelligence; XAI: Explainable Artificial Intelligence; WSIs: whole slide images

Introduction

Artificial Intelligence (AI) is growing exponentially within different industry sectors, including obstetrics and gynecology [1], where its usage can be found in several sub-fields. For instance, it can be used for detecting potential pregnancy complications, assisting gynecological surgery, or by the usage of computational systems that aid pathologists during cancer screening.

However, several traditional AI approaches have only focused on developing accurate systems, that while being very precise, they are black boxes that do not provide any insights about the decision reached. With these approaches, an AI system could effectively detect cancer on an image, but without giving any reasons about why. This is the reason why Explainable Artificial Intelligence (XAI) has emerged recently as a field, aiming to complement the decisions of an AI system with an explainability layer that offers actionable insights about the model outcome [2].

AI models can either be opaque systems that do not provide any information about their inner decision process, or they can be what is known as "white-box" models, where they provide a mathematical justification about it. None the less, XAI aspires to go beyond that and, regardless of the AI model, generate explanations that take into account the audience that will receive them (e.g., a medical doctor or a patient), that are aligned to prior domain knowledge [3], that are easy to understand [4], and that are useful and actionable. This is indeed an important aspect to include in many industry AI systems, and the best approach is to consider it from the beginning of their life cycle [5], since additional use cases can be discovered by using this strategy.

XAI is especially important within the medical domain because doctors need to trust the model decisions in order to consider them as a reliable source of information [6]. Due to this, XAI is appearing more often complementing other AI approaches in this field. This is the case of medical imaging, where AI has already been useful for cases like ultrasound imaging for gynecology and obstetrics [7] for tasks such as prove guidance, fetal biometric plane finder, anomaly scan completeness and anomaly highlighting, or cyst classification. For many of these tasks, the traditional AI approach will only provide an output (e.g., there is an anomaly or not), but with XAI, this is complemented with reasons behind that. This is the case of [8], where the authors work with whole slide images (WSIs). They propose a system called HistoMapr-Breast, a software tool based on XAI for breast core biopsies, that automatically sees breast core WSIs and provides a diagnostic over the image (e.g., 'Atypical Ductal Hyperplasia') that includes highlights over the image that indicate the regions in the WSIs that are associated to the diagnostic, indicating the key findings (e.g., apocrine & atypical nuclei). The system is also transparent by including a confidence in the diagnostic and has a "doctor-in-the-loop" approach by asking the doctor about whether the diagnostic is correct or incorrect.

Besides medical imaging, XAI has also been used for purposes like assisting breast cancer therapies [9]. The authors present a XAI-based framework, where the system collects patients' medical records (e.g., biomarkers), automatically outlines the most important clinical features for oncological patient profiling, and

performs a clustering over the patients, in order to associate each of them with a particular patient profile.

Another XAI use-case is its usage for safe intraoperative decision support [10]. Here, the authors present a XAI approach the provide surgeons with real time alerts about upcoming intraoperative events (e.g., bleeding), in order to augment their clinical judgement, based on real-time information, such as the vital signs of the patient. With this, surgeons have a complementary tool, so they can decide whether to take actions based on the recommendation and explanations provided by the AI system, or not. A XAI support similar to this has been proven useful in order cases, such as aiding anesthesiologists for the prediction of hypoxemia, as shown in [11], where their predictions increased from 15% to 30% thanks to using the explanations provided by the XAI system. With this, we see several uses cases where XAI has been useful for helping professionals within the medical domain. Even though there are still aspects within XAI that need further research (such as providing causal explanations or measuring the quality of the explanations [12]), right now XAI offers many possibilities, and is already helping within real-world use cases.

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