**Endometriosis early detection**

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A blue glowing uterus

Description automatically generated

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# Background

Endometriosis, a chronic inflammatory condition, primarily manifests through symptoms such as pain and infertility [1]. It occurs when tissue resembling the uterine lining grows outside the uterus, adhering to pelvic organs, and occasionally other areas of the body. This abnormal adhesion triggers inflammation and the formation of scar tissue, resulting in debilitating pain and, in some instances, infertility. Endometriosis predominantly affects women of reproductive age, with research suggesting that approximately 5-10% of this demographic, totalling around 180 million individuals globally, are affected [2].

Main known indicators of the endometriosis include:

* Pelvic pain and/or lower abdominal pain
* Painful menstrual cramps
* Abnormal menstrual bleeding pattern (either by amount or irregularity)
* Family history [3]
* Infertility [4]

Diagnosing endometriosis presents a challenge since adhesions are not always detectable through imaging techniques like ultrasound or MRI. Typically, a definitive diagnosis necessitates undergoing laparoscopic surgery [3] and a subsequent biopsy.

Problem Statement  
Our primary objective revolves around the prompt identification of endometriosis. Remarkably, 60% of women dealing with endometriosis navigate consultations with three or more clinicians before receiving a diagnosis, leading to an average delay of seven years before definitive diagnosis [5]. This prolonged delay intensifies symptoms, lowers overall quality of life, and contributes to enduring reproductive health challenges. Conventional diagnostic methods, predominantly reliant on invasive procedures and subjective assessments, further complicate the diagnostic process.

# Proposed Solution

This project endeavors to aid in diagnosing endometriosis by analyzing patient data. We will collect data on endometriosis and healthy patients from the UK Biobank and select a group of features (symptoms and risk factors) from which we will try to detect the existence of endometriosis. Our primary goal is to build the optimal machine-learning model for accurate endometriosis detection based on the features we found.

# Introduction

## Machine Learning

Machine learning, a subset of artificial intelligence, revolutionizes medical research by extracting insights from vast datasets to enhance diagnostic accuracy, treatment efficacy, patient outcomes, and identifying risk factors. There are two primary subcategories of machine learning - supervised and unsupervised learning.

Supervised learning algorithms use labeled data to train models to predict outcomes or classify instances, offering valuable insights into disease detection and prognosis.

Unsupervised learning techniques uncover hidden patterns within unlabeled data, enabling researchers to identify unexplored disease subtypes or biomarkers.

Deep learning, a subset of machine learning, utilizes neural networks with multiple layers to automatically extract complex features from raw data, paving the way for advanced image analysis, genomic sequencing, and complex medical issues.

With the integration of these machine learning paradigms, medical researchers unlock unprecedented opportunities to unravel the complexities of diseases, revolutionizing healthcare delivery.

## Endometriosis

Endometriosis, a prevalent chronic gynecological condition reliant on estrogen, concerns the presence of uterine endometrial tissue outside its normal cavity. This disorder is characterized by the presence of endometrial tissue outside the uterus, leading to pelvic pain and fertility issues.

## UK BioBank [6]

UK Biobank is a large-scale biomedical database and research resource, containing in-depth, de-identified genetic and health information from half a million UK participants. The database, which is regularly augmented with additional data, is globally accessible to approved researchers and scientists undertaking vital research into the most common and life-threatening diseases. UK Biobank’s research resource is a major contributor to the advancement of modern medicine and treatment and has enabled several scientific discoveries that improve human health.

# Solution Description

Stage one: Feature Selection

The first step of our research was to find the features we would like to try and detect endometriosis by. We have sorted the features into groups:

**General Features**

The general features include:

* Gender
* Age at recruitment
* Year of birth
* Weight/BMI

\* **check if there are male patients with endo in the dataset:** We will use the gender feature to first eliminate male patients. As endometriosis

We chose to include weight\BMI as features because we have found several research papers stating there is an inverse relationship between BMI and the risk of endometriosis, meaning endometriosis is more commonly associated with lower BMI [7].

The year of birth and age at recruitment features will help us infer which of the other features are relevant to our goal. Endometriosis mainly effects women of reproductive age, meaning data of patients over this age group may not be relevant.

**Pain Indicators**

One of the most recognizable symptoms of endometriosis is reported to be unusually painful periods, and pelvic pain in general. Research shows that 45% of patients with chronic pelvic pain also have endometriosis [8]. Other pain related symptoms that are usually associated with endometriosis include:

* Lower abdomen pain
* Back pain
* Hip pain
* Recurring Headaches and migraines

We have added these symptoms, including pelvic pain and menstruation pain as features.

**Infertility**

Research shows that 30% of patients with infertility have endometriosis. Researchers believe the two are connected, meaning endometriosis might cause fertility issues in some of the patients, depending on the severity (stage) of the endometriosis [8].

**Contraception:**

**Menstruation:**

**Diet:**

**Pregnancy:**

**Mental state:**

**Related diseases:**

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