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An Enhanced Framework for Postpartum Depression Diagnosis

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ABSTRACT

Postpartum depression (PPD) is a serious mental illness that affects women after childbirth. Identifying the illness accurately depends on the method that is used in diagnosis. As such, a model that accurately predicts PPD is needed to overcome the negative impacts of this illness on nursing mothers. Results obtained from human experts revealed further complexity issues in handling manual tools like the EPDS questionnaire by patients or caregivers. The dataset comprising symptoms that serve as indicators of the illness and expected outcomes was broken into dependent (y) and independent (x) variables respectively while following the Quasi-experimental methodology and tools like Python and Anaconda navigator open source package/libraries. The neural network algorithm was trained with 75% of the datasets (n=1500) obtained and then tested with the remaining 25%, this successfully yielded a 0.98% accuracy level and 100% prediction score for any PPD type. Given the subtleness, associated risk and complexity of the subject, more research is necessary to further explore other effective tools in artificial intelligence to tackle this health scare.

Keywords: Postpartum Depression (PPD), Diagnosis, Symptoms, Mood Disorder, Pathogenesis etc.

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1. INTRODUCTION

Medicine is a broad field with several branches ranging from surgery, mental health, dentistry, physiotherapy, obstetrics and so many other important parts that require proper diagnosis in order to provide needed treatments early. However, fast and accurate diagnosis coupled with prompt treatments are hallmarks of present day medical procedures such that several developments and innovations have been introduced into the medical field with information communication technology (ICT) related interventions ranging from nanotechnology, artificial intelligence and web-based systems being put into great use for ensuring delivery of quality healthcare services. Significantly, mental health constitute a major aspect of the medical field with overall cognitive, behavioral and emotional well-being of a person. Commonly, mental illnesses like depression have affected over 300 million people worldwide (WHO, 2017). This can negatively affect someone's feeling, thinking, behavior, ability to function. Symptoms of depressions include feeling sad, lack of interest in games or activities previously enjoyed, weight loss, insomnia, fatigue, feeling worthless, suicidal thought and extreme difficulty in thinking or making decisions (DelRosario *et al.,* 2013).

In the same vein, Postpartum Depression (PPD) is a kind of depression that occurs after delivery and comprises a major mental health problem that affects an estimated 13-19% of nursing mothers (O'Hara *et al.,* 1991). Postpartum depressive disorder is a developing public health issue among pregnant women and nursing moms that has received little attention, particularly in primary health care (PHC) level. Some investigators have reported a PPD prevalence of 10–15% in developed world and about 22% in developing countries. Although the exact cause of PPD is yet unknown, hormonal changes during the postpartum period, particularly the sharp decline in progesterone, estradiol, and estriol, may play a contribution (Soares and Zitek, 2008).

The risk factors of postpartum depression are usually previous incidence of depression or anxiety during pregnancy, stressful recent life events, poor social support, childcare stress, low self-esteem, and difficult infant temperament. Other factors might be having a single spouse, having a bad connection with your partner, and having a lower socioeconomic standing, including money. Incidence of PPD had no relationship with maternal age, parity, gender of child, level of education or ethnicity (Thurgood, 2009). Maternal PPD interferes with the affection between mother and child, and therefore, impedes the development of the child (Earls, 2010). Such impediments include negative effects on cognitive development and social–emotional development of the child (Marian, 2010). According to McLennan and Kotelchuck (2010), the family may be rife with vices including child abuse and neglect, domestic violence, divorce, etc. Clinical symptoms are used to make the diagnosis of PPD, and most psychiatrists frequently miss it.

Several studies exist on predicting Postpartum depression using depressive symptoms which either applied rule-based methods or machine learning methods with time frames and implemented as web-based systems (Mufidati *et al*., 2021; Andersson *et al*., 2021). Similarly, several predictors like palpitations, mood disorder or swing and other mental disorders which if low go unnoticed by the care provider and an implementation of a data-driven primary intervention approach using machine learning may be leveraged on to reduce the healthcare provider burdens in identifying PPD (Zhang *et al*., 2020). In this study, an expert system for the diagnosis of postpartum depression disorder will be developed whose inference system is made intelligent based on the machine learning algorithm (i.e. Artificial neural network) applied such that it is able to accept response from users (clinician or patient) through prompted displayed symptoms in a simplified format.

2. POSTPARTUM DEPRESSION

Postpartum depression (PPD) was described by the American Psychiatric Association as experiencing a mild or significant depressive episode while pregnant or up to one year after giving birth. The frequency of PPD ranges from 7 to 20%, but most studies suggest rates between 10 to 15% (Gavin *et al*., 2005).Lifetime risk is 10 to 25%, risk at two months postpartum is 5.7%, and at six months postpartum is 5.6% (Gaynes *et al*., 2005). The strongest risk factor for PPD is a history of postpartum major depression prior to or during pregnancy; in fact, Depression is the commonest psychiatric diagnosis among women with post-partum mental health disorders in most study. Other important risk factors include antenatal depressive symptoms (Milgrom *et al*., 2008), low level of social support, major life events or stressors during pregnancy, low socioeconomic status, and obstetric complications (Fitelson *et al*., 2011).

Untreated maternal illness disrupts the early mother-infant relationship and also contributes to short and long-term adverse child outcomes (Murray and Cooper, 1997). It also has negative effects on children including increased risk of impaired mental and motor development, infant cognitive competence, poor self-regulation, and low self-esteem and behavior problems (Field, 2010).

Insufficiently addressing depression places women in jeopardy of experiencing the consequences of untreated mood disorders, potentially leading to a chronic, recurring, and resistant form of depression.PPD is classified by the DSM-IV-TR as a subtype of major depressive disorder rather than as a separate diagnosis. Anxiety or irritability, lack of or excessive worry for the infant, lack of or disturbed sleep beyond that needed for baby care, poor concentration, poor appetite, and sorrow or loss of interest are all signs of postpartum depression. Within four weeks of delivery, it starts. Up to 50% of new moms have recurrence (Stowe *et al.,* 2005). According to Rai *et al*. (2015), Postpartum Disorders were earlier classified into: (i) Postpartum blues (PBs) (ii) Postpartum depression (PPD) (iii) Postpartum psychosis (PP) this was an oversimplification as there were some miscellaneous groups of anxiety and stress-related disorders occurring in peurperium. Postpartum illnesses have therefore been divided in recent years into five main categories: (i) Post-partum blues, (ii) Post-Partum Depression, (iii) Post-Partum Psychosis, (iv) Post-Partum Anxiety, and (v) Post-Partum Obsessive Compulsive Disorder (OCD). Table 1 shows the characteristics or symptoms of the different postpartum disorders and the different categories of Postpartum mood disorder respectively.

Table 1: Some Characteristics or Symptoms of the different Postpartum Disorders

S/N	POSTPARTUM DISORDERS	SYMPTOMS
1	Postpartum Blues	Tearfulness, anxiety, poor appetite, insomnia, mood swing, confusion
2	Postpartum Depression	Tearfulness, Insomnia, mood swings, anxiety, poor appetite, irritability, fear of harming the baby, depression, suicidal thoughts, fatigue, restlessness, loss of motivation
3	Postpartum Obsessive Compulsive Disorder(OCD)	Obsessions/intrusive thoughts, compulsions, hyper vigilance, anxiety
4	Postpartum Post-Traumatic Stress Disorder/Anxiety	Tension, nightmares, flashbacks, irritability, anxiety, insomnia, hyper vigilance
5	Postpartum Psychosis	Mood swings, confusion, Insomnia, poor appetite, auditory hallucinations or delusions, hyperactivity

2.1 Categories of Postpartum Mood Disorders

i. **Postpartum Blues or Baby Blues:** The baby blues affect between 50% and 75% of people after delivery. You will cry for extended periods of time frequently and for no apparent reason if you experience the baby blues, along with unhappiness and anxiousness. One to four days after delivery is when the problem typically manifests itself in the first week. Despite the unpleasantness of the situation, it normally goes away on its own after two weeks. The best course of action is to approach friends, family, or your spouse for support and assistance.

ii. **Postpartum Depression:** Postpartum depression, a considerably more severe condition than the baby blues, impacts approximately 1 in 7 new parents. A patient's risk escalates to 30% with each subsequent pregnancy if they've previously experienced postpartum depression.

You might encounter fluctuating emotional states, frequent bouts of crying, heightened irritability, and persistent fatigue. Additionally, feelings of guilt, anxiety, and a sense of incapacity to care for both your baby and yourself may arise. Symptoms can vary in intensity, ranging from mild to severe, and may manifest shortly after delivery or gradually, extending up to a year later. Despite the potential duration of symptoms, both psychotherapy and antidepressant medications prove highly effective in treatment.

iii. **Postpartum Psychosis:** Postpartum psychosis represents an extremely severe manifestation of postpartum depression, necessitating immediate medical attention. This condition is relatively uncommon, affecting only 1 in every 1,000 individuals following childbirth. The symptoms typically manifest shortly after delivery, are of a severe nature, and persist for several weeks to months. Indications include heightened agitation, confusion, a sense of helplessness and shame, sleep disturbances, paranoia, hallucinations or delusions, excessive activity, rapid speech, or manic behavior. Given the elevated risk of self-harm and potential harm to the infant, prompt medical intervention is imperative for postpartum psychosis. Treatment often involves medication, therapy, and, in some cases, hospitalization..

iv. **Postpartum obsessive compulsory disorder (OCD):** though not very common, but affecting more than 3% new moms. It is an anxiety disorder that can begin around the time of childbirth, causing women to experience unwanted thoughts or repeated behaviors called obsessions and compulsions. It is occasionally misinterpreted, as some new mothers may not exhibit a full-fledged case of OCD but could still manifest certain symptoms. Possible risk factors for this condition include a personal or family history of OCD or anxiety, as well as hormonal fluctuations during and following pregnancy.

v. **Postpartum post-traumatic stress disorder (PP-PTSD):** it is an anxiety disorder that develops as a direct consequence of a difficult or traumatic childbirth. Potential risk factors associated with postpartum post-traumatic stress disorder (PP-PTSD) encompass childhood sexual abuse, intimate partner violence, limited social support, instrumental birth, and caesarean section (Liu *et al*., 2021).

2.32 Issues affecting Postpartum Depression

Postpartum is a period of emotional and psychological upset for a woman's life . The risk of psychological impairment is increased by ten during the course of the puerperium and one woman out of ten will develop postpartum psychiatric disorders (Rezaie-Keikhaie *et al*., 2020). During this time, the new mother must adjust to her baby's company and also grow to understand her role to the child. For the woman to successfully adjust to motherhood, these psycho-affective processes are crucial (Virginie and Michel, 2019). However, many recently delivered mothers report experiencing psychological strain, environmental stress, mood swings, and emotional instability a few days after giving birth. These come together with behavioral issues such sudden irritation, sobbing, disregard for the infant, unwillingness to breastfeed, and nursing care.

Theoretically, this pain might be attributable to the hormonal changes that occur after delivery and the psychological adjustments related to training for the new circumstance that pregnancy represents. Psychological abnormalities result from these adaptive mechanisms failing or being threatened, with the baby blues being the most severe. The baby blues, sometimes referred to as pregnancy blues or postpartum blues, are minor, temporary, and physiological mental impairments that happen within the first two weeks after birth.

It represents one of the earliest and most prevalent mental disturbances during the postpartum period (Rezaie-Keikhaie *et al.,* 2020). The diagnosis primarily hinges on the identification of the baby blues syndrome, previously referred to as postpartum sadness syndrome. The baby blues are often characterized as minor and short-lived, whereas postpartum depression is recognized as a distinct and more severe depressive condition (Rezaie-Keikhaie *et al.,* 2020). These psychological disorders occurring in the postpartum phase can have repercussions on the mother-child relationship, impact the psycho-emotional and neurological development of the child, and tarnish the expected joyous atmosphere associated with the arrival of a newborn.. These may justify the necessity for an early recognition in order to ensure mother and baby wellbeing which is necessary for the baby's development. Epidemiological data over the frequency of postpartum blues and postpartum depression vary a lot from one country to another. This could be due to non-specificity of diagnostic criteria and diversity of measurement means (Virginie and Michel, 2019).

3. METHODOLOGY

This research utilized the quasi-experimental research design method. Similar to experimental designs, quasi-experimental research methodologies explore causal hypotheses. The Quasi-experimental designs aim to identify a comparison group that closely matches the treatment group in terms of baseline (pre-intervention) characteristics. Notably, this research did not involve direct observation of patients with postpartum stress disorder. Instead, the research utilized examples provided by medical practitioners from previous clinical studies, which illustrated various combinations of independent variables and their respective outcomes. This approach align with the principles of a quasi-experimental design, as it utilizes existing datasets without conducting new clinical studies on postpartum stress disorder.

3.1 The Existing System

An information system for the detection and treatment of postpartum depression was suggested by Mufidati *et al*. (2021). In order to diagnose postpartum depression, the study used a rule-based method, and the symptoms were inputted to an expert system. Only three types of postpartum depression, including suspected postpartum depression, suspected mild postpartum, and postpartum blues, could be distinguished by the model. Out of the three cases the system could only identify one type of postpartum depression (baby blue) and was extremely specific; the other forms lacked a categorical nature. In this information system, the diagnosis was made using the answers to the necessary questions provided by patients. The patient's diagnostic findings were contrasted with suggested courses of treatment. After using any browser to access the website, users visit the home page.

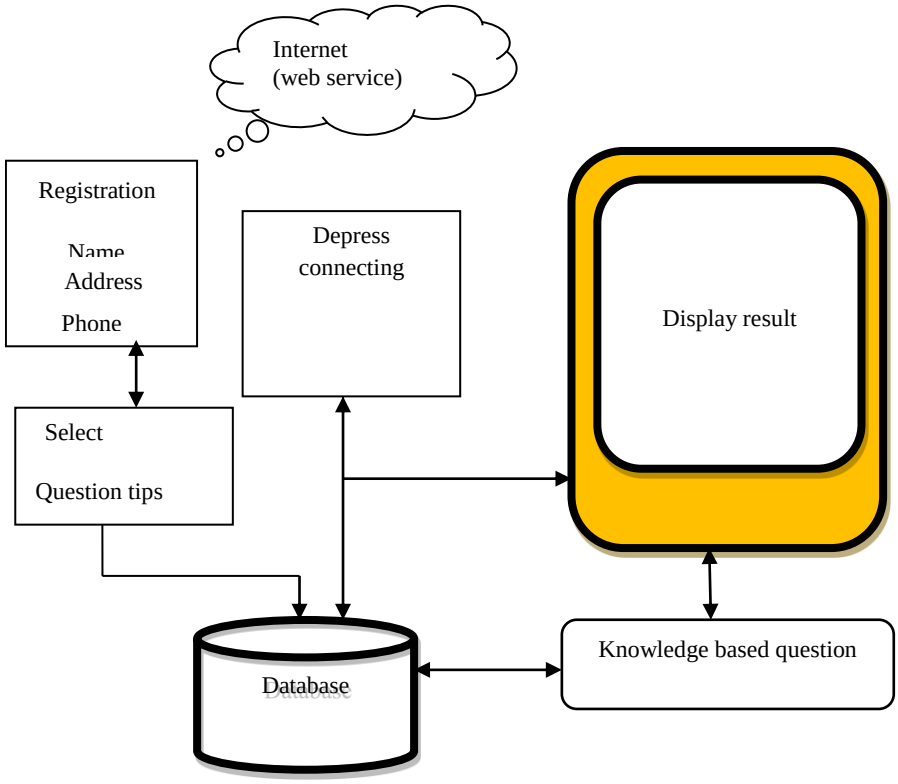

Figure 1: Architecture of the Existing System (Mufidati *et al*., 2021)

3.2 Limitations of the Existing System

The existing study has the following challenges:

i. Inability to categorically indicate the type of depression the patient is suffering from: the output of the application shows that a patient is depressed with postpartum blues, suspected postpartum depression, and suspected minor postpartum. It does not show the level of severity of postpartum depression.
ii. Since the application cannot categorically state the type of depressions, the health care personnel (particularly where there are no qualified personnel) may not be able to use the application to diagnose postpartum depression accurately.
iii. Users of the application will have to logon to the net to answer questions before the system will diagnose the status of a patient means that those patients that who do not have access to the internet or are not computer literate will not be able to use the application. When a patient has postpartum depression she may not be able to answer online objective questions accurately.
iv. Patients need to have knowledge of computing before they can access and use it. To be able to use the current model, users must first register on the registration menu and filling out characteristics bio-data. Afterwards, users can log in with their user name and password on the main menu. This is only possible for literate users with appropriate IT skills
v. Unregistered users cannot gain access from the main menu and hence, cannot perform screening for postpartum depression.

3.3 The Current System

The current system is a python application consisting of 1,500 dataset of independent and dependent variables. The training datasets were put together with the assistant of medical doctors who are familiar with management of postpartum depression. In this study, users can input symptoms experienced by the patient. The Machine Learning algorithm will classify the output based on the type of signs and symptoms inputted into the system. By specifying test size = 0.25, 25% of the total datasets were used for testing and 75% of the datasets for training. After training and testing the Machine Learning algorithm, the system was able to properly predict the dependent variable when a new independent variable is inputted in the system at run time for a patient suspected of postpartum depression. The system then classifies the independent variable accordingly as either baby blue, obsessive compulsive disorder, postpartum depression, postpartum stress disorder, psychosis or no depression, accordingly. Figure 2 shows the architecture of the current system, the program is first loaded, after which it presents the user with symptoms one after another to which the user gives responses as 'Yes/No'. When the responses have been given the inference system matches those responses with the facts on the database which interacts the machine learning algorithm(ANN) that has been trained with datasets obtained for accuracy and a diagnosis is given from which the user (clinician or care giver) can make proper treatment recommendations.

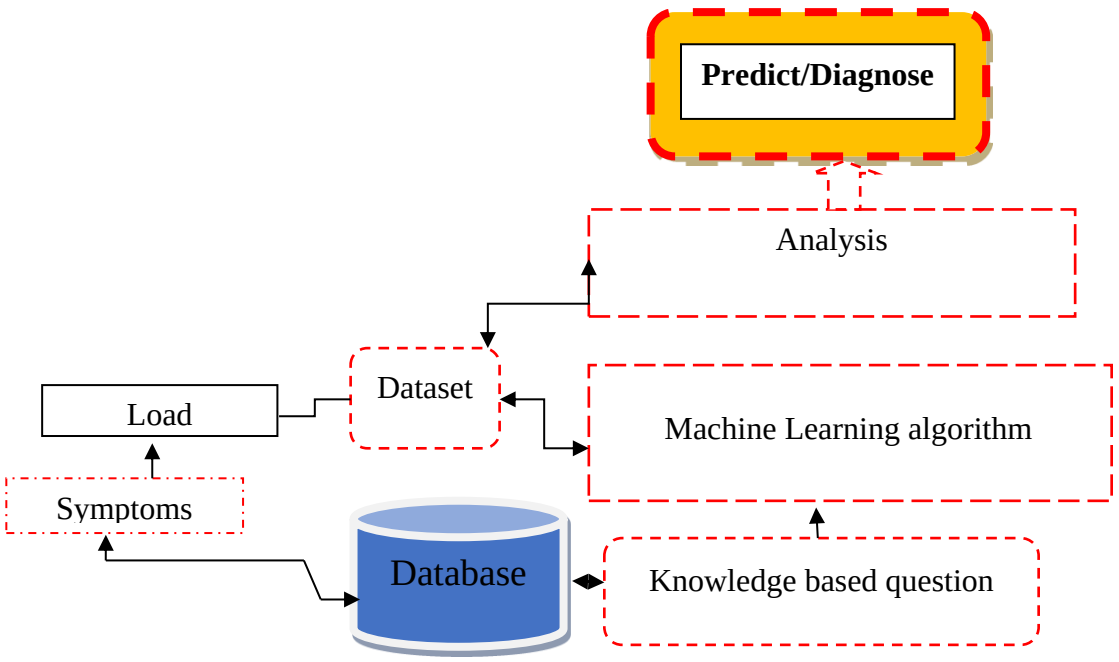

Figure 2: Architecture of the Current System

In the proposed model, five types of postpartum depression was identified with the ANN Machine Learning algorithm as shown in figure 3 below. They include:

i. Baby blue
ii. Obsessive compulsive disorder

iii. Post partum depression
iv. Post partum stress disorder
v. Psychosis.

All of the postpartum depression cases that can be diagnosed with our model are categorical in nature. Also the patients do not need to log online to access any website and answer question. Management of our model to diagnose postpartum depress is done by a trained medical personnel. The medical personnel obtain relevant data by both observation and interview with the patients. The signs and symptoms presented by the patient will first be converted into numerical form before inputting same into the ANN classification algorithm. Based on the training the algorithm has undergone, the system will automatically produce the kind of postpartum depression (dependent variable) after receiving the signs and symptoms. The system will present this data if the patient is not depressed. The classification algorithm's (ANN) accuracy will also be shown.

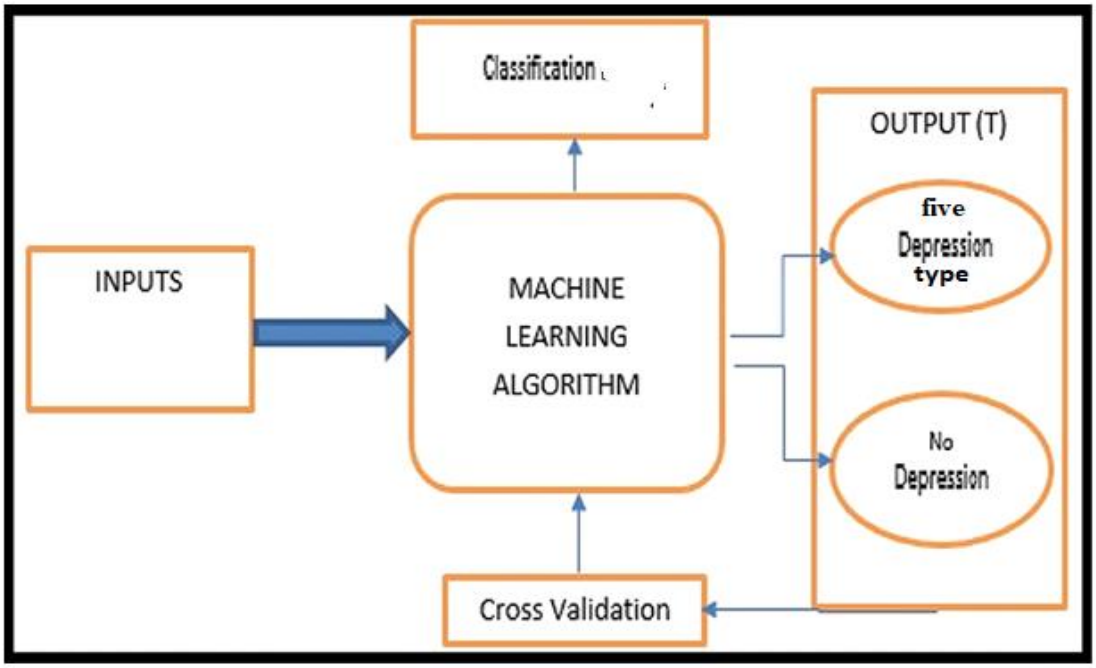

Figure 3: Updated model for Depression Classification

3.4 Advantages of the Current System

We developed the machine-learning model for this research after series of interview with the relevant stakeholders in postpartum healthcare delivery system. We also addressed all the limitations of the existing study as follows:

i. Categorization of the type of postpartum depression: From the discussion, we had with the relevant authorities the application was programmed to output the actual type of depression (baby blue, psychosis, etc.). The categorization of the independent variable into the different types of postpartum depression will be of great benefit to healthcare personnel to take appropriate measures to manage the patient so diagnosed.

ii. Ease of usage and access: symptoms display was made simple with easy and direct tags rather displaying open-ended questions that may confuse a user.
iii. Ease of user input: rather than typing long answers ANN makes it easier with binary input for yes or no responses
iv. Fast and accurate computation: ANN is known for its fast computational ability.

3.5 Output Form Design

The Output form design for postpartum depression is as follows:
POSTPARTUM DIAGNOSIS IS AS FOLLOWS
Percentage Accuracy of ANN : xxx.xx
Artificial Neural Network Predicted Result : ['xxxxxxxxxx']

At run time, the relevant signs and symptoms are inputted into the Machine Learning application and the result of the ANN classification algorithm is displayed. The output shows the percentage accuracy of the classification algorithm. The seaborn, a statistical graphics will show the total dataset used for testing the algorithm.

3.6 Input Form Design

The structure of the dataset is as follows:

Table 2: Structure of the Dataset

SN	Field	Data type	Width	Decimal
1	Mood change no interference normal life	Numeric	1	Nil
2	Tearfulness	Numeric	1	Nil
3	Irritability	Numeric	1	Nil
4	Thoughts of harming baby	Numeric	1	Nil
5	Depression/suicidal thoughts	Numeric	1	Nil
6	Hyperactivity and loss of control	Numeric	1	Nil
7	Anxiety	Numeric	1	Nil
8	Insomnia	Numeric	1	Nil
9	Auditory Hallucinations	Numeric	1	Nil
10	Confusion and poor judgment	Numeric	1	Nil

The structure of the input datasets (Table 2) represents the independent variables that was processed by the ANN algorithm to predict the outcome of the postpartum depression. The input variables were first converted in numeric data type before inputting the various signs and symptoms at run time. Where the said symptoms present in a patient the value is regarded as 1 otherwise it is regarded as 0.

4. RESULTS AND DISCUSSION

Table 3 and 4 summarizes the results of the system's performance with respect to accuracy, precision, recall and F1 scores. The training data is split into two (2) parts, 75% of the data is used for training while the remaining 25% is used for testing. The system was implemented using spyder, a powerful python IDE on Anaconda(3) 2021, with graphical plots showing the metrics of neutral network together with other machine learning algorithms is depicted in figure 4 and figure 5.

Figure 4 shows the accuracy level of neural network with six other machine learning algorithms on the same dataset graphically. ANN proved to be efficient in classification of the given dataset. Table 5 shows the performance of the neural network and six other machine learning algorithms. ANN shows a 0.97/ 0.99 precision, 0.98/0.98 recall and 0.97/0.98 f1 score of users responses or inputs which shows an improvement on the existing system results which was classified into mothers with postpartum blues (26.93%), those with suspected minor depression (23.38%) and those with postpartum depression (42.31%) based on the EPDS scores obtained from respondent inputs. Calculation for the existing system accuracy was gotten by dividing the number of matching data with that of the total data.

Table 3: Symptoms Data Type

S/N	SYMPTOMS		DATA TYPE
1	Age	1503	Non-null object
2	Feeling sad or Tearful	1503	Non-null object
3	Irritable towards baby & partner	1497	Non-null object
4	Trouble sleeping at night	1503	Non-null object
5	Problem concentrating or making decision	1491	Non-null object
6	Overeating or loss appetite	1503	Non-null object
7	Feeling anxious	1503	Non-null object
8	Feeling of guilt	1494	Non-null object
9	Problems bonding with baby	1503	Non-null object
10	Suicide attempt	1503	Non-null object

Table 4: Machine Learning Algorithm Performance

	ANN		SUPPORT VECTOR MACHINES		K NEAREST NEIGHBORS		NAÏVE BAYES		GRADIENT BOOSTING		RANDOM FOREST		DECISION TREES	
	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
PRECISION	0.97	0.99	0.81	0.87	0.94	0.90	0.75	0.84	0.98	0.99	0.95	0.91	0.88	0.88
RECALL	0.98	0.98	0.88	0.89	0.82	0.97	0.74	0.85	0.98	0.99	0.84	0.97	0.8	0.93
F1 SCORE	0.97	0.98	0.79	0.88	0.87	0.93	0.75	0.85	0.98	0.99	0.89	0.94	0.84	0.91

Table 5: Machine Learning Algorithms Accuracy Level

MACHINE LEARNING ALGORITHMS	ACCURACY LEVEL (%)
Neural Network	0.98
Support Vector Machines	0.85
K-Nearest Neighbors	0.91
Naïve Bayes	0.81
Gradient Boosting	0.98
Random Forest	0.92
Decision Tree	0.88

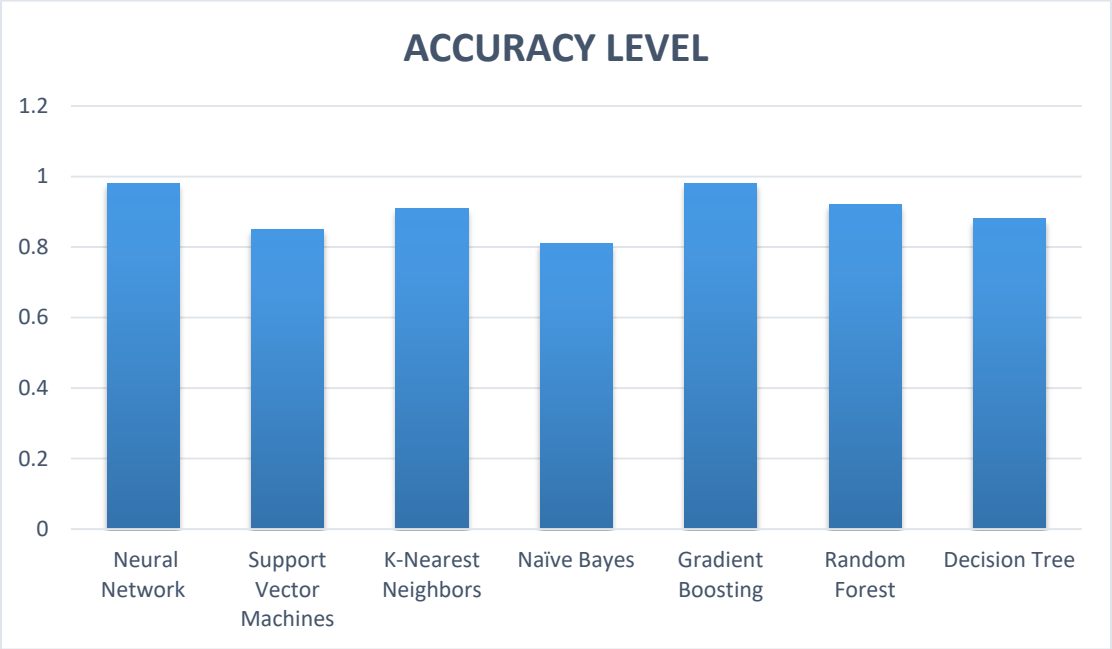

Figure 4: Graphical Plot of Accuracy Level

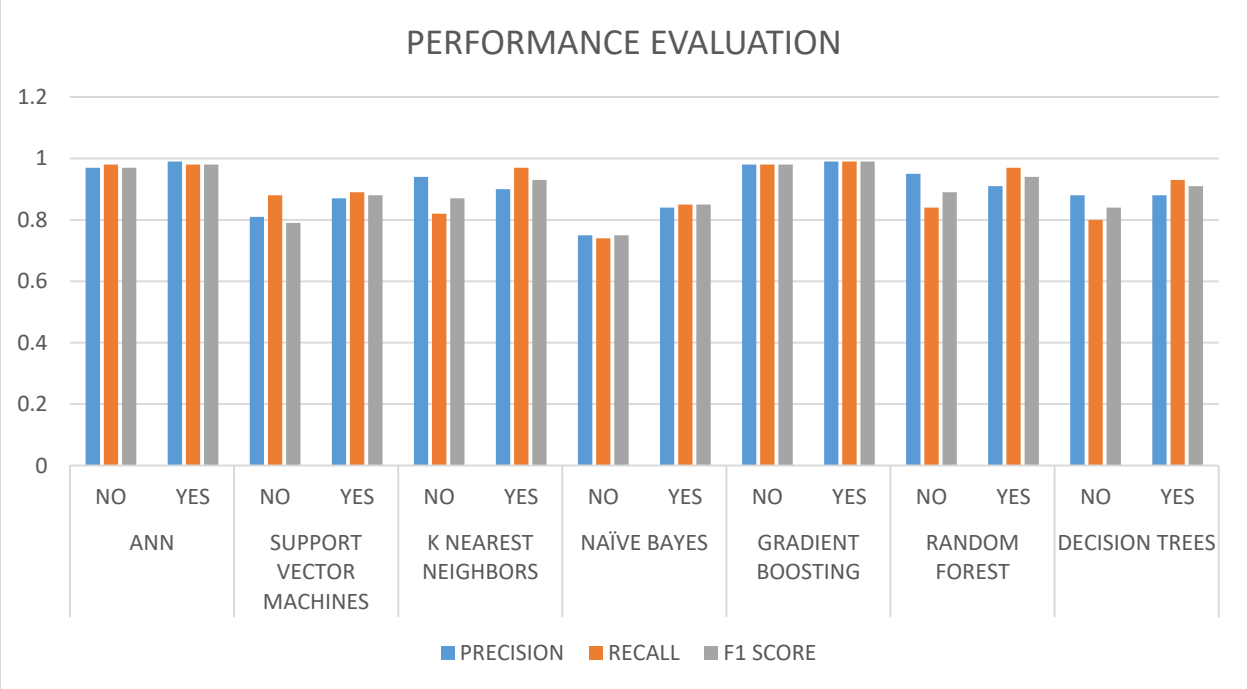

Figure 5: Performance Metrics of the Machine Learning Algorithms

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```
INPUT DATA FOR POSTPARTUM PREDICTION ALGORITHM

Mood change with no interference to normal life      :  0
Tearfulness                                  :  0
Irritability                                 :  0
Thoughts of harming baby                     :  0
Depression/suicidal thoughts                 :  0
Hyperactivity and loss of control            :  0
Anxiety                                      :  0
Insomnia                                     :  0
Auditory Hallucinations                      :  0
confusion and poor judgment                  :  0


 POSTPARTUM DIAGNOSIS IS AS FOLLOWS

Percentage Accuracy of ANN                :  100.0

Artificial Neural Network Predicted Result    :  ['NORMAL']
```

Figure 6: Output from the ANN classification.

Since all the independent variables are negative (0) the result shows that the patient did not present postpartum depression. This is consistent with earlier clinical result from the hospital. The result of the ANN, the classifier algorithm is Normal with an accuracy of 100 % as shown in figure 5.

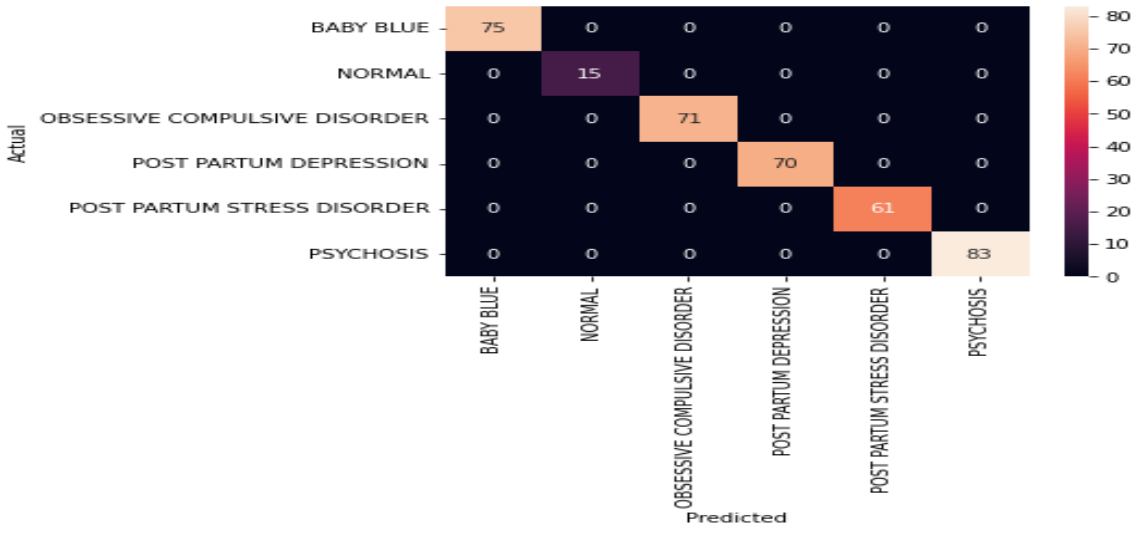

Figure 7: Graphical Representation of the Output from Test Data

The performance of the test data (25% of the total dataset) is as shown in figure 8. The figure represented the different cases of postpartum depression from the test data as follows:

i.	Normal	15
ii.	Baby blue	75
iii.	Obsessive compulsive disorder	71
iv.	Post partum depression	70
v.	Post partum stress disorder	61
vi.	Psychosis	83
	Total	**375**

Both dependent and independent variable consisted on 1500 datasets. 1125 datasets were used for training and 375 datasets were used for testing as shown in the seabone in figure 8.

Test run ii

```
INPUT DATA FOR POSTPARTUM PREDICTION ALGORITHM

Mood change with no interference to normal life      :  1
Tearfulness                          :  1
Irritability                         :  1
Thoughts of harming baby             :  0
Depression/suicidal thoughts         :  0
Hyperactivity and loss of control    :  0
Anxiety                              :  0
Insomnia                             :  1
Auditory Hallucinations              :  1
confusion and poor judgment          :  0


 POSTPARTUM DIAGNOSIS IS AS FOLLOWS

Percentage Accuracy of ANN             :  100.0

Artificial Neural Network Predicted Result    :  ['BABY BLUE']
```

Figure 8: Further Test Run

The input data for test run ii shows that the patients presented with mood change but does not interfere with normal life, tearfulness, irritability, insomnia and auditory hallucination. Consequently, the classification algorithm classified the depression as baby blue as shown in figure 9.

```
INPUT DATA FOR POSTPARTUM PREDICTION ALGORITHM

Mood change with no interference to normal life      :  0
Tearfulness                          :  0
Irritability                         :  0
Thoughts of harming baby             :  1
Depression/suicidal thoughts         :  0
Hyperactivity and loss of control    :  1
Anxiety                              :  0
Insomnia                             :  1
Auditory Hallucinations              :  1
confusion and poor judgment          :  1


 POSTPARTUM DIAGNOSIS IS AS FOLLOWS

Percentage Accuracy of ANN              :  100.0

Artificial Neural Network Predicted Result    :  ['PSYCHOSIS']
```

Figure 9: Further Test Run

The independent variables that were fed into the machine learning algorithm as they were being run included thoughts of hurting the infant, restlessness, auditory hallucinations, disorientation, and poor judgment. As a result, the algorithm determined that the patient had psychosis, which is consistent with the records that were made accessible to us in the mental institution.

5. SUMMARY

Depression is a health concern that affects nursing mothers, even though having low awareness on this part of the globe. As per the World Health Organization (WHO), postpartum depression impacts approximately 3 in 10 breastfeeding mothers. This form of depression emerges in women after childbirth and can have severe consequences if not promptly and efficiently addressed. Existing works and models have approached PPD from a variety of viewpoints, including accuracy in diagnosis, specificity of symptoms, accessibility of diagnostic instruments, etc. When a human expert on the subject was consulted at the Federal Neuro-Psychiatric Hospital in Uselu, Benin City, Edo State, it became clear that the difficulties in diagnosing PPD mentioned above were not unfounded.

Clinicians mentioned using manual tools like the EPDS questionnaire, which can be challenging for patients to complete on their own and produce results that do not accurately reflect the patients' illness. With the above information, the proposed study employed the use of AI powered tools in form of the artificial neural network machine learning algorithm in the analysis and implementation of a prediction system for postpartum depression diagnosis having better accuracy level, ease of usage and accessibility and the categorization of PPD which a patient may be suffering from. This model was designed to improve the limitations of the existing system of system.

5.1 Recommendations

The recommendations from the findings are as follows:

i. Medical specialists/institutions seeking automated tools for diagnosing Postpartum depression or other salient health challenges should collaborate more with data scientist in developing more intelligent tools for improved health care solutions
ii. This machine learning system developed should be incorporated into the psychiatric health sector to improve diagnosis
iii. Future researchers should work with clinicians to improve the robustness of this system by adding proven treatment options and modifying it into installable apps for users.

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