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Iraqi newborns mortality prediction using naive bayes classifier

Mohammad Khalaf Rahim Al-juaifari[1], Abdulhussein Abdulmohson[2], Radhwan Hussein Abdulzhraa Al_Sagheer[3]

[1]ITRDC, University of Kufa, Iraq
[2] Faculty of Education, Computer Science Department, University of Kufa, Iraq
[3] Department of Computer Science, Faculty of Education for Girls, University of Kufa,Iraq

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Abstract

Although the number of newborn deaths has decreased in the past ten years in Iraq in general, it is necessary to continue research through improving healthcare for both pregnant women and newborns, there is needs to study causes and generates alerts to prevent deaths of newborns in the future. A presenting a model with machine learning needs to predict newborn mortality. Article aims to use the best algorithm to predict the risks of neonatal deaths through factual case data and include results in the form of warnings reaching mothers through an intelligent system. Analytical results show that Naïve Bayes prediction classifier with different mortality classes and causes of death to generate alerts about the risks of possible infant death through probability by comparison with some other methods for the same purpose. Also in this paper, a proposed special application proposed for showing alerts by smart computing tools "Naïve Bayes" to reduce infant mortality statements by checking the health status of pregnant mothers and newborns to create procedures that limit these problems in the future. The use of the Naïve Bayes algorithm and its inclusion in an electronic system to monitor maternal health by generating alerts that indicate risks to newborns will contribute significantly to the development of health conditions in the country, especially in light of the usability of the same system and other diseases, especially chronic ones, and also by linking the causes to the causes of deterioration of the condition or death.

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1. Introduction

Designing an electronic application to predict and warn of neonatal mortality based on mother data and analyses it using internationally approved techniques and algorithms for the purpose of alerting future mothers to the risks that may lead to neonatal mortality by focusing on the causes in previous similar cases in the Najaf governorate and it is possible to apply searching on a broader segment and according to the availability of data on that at the level of Iraq, for example, since such systems are currently applied in developed countries which need to apply them in Iraq in a manner appropriate to the nature and status of Iraq.

The goals of medical systems designed in developed countries are summarized by providing requirements for improving medical services, taking into account their guarantee for all groups and different places in the country.

Contributions of this paper are proposed new health system predicting model for Iraqi newborn mortality with best and latest methods available which need for this system, naïve Bayes

algorithm implied within a system as best algorithm for prediction as will describe in section II, effectiveness of model in predicting the mortality classes using external most critical selected features related to the mother of the newborn, less effective data set yields better performance due to less translates with less uptime mathematical expenses.

Most of the technologies that are used in the field of public health need clear and easily accessible outputs by users for the purpose of ensuring their spread and use on a wider segment of the country's people. It is better to engage the proposed system in section IV of the results in section III as it will be discussed later with the systems currently approved by the sector Health in the country for the purpose of obtaining more than one benefit for the same application, taking into account the application of the international standards based on the proposed system and trying to overcome the difficulties and problems in most health medical applications that do not find a practical application of their outputs and for various reasons.

2. Related work

Related works are displayed using the linked data For health with a little reference to infant mortality rates for the past years in Iraq, we find that the years between 1974-1990 from (91.7) to (61.7) deaths per live birth [1] where it was planned to decrease by nearly half by the year 2000, which did not It is due to the imposition of the economic embargo on Iraq in 1990; Where infant mortality rates rose to 127.1 per thousand compared to the years before the siege [2] due to inadequate health services in particular and individual living conditions in general.

As for the Iraqi health situation, it has witnessed a clear deterioration since the eighties of the last century until now:

In general health system in Iraq The country's health system has clearly deteriorated after Gulf Warm [3], also after America's entry into Iraq still the situation of Lack of hospitals in general medicines and medical supplies, including devices and laboratories [4-5].

The health system also did not improve in spite of many trials, especially with the political deterioration and increasing population [6].

Iraq is not expected to achieve Millennium Development Goal 4 of reducing the mortality of children under the age of five by two thirds of those deaths, while there is hope for achieving Millennium Development Goal 5 to reduce maternal mortality to three quarters [7].

Many birth defects were recorded in Fallujah Hospital [8], After selecting six health facilities, the evaluation of the researcher's procedure proved that the immunization of children with full coverage exceeding 90% in [9].

In 2006, one visit was recorded at 84% of the antenatal clinic for women who give birth [10], The weakness of management and drawing clear strategies and the absence of institutional work and other factors led to the failure of most attempts to advance the health situation, especially those funded by entities interested in the health sector inside and outside the country [11]. Leverage

the concept of contained embedding's literature of localized structured prediction in [12- 13].

Many obstacles facing the Nigerian health system, especially in rural areas, are due to the lack of health professionals and medical equipment and the lack of health facilities [14], while in system based on [15] predictive classifier by software services had been proposed in the Brazilian northeast to prevent infant mortality to enhance decision making in government health systems agencies.

Processing statistics data of breast cancer in [16] age of patients between (40-50) years with breast cancer in Iran and is between and lower than (10- 15) years in the developed countries, also several classification and prediction influential data mining algorithms had been proposed of breast cancer performance of four classifiers: k-NN8, NB6, C4.57 and SVM5.

The prediction models algorithm is constructed which is derived from Bayes classifier in [17], authors in [18] attribute selection of Classification algorithms. Gain Ratio in [18] measures is named Gain RatioAttributeEval in Weka the gain ratio which is entropy formula Feature Evaluation calculates the information gain. Feature independent selection heuristics are applied in [19] to remove redundant features by no relation among variables, for better accuracy highly correlated and redundant features are used, while in many recent development conduct feature selection [20]. Many applications of Artificial Intelligence in field such as: weather prediction and astronomical exploration to autonomous systems [21].

Systems developed E- health system with various functionalities is quite similar to our system are proposed in [22] application of e-health that an emerging tactile Internet-based Nano network, [23] China and the e-Health framework in the Ukraine, and [24] designed to recall memories of Alzheimer patients using hybrid method.

Grid search algorithm in [25] hyper parameters of n_estimaor with 100 value with criterion gini value and max depth is 2.

3. Naïve Bayes Classifier

Data set divide in to two set of observations Xi and prediction Yi due to newborn status after birth as follow:

$$Y_i \begin{cases} \text{live birth positive diagnose} \\ \quad \text{dead birth otherwise} \end{cases} \tag{1}$$

Evaluation of test sets by distribution of two set classes.

$$P(Y = 1 \mid Xi) = \frac{P(Xi \mid Y_i = 1)\, P(Y = 1)}{P(X_i)}$$

Where

$$P(Y = 1 \mid Xi) > P(Y = 0 \mid X_i) \text{ positive case} \tag{2}$$
$$\text{else it is negative case}$$

Also Y represent particular diagnose of case equation 2 calculates probability of positive cases for each selected features.

In equation 3 evaluates P $(Xi / Y = 1)$ using number of positive and negative samples in dataset.

$$P (Xi / Y = 1) = \prod_{i=1}^{n} P (Xi \mid Y = 1) \qquad (3)$$

$$\text{Preliminary y factor} = \frac{T_P + T_N}{T_P + T_N + F_P + F_N} \qquad (4)$$

Where

$$\text{Sensitivity y} = \frac{T_P}{T_P + F_N}$$

$$\text{Specificity y} = \frac{T_N}{T_N + F_P}$$

Equation 4 used to calculate the factor of live and dead birth "positive and negative",
T_P: true positive, T_N: true negative, F_N false negative, F_P false positive, and k is number of iteration. Preliminary combined both sensitivity and specification.

4. Proposed Health Management System (HMS)

The duties of any health system are summarized in a series of tasks that start from accurately assessing the patient's health status through specialized consultants, through providing health care to the child and the family with high quality, taking into account the economic feasibility and ending with the evaluation of health services and trying to develop them through the experiences of developed countries in this field.

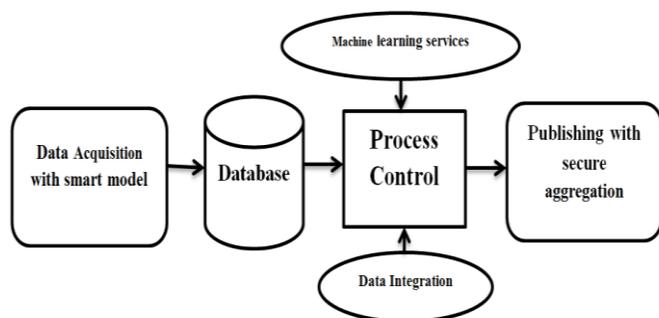Fig.1 below shows the general structure of proposed system with some aspects to adequate with Iraqi health system.

Figure 1: Framework architecture

4.1 Data Acquisition with smart model

This aspect used to data collection processing which contains four different aspects: end user generated (computer, mobile phones etc.), internet, device of health agent "hospitals", and symptoms. End users consist of alerts for mothers before birth

then after born alive take care of the child and continue vaccine campaign.

4.2 Database with smart model

Process mainly applied to the database is Data integration of various databases and implied also ontology services which are a model that represents the formal framework for a set of concepts, relationships and their characteristics. Table 1 demonstrate 8 different features possible to easy collected to associated birth characteristics for both mother and newborn with causes of death.

Table 1: System modelling features february 2020

Feature	Description of features
Gender	Child's Gender
Age	Age of mother
Weight	Infant weight at birth
Birth	Type of birth
Gestation week	Gestation weeks numbers
Birth type	Vaginal or Caesarea
Number of baby per birth	One or many
Diagnoses	Prenatal Diagnoses

Table 2 shows abbreviation of diagnoses of influence and most repeated case for life and dead newborn to use in next section V.

Table 2: System modeling features february 2020

Abbreviation	Description
TCC	Thermal seizures
RDS	Respiratory distress syndrome
D	diabetes
CA	Congenital anomalies
C	Cardiomyopathy
lbw	Disorders relating to low birth weight
sep	Septicemia
IM	Meconium Aspiration syndrome
NJ	Neonatal jaundice
BA	Birth asphyxia
cp	Congenital pneumonia
M	Malnutrition
IB	Inflammatory bowel

4.3 Process control

This part includes Machine learning services: prepare data set statically, construct models after evaluation of proper model of classification, and design optimal method of performance to product required classifier model as output then it will be ready for new data input, task adaptive structured Meta learning because of both learns a set of tasks for a set of useful Meta parameters and adapt to the target tasks during the test time [26].

4.4 Publishing with secure aggregation

Publishing result with security needs to ensure reaches to it final end user as output results for system via different platforms and environments.

5. Experimental Results:

The analytic results use naïve Bayes technique does better than rest the approaches [14] used to analyze data set for mothers and newborns birth dataset constancies of eight features within February 2020 births in Najaf Ashraf.

A sample consisting of eight different characteristics of 472 mothers and newborn babies up to the age of 28 days as in Table 1 was evaluated, where the characteristics were divided into two main parts, the first is the first seven characteristics, and the second is the diagnosis of diseases that newborns are exposed to 63 deaths were reported. Table 3 shows the live and death factor using naïve Bayes. Mothers who are over forty years of age are at greater risk for the death of her new baby than the rest of the ages, with 4 newborns out of 10 registered, especially the 48-year-old, when two newborns were stillborn.

With regard to the diagnosis of diseases, most of the deaths were recorded for children of low weight at birth, where they were 30 out of 63, while the number of those who survived were 17 who were less than the normal weight "less than 2.5 kg", where he had a direct correlation with the number of months Pregnancy "less than 37 weeks", where 53 deaths were recorded out of the total number of deaths. Fig.2 and 3 also represent factor value of live and dead cases of newborn with feature of diagnoses only, other factors value of live and dead cases features "first seven" calculated in table 3 & 4 below.

Table 3: factor of features excluding the weight

Factor type	Value of probability
Factor of Live birth	2.83118E-06
Factor of dead birth	6.14829E-07

Table 4: factor of three diagnose of features

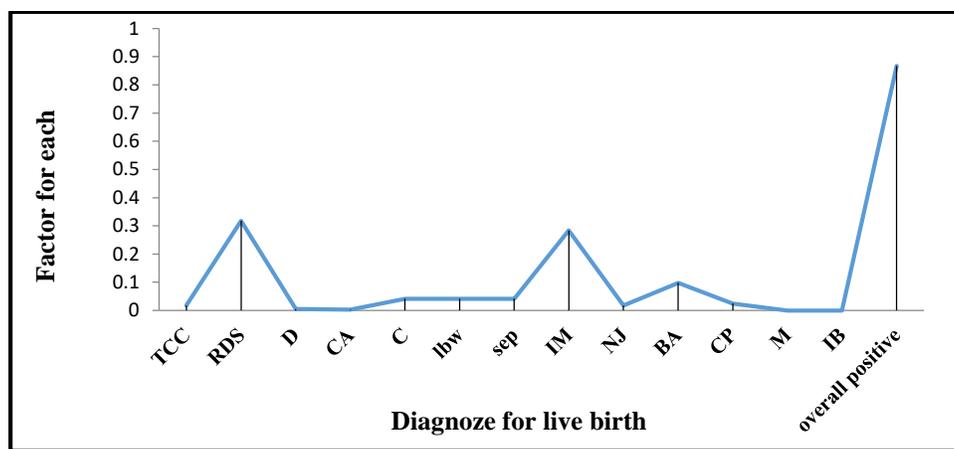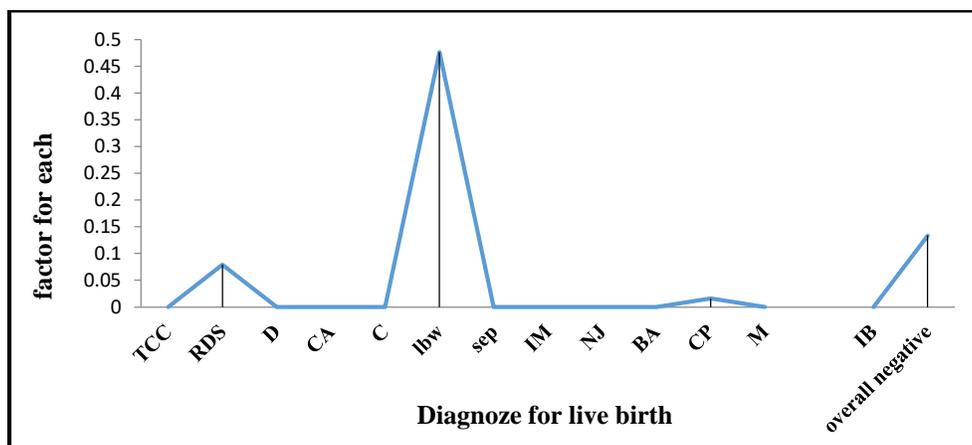| Factor type	Value of probability
Factor of Live birth	0.001119
Factor of dead birth	8.01E-05

Figure 2: Diagnoses of live new birth

Figure 3: Diagnoses of Dead new birth

Finally, results submitted to mothers and decision makers through end user system described in section IV, decision maker needs to take future prevention measures to avoid health problems and to create appropriate conditions and required supported to avoid deaths.

6. Conclusion and future system

Suggested model describes data structure and data integrity for newborns death risk calculations.

The main two important contributions of this work are focused on first: choose optimal appropriate technique to imply with data set of Iraqi newborns; second: proposed intelligent healthcare system focused on health management in Iraq. There are also need for data online available with easy access for researchers to improve the healthcare system and overcome all trouble and problems against execute it.

This system can have applied to same cases for other related diseases to generate alerts for same purpose by calculate various features with disease causes.

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