Chapter 5
A Predictive Analytic Model for Maternal Morbidity

Edgardo Palza
École de technologie supérieure, Canada

Jorge Sanchez
Universidad Peruana Unión, Peru

Guillermo Mamani
Universidad Peruana Unión, Peru

Percy Pacora
Hospital Nacional Docente Madre Niño "San Bartolomé", Peru

Alain Abran
École de Technologie Supérieure, Canada

Jane Moon
University of Melbourne, Australia

ABSTRACT

This chapter presents a predictive analytic model for preventing neonatal morbidity through the analysis of patterns of risky behavior regarding morbidity in newborns. The chapter presents the design and implementation of a forecasting model of Neonatal morbidity. The model developed is based on artificial intelligence using Bayesian Networks, Influence Diagrams and principles of traditional statistics. The model research is based on a repository of 10,000 medical records at a hospital in Peru. The model aims to identify the factors that are causes of morbidity in newborns, is based on data mining techniques and developed using the CRISP-DM methodology.

INTRODUCTION

The World Health Organization (WHO) defines maternal morbidity as "Maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes" (OMS, UNICEF, UNFPA, & Banco Mundial, 2005).

Morbidity in the pregnancy period is one of the leading causes of death in women: WHO mentions that around 800 women die every day from complications related to pregnancy or childbirth. For instance, 287 000 women died in 2010 before, during and after the pregnancy and childbirth (OMS, 2014).

A key problem encountered in maternity consultations or emergencies, is the complexity of identifying risk factors of morbidity in order to minimize or eliminate them through a timely and accurate

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diagnosis (Say L, Pattinson RC, & Am G., 2004). Therefore, hospitals and clinics require adequate processes starting with collecting necessary data to create assertive knowledge about the patient and therefore offer an adequate treatment.

Our research aimed to create knowledge related to medical diagnosis. To analyze data from this database Influence Diagrams and Bayesian probabilities will be used to create a model for the detection of morbidity patterns and risk factors in the pregnant mothers during consultations or in intensive care units (ICU).

This research work was carried out with the collaboration of the National Teaching-Hospital Mother-Child "San Bartolomé" (HNDSB) in Lima (Peru) whose most important activities are maternal education, monitoring of pregnant women, delivery care and care of the newborns.

This chapter presents the empirical context and the project phases for the development of the predictive analytic model with examples of diagnosis scenarios developed using this predictive model and the knowledge repository available for research purposes.

RELATED STUDIES

Bulegon *et al.* (Bulegon, Bortoleto, & Roman, 2009) discuss the creation of data models in the context of health. They propose an entity-relationship model that includes cardiovascular risks, tests, exams, risks and other considerations that allow monitoring of the patient's conditions and they suggest some specific data mining techniques to explore the data.

Flores *et al.* (Flores C, Barros P, & S, 2013) present criteria for creating and modeling of Bayesian networks and propose a multi-agent software that simulates clinical cases for learning within an academic environment. Their knowledge database was created by experts in the domain and their system uses influence diagrams to organize a teaching strategy.

Fernandes *et al.* (Fernanez J, Martínez-Selles M, & Arredondeo MT, 2004) present a model for decision support systems based on Bayesian networks and influence diagrams. Their model attempts to provide a solution to determine the best treatment for patients suffering systolic heart failure disease. Their model also offers a probability of a patient's developing systolic heart failure. In terms of prediction, their model uses the signs, symptoms, risk factors, previous heart problems and test results; in addition, this model reports the most appropriate corrective treatment.

Kayaalp (Kayaalp M, 2012) reports on a study to predict, with some degree of accuracy, the mortality of a patient in an intensive care unit (ICU). Variables used in the study include physiological measurements of the patient in the first 48 hours. The Bayesian model proposed predicts the result with a posterior probability.

THE EMPIRICAL CONTEXT AND THE DEVELOPMENT PHASES FOR THE PREDICTIVE ANALYTIC MODEL

Empirical Context

The HNDSB has a Perinatal Information System (PIS) which records the basic history of the mother and child, including all tests and controls that have been undertaken from the beginning of pregnancy