Alleviate the Parental Stress in Neonatal Intensive Care Unit using Ontology

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Abstract

Parents of preterm infants are facing difficultiesin lack of information, lack of understanding of medical terminologies, preterm infant's risk factors and their feelings of emotional stress in Neonatal Intensive Care Unit (NICU). In order to release their stress, need to develop an automatic system that generates a clear and brief summary about the infant process and also generatea meaning of medical terms which is used at NICU. To accomplish the system properly, there is a necessity of ontology. In this paperwork, we present an ontology which holds few main concepts in NICU domain. This ontology was constructed through protégé 4.3. This ontology predominantly covers classes, data properties, object properties, individuals, existential restriction, and cardinality restriction on the relationship between classes and other description. At the end of this paper, HermiT Reasoner was usedto examineinconsistencies and unsatisfiability.

Keywords: Infant, Medical Terminology, Neonatal Intensive Care Unit, Ontology, Protégé

1. Introduction

NICU mainly concentrates on preterm newborn infants. Neonatal Intensive Care Unit is a platform that has an action in information receiving and the ability of understanding. The central unit enclosed with an affiliated health professional with higher experience in patient responsibility. Such as (i) attending doctor - responsible for infant care, (ii) Neonatology fellow - a doctor who has a practice under Neonatology, (iii) Medical scholar - might audit and manage a patient in hospital, (iv) NICU caregiver- plays a vital role in monitoring infant and aiding and cultivating the family, (v) Pharmacologist - helps to prepare medications, (vi) Dietitian - helps to monitor what infants are fed, how their bodies reacts with their food and how they grow. For parents, the NICU exposure is an unexpected drive with fear, stress, and loss of control during the labor as they awaited the anonymous outcome of their preterm labor. In many situations,peopleexpress condolencesto preterm infant parents fear and hardship living with an anonymous outcome to their baby. Now

a day's, the hospitals are providing facility to stay in the hospital that are convenient for preterm infant parents. However, providing the fair and summarized information is crucial for parents a sense of hope and an involvement towards their kids care. Therefore, the aim of this paper is to develop an interference which is an automatic summary generator to support parents. This system will generate textual concise in a number of steps; everyone admittance a domain called "ontology". This ontology holds concepts and medical term description which is used by the staffin the hospital to speak about the infant treatment. In addition, relates properties and relationships between these concepts.

Ontology is a thesis of objects and their connections. It supplies criteria to categorize divergent types of objects and their ties. To compare conceptual information across two knowledge bases on the web, a program must have a path to detect the common meaning and solution to this is to collect in a common place is called "ontology". There are number of ontology editors available to develop ontology (e.g.: protégé, cognitum, neon-tool kit, SWOOP,

vitro and etc.). But protégé is a tool which is generally used by a researcher, professionals, programmers and others alike. Protégé used to load, design, edit and save ontologies in OWL and different other formats.

The current Infant Mortality Rate (IMR) in India is 40 per 1000 births, according to the Sample Registration System (SRS) 2013. At the current rate of decline, it seems it will be critical for India to reach the target of less than 39 per 1000 births by the end of 2015.

2. Background

A few cognate studies on Neonatal Intensive Care Unit. Many of the studies justify there is the necessity to boost parent involvement in infant management and also describe parental stress about their infants. This paper[1] provides interpreting of the parent in infant pain management through some steps: (i) they separate parents into intervention and baseline groups and also afford brochure to print. The brochure consists of the details regarding infant and their treatment. In addition, provide procedures to infant parents about pain management. (ii) For understanding purpose, they explain Analysis, Enrollment follows and compliance, Parent attitude about infant pain and pain care, Parent pressure, nursing Pain assessment, Parenting tension at home, Parent belief and attention of Caregiving. This study provides new information on Parental experience, given the importance of infant pain management to parents. However, parents in the intervention group were able to take an active role in the infant pain care and had a more positive aspect about their role accomplishment in the post-discharge.

Neonatal care is a dynamic environment, the sources and profundity of stress for parents can vary over time and therefore, it's necessary to acquire successive stress measurement to get a definite rating of parental stress (Reid et al., 2007).

The idea to Identify Internal and External Stressors in parents of Newborn neonate kids[2] is to ascertain what internal stressors and to assess External stressors. They used Parental Stressor Scale: Neonatal Intensive Care Unit (PSS: NICU) to gauge parental stress over 20 years. Stress level reported by parents was scored from 1 to 5. In addition, they use (i) NICU External stressors and (ii) Stress reduction scale. These tools are used to describe parental stress and mechanism of parents used to cope with stress during the NICU stay. Finally, they evaluate (i) internal stressors are long term effect of NICU journey,

(ii) external stressors strongly support to implement an assessment of outside stressors that affect the NICU parents experience due to lack of information.

The Neonatal Intensive Care Unit uses Baby Talk (BT) Nurse System[4] to generate nursing shift summary in NICU. The BT-Nurse System uses data-to-text architecture is solely based on electronic data record with no additional data entry was not required. Natural language NICU shift summaries automatically generated from an electronic patient record. BT-Nurse Systemconstructs a standard data-to-text "pipeline architecture". In which information is managed by modules which communicate via a domain on ontology. This ontology provides the following mechanisms (i) Data translation, (ii) Data pre-processing, (iii) Signal analysis, (iv) Data interpretation, (v) Data planning and (vi) Micro planning and Realization to implement BT-Nurse Shift summary system. They are not having enough time to ladder a system which generates a complete shift summary. From that summary, (i) 58% BT-Nurseswho generates a helpful comment, (ii) 90% BT-Nurses generates a comment only for their understanding. The biggest challenge of this architecture is dealing with incomplete input data and generating good narrative text. This study shows only the possibilities to use data-to-text architecture. This study only a proof of concept and it considerably requires engineering effort before it realistically deployed.

The research[6] aid is to explore, examine, chronicle and describe parent experience when their child is confessed in the hospital as apreterm infant. This study was processed at the NICU in King Abdul-Aziz Medical Health affairs organization in the kingdom. This research spoke that most of the parents were not agreed about the nurse underpin towards their intangible feelings and aegis. Additionally, findings specify that a decrease in support level being bounded with enlarged stress and anxiety level. The questionnaire survey was taken from parents. This survey contains, (i) Study area and setting, (ii) Study subject, (iii) Study design, (iv) Sample size, (v) Sampling technique, (vi) Data collection methods, an instrumentused measurement, (vii) Data management and analysis. However, the main drawbacks in this research are (i) Small sample size, (ii) Cross-sectional study design, (iii) Statistical regression. The majority of respondents were mothers (76%), the remaining (24%) from fathers.

The stress and panic of having a sick child in Neonatal intensive care might also mean that a parent will not be able to ingress overwhelming information. Generally,

the goal of baby talk project is to expand the system that generatesa summary of babies' medical data.BT Family system[8] provides strategies to develop medical text for parents of neonate kid. The BT Family uses Adaptive Natural Language Generation (ANLG) architecture. In this BT Family system, two types of text versions (Affective and Effective text versions) are available. More of parents in NICU prefer Affective Text Version. The BT Family system does not contain clinical data (Blood gas, Apnea, Sepsis and etc.,) of infants.

3. Methodology

3.1 Determine the Domain and Scope

The domain of planned ontology presents the ideas and inferences for neonatesin hospice. In order to support ontology application, we can fetch the information about Preterm Infant, the medical terminologies, and clinical data from the domainin which from ingress the natural language processing. Due to the stipulation of this paper, the concept provides the information for parents related to preterm infant process and medical terminologies which are used in the NICU unit. In addition, it includes information related to the nutrition and treatment of preterm infant. It supplies the information to parents about their preterm child treatment and clinical data.

3.2 Consider Reusing Extant Ontology and Ontology Salient Term Catalogue

The basic idea of this paper is to develop an automatic summary system. Ontologymethods are already present and can be discovered from the internet for understanding. Such as Bioportal site (http://bioportal.bioontology.org/ontologies/) and the medical terminologies obtained from the internet through (http://www.urmc.rechester.edu/childrens-hospital Neonatology/parent-info.aspx) then the viewpoint of ontology can be created and developed. From the above site, we get onlyrelated information.

This ontology appends the following terms as a foremost term: Neonatal_Intensive_Care, Medical_Terminologies, Risk_factor, Nutrition and its subtypes Feed and Fluid, Carer (Nurse), Neonate_Infant (Preterm_Infant), Treatment, Parents and its subtypes Mother and Father. Finding an important term will help to p0 build ontology with minimum inconsistency.
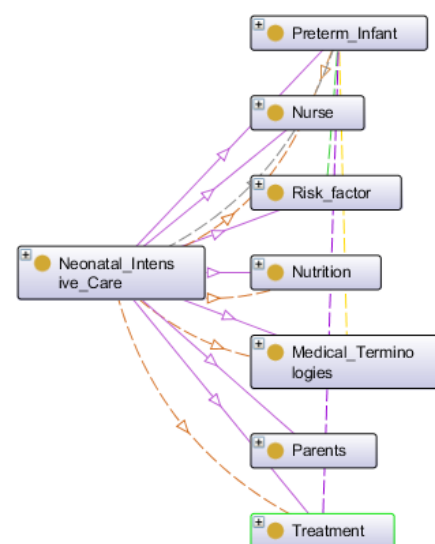
3.3 Representation of Classes

There are many approaches available to develop a class hierarchy in the ontology. In this paper, the author applied a top-down approach to represent classes. Westart to develop a class hierarchy for the initial concept which is Neonatal_Intensive_Care and proceed further with specialized subclasses of Medical_Terminologies, Carer (Nurse), Nutrition, Parents, Risk_factor and Treatment. After that parent class divides into Mother and Father.

Similarly, Nutrition class divides into Feed and Fluids. Figure 1 shows the class representation via protégé tool.

3.4 Formalizing Ontology Properties

3.4.1 Data Property

Ontology properties are used to represent relationships that exist in ontologies. Generally, data properties are used to connect the data with their properties. In this section, we are going to definedata properties for the neonatal intensive care unit. Initially start to expound the data properties for the class of Neonate_Infant(Preterm_Infant) and it has the following data properties: "Neonate name, Medical Record Number, Cot, Weight, Admitted_date, Counselor, Length and Growth". Nutrition and Parent class embody "Name" as their data property. The Nutrition class includes "Calories and some of the treatment class property" as data properties. The Treatment class deploys the data properties of "Commence, Finish, Treatment name and Statement about Infant and

Figure 1. Class Representation via Protégé. Each class has their corresponding subclasses and their instances.

Treatment". The Nutrition subclass Feed contains "MI, Frequency and Route" as data properties. After commentating all the data properties,we should mention Domain and Scope for those data properties. The result of data property helps to understand the relationships between data and property. Table 1 shows the Domain and Range for the Data properties.

3.4.2 Object Property

Generally, object property narrates the relationship between an individual to individual. Object properties playa vital role in ontology. The "Understandby" property created to incorporate Medical Terminologies, Nutrition, and Parents. The "Typedby" property correlates Parents and Risk factor. The "Caredby" and "Nourished by" object properties fabricated to concatenate Neonate_Infant,

Table 1. Domain and Range for Data Properties because the Data Properties are used to connect Data with their Properties

Property	Domain	Range
Neonate_ name	Neonate_Infant	Integer
Medical Record Number	Neonate_Infant	Literal
Cot	Neonate_Infant	Literal
Weight	Neonate_Infant	Double
Admitted date	Neonate_Infant	Date time
Counselor	Neonate_Infant	String
Length	Neonate_Infant	Double
Growth	Neonate_Infant	Double
Name	Nutrition and Parents	String
Calories	Nutrition	Integer
MI	Feed	Integer
Frequency	Feed	Integer
Route	Feed	String
Commence	Nutrition and Treatment	Date time
Finish	Nutrition and Treatment	Date time
IV Fluids	Fluid	String
Treatment name	Treatment	String
Medical term	Medical Terminologies	String
Statement about Infant &Treatment	Nutrition and Treatment	String

Carer and Neonate_Infant and Nutrition respectively.The "Caredby"property used to retrieve information about the person who takes care of the infant child. The Nourished by property used to retrieve the information about food process of Infant child. The "Hasinfant" object property harmonizes the classes of Neonate_Infant and Parent. The "Hasparent" property is an inverse of "Hasinfant" property. If the property has an inverse functional then the inverse property is functional. The "Hasparent" property cleaves into "Hasmother" and "Hasfather". The "HasA" property portrayed the entire classes of Neonatal_Intensive_Care. Every object property is used to correlate an individual to build an effective ontology. Table 2 shows the object properties and their relationship.

3.5 Medical Terminologies

New born preterm infants' facing a number of problems and it varies based on the days of pre-birth. The problems may vary from short term to long term. Medical Terminologies consist of Medical terms which are used by NICU staffs to represent preterm infants' problems. These terms are described forparents to understand the medical terms which relate to preterm infants. Because, the parents do not understand about medical terms. It increases their anxiety level. The medical terms are employed in this paper is to help parents of preterm infants at NICU. Table 3 shows that the sample of Medical terms with an explanation.

Table 2. Object Properties and their Relationships. Generally the object properties make a relationship between one individual to another individual

Property	Relationship
Caredby	Neonate_Infant, Carer
Nourished by	Neonate_Infant, Nutrition
HasA	Neonatal_Intensive_Care class to entire classes
Hasinfant	Neonate_Infant, Parents
Hasparent	Inverse of Hasinfant and link between Parents and Neonate_Infant
Hasmother, Hasfather	Sub properties of Hasparent
Treatedby	Neonate_Infant, Treatment
Understandby	Medical_Terminologies, Parents
Typedby	Risk_factor, Parents

Table 3. Medical term explanation for parents

| Medical term	Explanation
Bagging	Filling the baby's lungs with air using a rubber bag, mask and oxygen.
Blood gas	A measurement of the amount of oxygen, carbon dioxide and acids in the baby's blood.
Sepsis	An infection, symptoms may include fever, poor feeding, continued Apnea and bradycardia.
Apnea	A prolonged pause (or) stopping of breathing. It's a common problem in premature babies.
Cyanosis	Blueness of the skin as a result of oxygen levels in the blood that is too low.
Residual	The amount of formula remaining in a baby's stomach before the next feeding.
NPO	The Latin abbreviation for nothing by mouth.
Respirator	Ventilator machine to help with breathing.
Vital sign	Measurement of heart rate, breathing rate, temperature and blood pressure. In NICU also measure baby's abdominal girth.
Intravenous	Fluids given into a vein.

3.6 Ontology Scrutiny

Protégé 4.3 with HermiT Java reasoner developed at the University of Oxford and it used to analyze whether the ontology is gratis from inconsistencies within the reasoning boundary of HermiT.

4. Result and Discussion

In this paper, ontology results comprise main concepts, sub concepts, object properties withsub object properties and their cardinalities and also embody data properties. In addition, this paperwork accommodates sundry instances has been designed with correspondence. Found some inconsistency in data property value when the HermiT reasoner was applied. After that the inconsistencies of data property values are rectified. When the inconsistencies were corrected some SPARQL queries was executed to obtain required information.

The output result was anticipated and no dispute arises during the reasoner was applied,and then the ontology is accurate. Figure 2 shows the list of all individuals and the decryption of one of the individuals (Ahmad). This decryption is possible only when the ontology does not
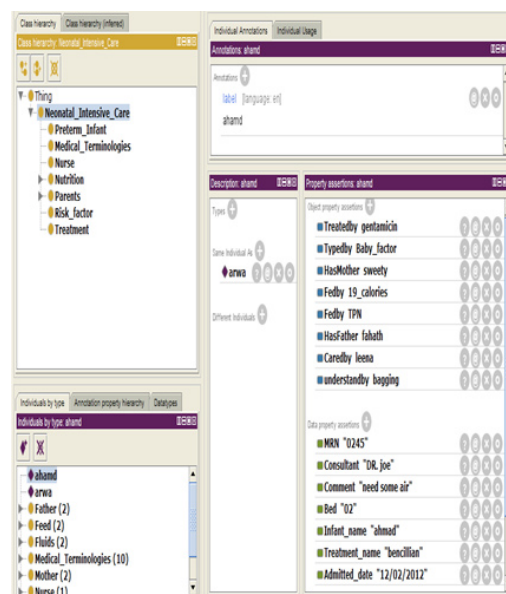
Figure 2. List of all individuals and the decryption of one of the individuals (Ahmad).

provide any discrepancies. (i.e. the reasoner does not provide any error message).

5. Conclusion

Several parents are facinga lot of negative feelings and bad experiences in NICU environment. They may not get enough information about their infant or not understand it. One way to support parents is to develop an automatic summary system. This paper projected, anontology progressive development of NICU domain comprises Resource Development Framework (RDF) and the Web Ontology Language (OWL). In addition, the ontology method proposed the system of the automatic summary generator. It is designed actually for knowledge sharing purpose. At the end of this paper, Hermi Treasoner was used to scrutinize inconsistency of ontology and also executes some SPARQL queries to attain required information. Ontology knowledge demonstratesa successful path to the concept term based information retrieval. In future, this method can be extended into automatic validation of message exactness between the other healthcare framework and application.

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