AN ONTOLOGY-DRIVEN APPROACH FOR STRUCTURING SCIENTIFIC KNOWLEDGE FOR PREDICTING TREATMENT ADHERENCE BEHAVIOUR: A CASE STUDY OF TUBERCULOSIS IN SUB-SAHARAN AFRICAN COMMUNITIES

By

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A thesis submitted in fulfilment of the academic requirements for the
Degree of Doctor of Philosophy
in the
School of Mathematics, Statistics and Computer Science,
College of Agriculture, Engineering and Science,
University of KwaZulu-Natal, Westville campus,
Durban, South Africa

June 2016

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June 2016

As the candidate's supervisor, I have approved this thesis for submission.

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ABSTRACT

Poor adherence to prescribed treatment is a complex phenomenon and has been identified as a major contributor to patients developing drug resistance and failing treatment in sub-Saharan African countries. Treatment adherence behaviour is influenced by diverse personal, cultural and socio-economic factors that may vary drastically between communities in different regions. Computer based predictive models can be used to identify individuals and communities at risk of non-adherence and aid in supporting resource allocation and intervention planning in disease control programs.

However, constructing effective predictive models is challenging, and requires detailed expert knowledge to identify factors and determine their influence on treatment adherence in specific communities. While many clinical studies and abstract conceptual models exist in the literature, there is no known concrete, unambiguous and comprehensive computer based conceptual model that categorises factors that influence treatment adherence behaviour.

The aim of this research was to develop an ontology-driven approach for structuring knowledge of factors that influence treatment adherence behaviour and for constructing adherence risk prediction models for specific communities. Tuberculosis treatment adherence in sub-Saharan Africa was used as a case study to explore and validate the approach. The approach provides guidance for knowledge acquisition, for building a comprehensive conceptual model, its formalisation into an OWL ontology, and generation of probabilistic risk prediction models. The ontology was evaluated for its comprehensiveness and correctness, and its effectiveness for constructing Bayesian decision networks for predicting adherence risk. The approach introduces a novel knowledge acquisition step that guides the capturing of influencing factors from peer-reviewed clinical studies and the scientific literature. Furthermore, the ontology takes an evidence based approach by explicitly relating each factor to published clinical studies, an important consideration for health practitioners.

The approach was shown to be effective in constructing a flexible and extendable ontology and automatically generating the structure of a Bayesian decision network, a crucial step towards automated, computer based prediction of adherence risk for individuals in specific communities.

PREFACE

The experimental work described in this thesis was carried out in the School of Mathematics, Statistics and Computer Science, University of KwaZulu-Natal, Westville campus, from July 2012 to June 2016, under the supervision of Dr. Deshen Moodley, Mr. Anban Pillay and Professor Christopher Seebregts.

These studies represent original work by the author and have not otherwise been submitted in any form for any degree or diploma to any tertiary institution. Where use has been made of the work of others it is duly acknowledged in the text.

DECLARATION 1 - PLAGIARISM

I, Olukunle Ayodeji Ogundele declare that

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
3. This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
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5. This thesis does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the References sections.

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DECLARATION 2 - PUBLICATIONS

1. Ogundele O.A, Moodley D., Seebregts C., and A. Pillay (2014) Building semantic causal models to predict treatment adherence for tuberculosis patients in sub-Saharan Africa. Paper presented at the FHIES/SEHC 2014, Washington D.C. 17-18 July 2014.
2. Ogundele O.A, Moodley D., Seebregts C., and A. Pillay (2015). An Ontology for Tuberculosis Treatment Adherence Behaviour. Proceedings of the 2015 Annual Research Conference on South African Institute of Computer Scientists and Information Technologists, (SAICSIT '15), Stellenbosch, South Africa, September 28-30, 2015. Published by ACM (2015). http://dx.doi.org/10.1145/2815782.2815803
3. Ogundele O.A, Moodley D., Seebregts C., and A. Pillay (2016). An ontology for factors affecting tuberculosis treatment adherence behavior in sub-Saharan Africa. Patient Preference and Adherence. 27 April 2016 Volume 2016:10 Pages 669—681. http://dx.doi.org/10.2147/PPA.S96241

Signed:

DEDICATION

All glory to God Almighty, Jesus Christ his son and Holy Spirit, the Spirit divine. You are the source of my inspiration, wisdom and understanding.

Dedicated to Oluwatobi Ogundele. Good things comes to those who wait, those who wait upon the Lord.

Proverbs 3:5-6

ACKNOWLEDGMENT

First, I acknowledge the support of my supervisor, Dr. Deshen Moodley. Thanks for giving me this opportunity and for supporting me through this study. I also acknowledge the support of my co-supervisors, Mr. Anban Pillay and Prof. Christopher Seebregts. Thank you all for your time and professional guidance that have helped me through this study.

I appreciate my lovely wife for her patience, encouragement, prayers and for spending lots of hours editing my draft thesis over and over again. Tobi, you are my one and only cheer leader. God bless you!

I am thankful to my family: Deacon and Deaconess Ogundele, Olumide, Sola, Seun and Opeoluwa. All your prayers over the years have built me up. Thank you all for holding up for me. We already have a story to tell.

My friends, who have always been my encouragers, I appreciate you all. I may not be able to mention your names but, I am grateful for your prayers and words of encouragement. Mr Jude, thanks for your technical support. Laila Gurudas, Thanks for your administrative support. Dr. Bev Soane, thanks for your professional touch in proof reading my thesis.

Lastly, I acknowledge the scholarship and support which I received from the Health Architecture Lab (HeAL) from May 2012 to June 2015. HeAL is an applied Computer Science research laboratory for health informatics to resource-limited settings, which was established through grants from the Rockefeller Foundation (Grant Number: 2010 THS 347) and the International Development Research Centre (IDRC). I also acknowledge the scholarship that I received from UKZN/CSIR Meraka CAIR from July 2015 to June 2016.

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LIST OF ABBREVIATIONS

ABox	Assertional Box
API	Application Programming Interface
BN	Bayesian Network
BDL	Bayesian Description Logics
CDC	Centre for Disease Control and Prevention
CPT	Conditional Probability Table
CQ	Competence Question
DE	Domain Expert
DOT	Direct Observation Therapy
EMR	Electronic Medical Record
KE	Knowledge Engineer
LOINC	Logical Observation Identifiers Names and Codes
OMEN	Ontology Mapping Enhancement
OWL	Web Ontology Language
PR-OWL	Probabilistic extension to OWL
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
SNOMED CT	Systematized Nomenclature of Medicine-Clinical Terms
SPARQL	Simple Protocol and RDF Query Language
SSA	Sub-Saharan Africa
SWAP	Sensor Web Agent Platform
TAB	Treatment Adherence Behaviour
TB	Tuberculosis
TBox	Terminological Box

UML	Unified Modelling Language
UPON	Unified Process for Ontology Building
W3C	World Wide Web Consortium
WHO	World Health Organisation
XML	Extensible Markup Language

Chapter 1

INTRODUCTION

1.1 BACKGROUND

Treatment adherence behaviour is defined as the extent to which a person's practice of taking medication, following a diet and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider [1], [2].

Poor treatment adherence is a pervasive medical problem and a universal risk factor for patients [3]. According to a WHO report [1], there is strong evidence that a large number of patients with various illnesses have difficulty adhering to their recommended regimens, with one study estimating that as many as 50% of patients do not take prescribed medication [4]. Poor adherence negatively impacts patient management, healthcare costs and disease control and can be life threatening to patients suffering from chronic and infectious diseases. For instance, poor or non-adherence of tuberculosis (TB) patients to prescribed treatment leads to resistance to prescribed drugs [5],[6],[7].

Adherence is a complex and dynamic phenomenon with a full range of socio-economic factors affecting a patient's adherence behaviour [8], [9]. Individual treatment adherence behaviour can be influenced by a range of personal, cultural and socio-economic factors that vary between geographical regions and communities and are usually inter-related. Furthermore, their assessment requires information about patients that is not routinely included in clinical data collection [1].

Knowledge of the different types of socio-economic factors, the nature of their influence on different communities and the identification of which factors are most likely to contribute to poor adherence, is essential for the construction of models to predict the risk of poor adherence for a

given patient. Curating and structuring current knowledge about influencing factors is vital for effective resource allocation, intervention and treatment planning in disease programmes[1], [10].

Current knowledge about adherence behaviour includes: categorisations of types of factors that influence adherence; type of effect of factors on patients' adherence behaviour; and strength of influence or probability that the factor will have an impact on adherence behaviour. Categorisations involve grouping of factors based on various themes that define their similarities. For instance, gender and age group can be categorised under "patient-related factors" [1]. The effect of a factor on adherence behaviour could be positive or negative. For instance, in South Africa, persistence of TB symptoms and lack of food have a negative influence on patients' adherence, while the expectation of incentive at the health facilities has a positive influence on patients' adherence [11]. Lastly, the strength of influence deals with the probability or degree of effect on adherence behaviour. For instance, a study by Muture *et al* [12] which was carried out in Nairobi, shows a 95% chance of stigmatisation leading to poor adherence behaviour and the patient's eventual defaulting on treatment.

Formal concept ontologies can be used to capture and structure known factors that have been found to influence adherence behaviour. An ontology is an explicit specification of a conceptualization [13]. Ontologies have a significant capacity to structure and classify categorical knowledge from an unstructured source of data, and provide connections between concepts in a given application domain [14]. They are already used extensively in representing and structuring biomedical and public health concepts [15], [16], [17], [18], [19]. An ontology can underpin a shared knowledge repository of factors that is available to the community and reflects the current knowledge of these factors. However, the applicability of ontologies to deal with causal relationships and uncertainty is limited [20], [21], [22]. For instance, uncertainty associated with the type and degree of influence a factor has on a patient cannot be adequately represented with ontologies.

A Bayesian Network (BN) is a modelling paradigm that has strong support for the way it represents uncertain causal relations. BNs have been used to represent vague and uncertain causal relations between different variables coherently [21], [23], [24] and can potentially be used to represent the causal relationship between certain factors and patient adherence behaviour, and provide an effective structure for predictive modelling. Causal relationships exist between the factors and patients' adherence behaviour. For instance, alcohol abuse, stigmatisation and depression are factors that can lead to a patient's poor treatment adherence behaviour. [1], [25], [12], [11]. However, BNs are limited in their ability to handle complex structured domains [26].

1.2 PROBLEM STATEMENT

A predictive model based on BN requires appropriately structured and unambiguous expert knowledge and data to create its structure and set its parameters and structure [27]. Hence, building a BN to predict adherence risk for a given community requires consolidation and structuring of diverse and even contradictory expert knowledge about factors that are known to influence adherence. While many clinical studies and abstract categorisation systems [1], [8], [28] are discussed in the literature, there is no formal, unambiguous and comprehensive computer based model that structures the factors that influence treatment adherence behaviour. Existing models are ambiguous, have different granularities and a degree of overlap in categorising the factors.

A combination of ontologies and BN has the potential to both formalise and structure current factors that influence adherence behaviour and construct predictive Bayesian networks.

1.3 AIM AND OBJECTIVES

The aim of this research is to develop an ontology-driven approach for predicting treatment adherence behaviour. The objectives of this study can be summarized as follows:

- To develop a comprehensive conceptual model and ontology for structuring current knowledge of the factors that influence tuberculosis treatment adherence behaviour in sub-Saharan Africa
- To design and evaluate a mechanism that uses this ontology for generating Bayesian risk prediction models for specific communities
- To generalise the above approach for developing ontologies to support adherence risk prediction for other diseases

1.4 METHODOLOGY

1.4.1 A Case Study Approach for Exploring Adherence Behaviour

A case study approach was used which allowed for an initial analysis of a concrete real-world situation to inform the design and evaluation of the proposed system.

Adherence behaviour of TB patients within Sub-Sahara Africa (SSA) was selected as the focus of the study. TB adherence in SSA is considered a viable case study for validating the ontology-driven approach and demonstrating its application to real-world situations. Adherence behaviour of TB patients was chosen as the case study because adherence behaviour is crucial for control programmes [1], [2], [12]. Treatment adherence behaviour is considered a critical challenge facing the control of tuberculosis mitigation in SSA [5], [6], [7], [29]. Extensive research has previously been conducted in several SSA countries on TB patients' adherence behaviour that identified several factors as influencing such behaviour [5], [6], [7], [30], [31], [12], [32].

1.4.2 Methods for Achieving the Objectives

The TB adherence case study is used to inform the development and validation of the approach. The following process steps were taken in order to develop an ontology-driven approach for predicting adherence behaviour. First, a review of existing ontology engineering methodologies was carried out in order to identify a suitable methodology for building an ontology-driven

approach for representing adherence behaviour. Second, adherence behaviour modelling and adherence studies, specifically those relevant to tuberculosis in sub-Saharan Africa, were reviewed to understand the need for developing an adherence behaviour knowledge base to support prediction. Third, a suitable ontology engineering methodology from the reviewed methodologies is selected and adapted for developing an ontology-driven approach for modelling treatment adherence behaviour. Fourth and lastly, methods of integrating ontologies and BN for probabilistic reasoning were reviewed in order to identify suitable mechanisms and formal languages for generating and representing a BN model with an ontology. A suitable mechanism is integrated into the ontology-driven approach.

The developed approach is evaluated using the TB case study mentioned above (section 1.4.1), through which a conceptual model and an ontology for factors that influence TB adherence behaviour was developed. Firstly, the approach is used to develop a conceptual model for factors that influence TB adherence behaviour which is more comprehensive than the existing categorisation systems. Secondly, the conceptual model is formalised into an ontology and is used to capture facts from scientific publications about the factors that influence treatment adherence. Thirdly, the ontology that is developed with the approach is used to construct a BN model for a specific TB community. This involved transforming the factors captured with the TB adherence ontology into BN primitives, generation of a BN model with the primitives and representing the BN model with the ontology.

1.5 MOTIVATION FOR THE STUDY

The construction of a predictive model from the factors affecting treatment adherence is needed, especially in sub-Saharan African countries that characteristically have low resources for disease control. The knowledge of these factors is essential for predicting which individuals and communities are at a high risk of non-adherence [33], [34]. Stakeholders in the health sector need to support decision-making processes regarding resource allocation, patient management and

intervention planning, with the knowledge of patient adherence in order to improve treatment outcomes [28], [8].

Existing models [1], [8], [28] are not developed for risk determination and predictive modelling. Although the models provided categories of factors and their influence on adherence behaviour, they do not specify the relations between the factors, the findings presented in clinical studies and the communities where the influence of these factors is established. This poses challenges for understanding and comparing findings in clinical studies, and using the models to construct predictive models for specific communities.

1.6 CONTRIBUTIONS OF THE STUDY

The study has two main outputs that have made a contribution to adherence modelling and knowledge representation. First, an ontology-driven approach for modelling adherence behaviour useful for constructing BN models is presented. The approach provides a sequence of steps to classify and structure adherence factors via a concept hierarchy, and links these concepts with scientific knowledge about adherence factors. Second, an ontology for TB adherence factors is produced through the application of the approach to SSA TB patients' adherence factors.

1.6.1 The Contribution of the Study to Adherence Modelling

The study provides a specific methodology for building an adherence behaviour knowledge-base which can be navigated, queried and used for supporting adherence risk prediction. The study presents a method for modelling adherence behaviour in a manner that can facilitate prediction of risk adherence for communities. The approach also contributes to the structuring of explicit knowledge (scientific research) about adherence behaviour; thus providing an evidence-base for decision-making in medical practises, disease intervention and public health policy development.

1.6.2 Contribution to Knowledge Engineering

The study contributes to ontology engineering by establishing the use of scientific publications as a viable source of knowledge. Scientific publications are used in the study as sources for acquiring concepts that can be developed into an ontology, as well as sources for acquiring facts that are captured in the ontology.

An ontology engineering method and BN modelling concepts are integrated to build an approach that can be used to develop an ontology for predictive model construction. The steps of the approach enable the creation of an ontology that can be used to construct a BN model; clinical facts are captured as evidence for constructing BN primitives in an ontology.

1.6.3 The Impact of the Study

The ontology-driven approach proposed in this study will impact disease control programmes, especially in the monitoring of treatment defaulters and intervention planning for communities at risk. It will impact the decision-making processes of community health officers and the re-use of knowledge by adherence experts. The impact of the study will be to:

- influence adherence modelling with a method that can be used to produce a computer based model for adherence behaviour across various geographical regions and disease areas
- enhance understanding and interpretation of knowledge about adherence behaviour with the opportunity to access and navigate through structured facts about the adherence behaviour of various communities
- enable scientific research (explicit knowledge) use as an evidence-base for decision-making support in medical practices and intervention planning in various disease control programmes

- contribute to the prospect of establishing a global ontology-based repository of adherence knowledge to facilitate sharing and re-use of adherence knowledge across regions and various disease areas

1.7 STRUCTURE OF THE REMAINING CHAPTERS:

The remaining chapters are structured as follows:

- **Chapter 2- Literature Review:** This review presents the state-of-the-art in factors influencing adherence behaviour and the application of ontologies and Bayesian networks for knowledge representation, especially in the public health domain.
- **Chapter 3- An Ontology-Driven Approach for Adherence Behaviour Modelling:** This chapter introduces the proposed ontology-driven approach for constructing a computation representation for adherence behaviour. The steps to be followed in developing the adherence behaviour conceptual model and formalising it into an ontology are also explained in the chapter.
- **Chapter 4- A Conceptual Model for TB Adherence Factors:** This chapter discusses the application of the proposed approach to TB adherence behaviour. It consists of a description of the application of the first four steps of the ontology-driven approach to TB adherence. A conceptual model for TB adherence is further discussed.
- **Chapter 5- An Ontology for TB Adherence Factors:** This chapter discusses the formalisation of the conceptual model into an ontology that is sharable among human experts and understandable by machines. The chapter also explains the formalisation process using the TB adherence conceptual model as the departure point into the construction and testing of the TB adherence ontology.
- **Chapter 6- Constructing Models for Predicting Adherence Risk:** This chapter discusses the design and implementation of probabilistic reasoning of the TB adherence ontology. It discusses the approach to generating BN primitives from the ontology and

extension of the ontology with a SWAP-Uncertainty ontology for representing BN models. The chapter also demonstrates how the ontology can be used to construct a BN model for a specific community.

- **Chapter 7: Discussion and Conclusion:** The last chapter presents the key achievements of the study in relation to the set objectives. It presents a reflective discussion of the set objectives from chapter 1. Discussions on the significance of the ontology-driven approach to representing the complexity of adherence behaviour are also highlighted in this chapter. Lastly, the limitations of the approach are discussed as well as the areas needing further development and active research work.

Chapter 2

LITERATURE REVIEW

Understanding which factors influence treatment adherence is essential for supporting disease programmes in terms of resource allocation and intervention planning, and for predicting which individuals and communities are at a high risk of non-adherence. This chapter highlights the importance of factors that influence adherence behaviour for disease control programmes, specifically pertaining to tuberculosis-related behaviour in sub-Saharan Africa, and the challenges with current models that categorise factors that influence adherence behaviour. It then discusses recent research on the use of ontologies as a paradigm for modelling complex phenomena similar to adherence behaviour. Lastly, it discusses various approaches for integrating Bayesian Networks with ontologies to represent the causal relationships and uncertainties associated with adherence behaviour.

2.1 UNDERSTANDING TREATMENT ADHERENCE BEHAVIOUR

Generally, adherence to treatment is referred to as the ability of a patient to follow the recommended course of treatment, for instance, by taking all the prescribed medications for the entire duration of treatment. The World Health Organisation (WHO) defines treatment adherence as "the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider" [1]. According to the Centre for Disease Control and Prevention (CDC) report, refusal or inability to take the prescribed drugs is termed non-adherence [2], or poor adherence.

Non-adherence or poor treatment adherence is either the inability caused by situations beyond the patient's control or refusal, which is the sole determination of the patient to adhere to medication,

diet and lifestyle [28], [9]. Adherence behaviour will be limited to the ability or inability to take prescribed medication. For the purpose of this study, all other kinds of therapy are excluded to establish a narrow scope for the review. The definition of adherence that will be considered in the study will include patient's inability to follow prescriptions. For instance, there are situations where physical or social barriers cause poor adherence in patients, and there are other cases where certain personal conditions hinder patients from taking medications.

2.1.1 Impact of Adherence Behaviour on Disease Control Programmes

Adherence behaviour of patients is a key determinant of treatment success [35]. It has clinical consequences, a major effect on treatment outcomes, and can lead to financial burden for societies [28]. According to a WHO report [1], there is strong evidence that many patients with various illnesses have difficulty adhering to their recommended regimens. Brown and Bussell state that approximately 50% of patients do not take prescribed medication [4]. This can have consequences for medical practices and disease intervention programmes [9], [35]. Quality healthcare outcomes rely on patients' adherence behaviour [9].

According to Sokol *et al*, good adherence behaviour offsets healthcare costs for diabetics and hypertension patients and significantly lowers hospitalisation rates, which is one major high cost factor in healthcare [36]. Also Brown and Bussell [4] note that increasing adherence may have a greater effect on health than improvements in specific medical therapy. They affirm that adherence is a key factor associated with the effectiveness of all pharmacological therapies but is particularly critical for medications prescribed for chronic conditions [4], [9].

Munger *et al* state that poor treatment adherence is a pervasive medical problem and a universal risk factor for chronic disease patients [3]. Poor adherence causes medical and psychosocial complications of disease, reduces patients' quality of life and wastes health care resources [1], [9], [35]. The WHO report also confirmed the negative impact of poor adherence on costs for management and the control of chronic diseases [1]. This is significant in developing countries

where failing treatment impede national and international efforts to control chronic and infectious diseases.

On the other hand, knowledge of treatment adherence behaviour is crucial for unravelling patient-centred treatment and alternative intervention plans for disease control. The WHO report on adherence behaviour [1] has identified the need to change the intervention programmes to a system that is patient-centred, and which is anchored on understanding the existing behaviour and perception of target groups [37]. This requires that healthcare officers are able to identify the social characteristics of patients and to have a knowledge of how patient behaviour affects treatment compliance [10]. A patient-centred treatment service calls for an understanding of patient adherence behaviour and how this can be used to package patient-based intervention plans[9], [35], [8].

The need to understand the cause of treatment failure and treatment defaulting cannot be over-emphasised. For example, the ability to identify TB patients' adherence behaviour through profiling of TB communities will go a long way to influence how the healthcare services and intervention plans are prepared [9], [35]. Treatment services are often packaged equally for all patients, using their biomedical information. However, patients' decisions not to access treatment makes them treatment defaulters and also contributes greatly to drug resistance. Patients' decisions are greatly influenced by their adherence behaviour, which result from socio-economic characteristics of the communities and the psychological behaviour of a patient [1]. The preparation of comprehensive treatment packages and intervention plans should not only involve consideration of biomedical information but also the adherence behaviour of patients [9], [28], [8], [1].

Furthermore, planning and resource allocation is usually based on expert knowledge which is informed by healthcare providers' clinical experience: from treating patients from local communities, awareness of local conditions and culture, and findings from studies in other regions

and communities with similar characteristics [1]. Knowledge of adherence behaviour can help leverage patients' responsiveness on their adherence risk indexes, thus helping in the allocation of resources for their treatment access [9]. This will greatly support intervention programme planning in regions where resources are low and there is a need to dynamically diversify limited resources. In such a case, resource requirements of communities can be leveraged with the adherence risk indexes. A high risk community will be allocated more resources due to the high likelihood of having defaulters. Allocation of resources can become dynamic using the available knowledge of treatment adherence behaviour of varying communities.

2.1.2 Adherence Behaviour and Tuberculosis Control Programme in SSA

One of the greatest challenges facing TB control programmes in SSA is treatment failure, mostly resulting from patients' not completing their treatment for various reasons. Treatment failure has been identified as a major cause of death and drug resistance in TB patients [29], [5], [6], [7]. In order to reduce treatment failures, the Direct Observation Therapy (DOT) strategy was proposed and widely adopted by several countries for monitoring patients undergoing anti-TB treatment [38]. Subsequently, poor adherence to treatment has been identified as a significant contributor to treatment failure [5], [6] in tuberculosis (TB) patients in SSA. It is regarded by WHO [1] as one of the causes of drug resistance and high rates of morbidity and mortality, especially in developing countries.

The understanding of treatment adherence behaviour is important for carrying out a successful TB intervention programme in SSA. Accurate assessment of treatment adherence behaviour is necessary for effective and efficient TB treatment planning and for certifying that fluctuations in treatment outcomes can be attributed to the recommended regimen [1]. Patients' adherence information will help healthcare workers to have a knowledge of how patient behaviour affects treatment outcomes; using the social characteristics of patients in relation to their responses to

treatment, improved outcomes are achieved [10]. Treatment adherence is not seen as the exclusive responsibility of the patient, it is rather a collective responsibility of the patient, healthcare giver, the family and the community at large [4], [9].

2.2 FACTORS THAT INFLUENCE TREATMENT ADHERENCE BEHAVIOUR

Despite the fact that adherence behaviour measurement provides useful information for managing patients and predicting treatment outcomes, it is still very difficult to measure. Brown and Bussell state that identification of non-adherence is challenging and requires specific interviewing skills [4]. This is because adherence is a complex and dynamic phenomenon [10]. Adherence information cannot be provided by outcome-monitoring alone [1] but also from further insight into the behaviour of patients under treatment.

Measuring treatment adherence behaviour is challenging; it is costly and requires patient information that is not included in clinical data collection [1]. Adherence behaviour is difficult to understand and it is even more challenging for health workers to identify potential treatment defaulters [1] because adherence behaviour in patients is caused by complex factors [3], [1]. These factors, which have been classified into categories such as social, economic, clinical, biological, patient-related condition-related and so on [4], [1], [10], [12] interconnect to motivate the autonomous and dynamic behaviours of patients receiving treatment. They vary in granularities and also vary across socio-economic regions and degrees of influence. The complexity of the cause-effect relationship that exists between the factors and poor adherence eventually leads to patients' refusal to take drugs, defaulting treatment and dropping out of treatment plans.

Most of the factors that have been identified from various studies have been shown to cause poor adherence in patients. These factors include adverse effect of drugs, poverty, substance abuse, stigmatisation, wellness perceived as disease cured, lack of belief in treatment efficacy and lack

of knowledge about the illness and its treatment [6], [12], [29]. These factors, however, can also be linked to good adherence behaviour, depending on the state and perception of patients.

The above factors and their effects on patients are related to the patient's state, perception or experiences. Patients' physical and mental state, perception and experience of these factors is linked with poor or good adherence to treatment. For example, the adverse effect of drugs is based on the patient's experience with medications; negative experiences are seen to cause poor adherence. Also, a strong belief in treatment efficacy seems to promote good adherence, while the lack of belief is regarded as a negative influence on adherence behaviour.

2.2.1 Existing Categorisation for the Factors

Earlier studies carried out an assessment of factors that influence adherence behaviour for the purpose of providing a better understanding of the relationship between the factors and patients' adherence, and for proposing appropriate intervention strategies. These studies include a World Health Organization (WHO) study by Sabate, 2003 [1], a systematic review by Munro *et al* [8], Jin *et al* [28], Brown and Bussell [4], Castelnuovo [39], and Kruk *et al* [40]. While studies by Munro *et al* [8], Castelnuovo [39] and Kruk *et al* [40] focused on TB, the WHO study by Sabate, 2003 [1], Jin *et al* [28] and Brown and Bussells [4] focused on adherence and considered multiple diseases. Some of these studies published categorisation systems through which some dimensions for categorizing the factors were established. The dimensions identified from the studies include factor type, type of effect, degree of effect, regional and temporal variation. These categorisations will be briefly described in this section and the detail assessment will be presented in Chapter three.

A study by the WHO was aimed at structuring appropriate intervention plans for several infectious and chronic diseases [1]. This is the earliest known attempt to consolidate knowledge about influencing factors from several qualitative and quantitative studies for the purpose of proposing comprehensive intervention plans for different types of diseases. The study presented a

categorization with five major categories based on factor type dimension; these are p*atient-related*, *socioeconomic*, *health system*, *therapy-related*, *condition-related*. It also presented another categorisation based on the type of effect; namely, *positive factors* and *negative factors*

Munro *et al* conducted a systematic review of the literature from 1999 to 2005 and developed a model for categorizing the factors [8]. The review was aimed at understanding which factors are considered important by TB patients, caregivers and healthcare providers. A total of 44 articles drawn from different regions of the world were reviewed. From the study, four main categorization themes were developed based on factor type dimension: structural factors, personal factors, social context factors and health service factors.

Jin *et al*. [28] identified some categorizations for representing influencing factors through a systematic review of 102 articles that focused on all types of therapy for several chronic and infectious diseases. The study examined common factors causing therapeutic non-adherence from the patient's perspective and identified 3 dimensions for classifying these factors. Firstly, they presented five categories based on factor type: *patient-centred*, *therapy-related*, *healthcare system*, *social and economic*, and *disease-related*. Secondly, they presented three categories based on the type of effect: *compliance increment, compliance decrement* and *no-effect*. Thirdly, they presented three categories based on difficulties encountered in measuring the effect and counter intervention of the factors: *hard factors* and *soft factors*.

Two categories were identified through a review of six studies carried out by Castelnuovo [39] to depict the period of effect of factors. The categories relate to the treatment phases of an anti-TB treatment plan. They are the *intensive phase* of anti-TB treatment after the patients are diagnosed with TB and the *continuation phase*, which starts immediately after the intensive phase.

Other categorisations include temporal representations, such as the weekly and monthly categorizations introduced by Kruk *et al* [40] based on a review of 14 studies that focused on the timing of default in low income countries' TB treatment. Another categorisation is the study of

Brown and Bussell [4] that identified 3 broad categories based on factor type through a review of 127 papers. The three categories are *patient-related*, *physician-related* and the *health system-related* factors.

2.2.2 Challenges with Existing Categorization Systems

It is imperative that stakeholders in the health sector support the disease programmes regarding resource allocation and intervention planning. However, the mandate can only be effectively achieved if they understand which factors influence treatment adherence. The knowledge of these factors is essential and useful for predicting which individuals and communities are at a high risk of non-adherence. Conversely, there exists no computational representation of knowledge about these factors, which can be used to curate and share the factors among human experts and predictive modelling tools.

There are some challenges with the existing systems that make them unfit as a concrete computational representation of factors that influence adherence behaviour. Some will be highlighted here to show the gap that is required to be filled by this study. The detailed discussion of these shortcomings will be elaborated on in chapter three as a pre-analysis for the construction of a conceptual model for representing the factors.

- There are large variations in the systems presented in existing studies and this is a challenge for a common and sharable representation of the factors. For instance, the categories identified across the papers may appear similar, but the description of the categories and the factors belonging to each category vary
- There is inconsistency in the naming and definition of existing categorization systems as there are no generally accepted names for the categories. For instance, patient-related factors have different names and meanings across the systems that have included it in their categorisation

- There is also no uniformity in the classification hierarchy as some of the existing systems introduce sub-categories while others do not. In the systems that do not have sub-categories, factors are directly grouped under the main categories
- None of the categorization systems represent all the categorization dimensions. While some represent more than one dimension in their studies, others concentrate only on one dimension. Also, some dimensions are not included in any of the categorizations. One of these is the cross-dependency between influencing factors; some clinical studies have established cross-dependencies among factors, that is, a factor's influence is dependent on another factor [41]
- Lastly, none of these categorisations are concretely defined. There is no concrete definition of the dimensions and elements of the categorisation system.

2.3 KNOWLEDGE REPRESENTATION WITH ONTOLOGIES

Gruber [13] defines an ontology as an explicit specification of a conceptualization. According to Hoss [42] an ontology consists of hierarchically arranged concepts, relationships among these concepts and rules that govern these relationships. Similar descriptions of ontologies by Noy and McGuinness [14], Roussey *et al* [43] and Musen [44] highlight the significance of ontologies to facilitate proper organization of concepts, information and ideas within a specific domain. The benefits of ontologies include the following:

- An ontology defines a common vocabulary within a domain. It reveals the connections and relationships between concepts in ways that are broadly accepted in a specific domain.
- Ontologies allow human users to share a common understanding of concepts and information relating to these concepts.

- Ontologies allow re-use of expert knowledge which is captured in knowledge bases and facilitate sharing of this knowledge among people.
- Ontologies allow for reasoning. Facts that are not explicitly expressed may be inferred from the knowledge base.
- An ontology includes machine-interpretable definitions of basic concepts in the domain and relationships among them. Thus, they can be understood, used and shared by different software agents.

The wine ontology [14] is a typical example of an ontology. A list of examples of good ontologies are given by W3C, which include the Dublin Core (DC), Friend Of A Friend (FOAF), Socially Interconnected Online Communities (SIOC), Music and MarineTLO ontologies[1]. In public health, some exiting ontologies include drug and patient information classifications [69] and TB care pathways [46].

2.3.1 Types of Ontology

According to Roussey *et al* [43], it is imperative to differentiate between various types of ontologies in order to provide clarity regarding their goal, use and content. There are several classification dimensions for ontology; three of these will be discussed in this section. They are classifications based on conceptualisation level [47], language expressivity and formality and scope of the ontology/domain's granularity [43].

2.3.1.1 Classification Based on the Scope of the Ontology/Domain Granularity

A comprehensive analysis of ontology classifications was carried out by Roussey *et al* [43]. They identified types of ontologies using two major categorisations: classifications based on language expressivity and formality, and classifications based on the scope of the ontology. According to Roussey *et al* [43] ontologies can be classified according to the scope and focus of the ontology;

[1] https://www.w3.org/wiki/Good_Ontologies

this is similar to the classification by conceptualisation level that was presented by Bermejo-Alonso and Sanz [47]. Figure 2.1 below shows various types of ontologies based on scope.

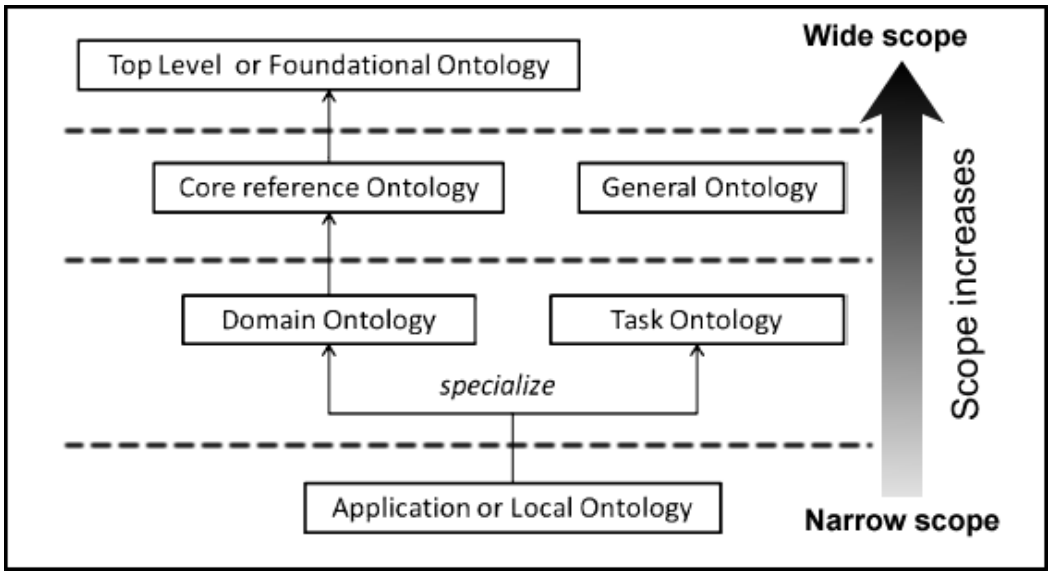

Figure 2.1: Ontology classification based on scope; adapted from [43]

- **Local/Application Ontologies:** Local or application ontologies are specializations of domain ontologies where there could be no consensus or knowledge sharing. This type of ontology represents the particular model of a domain according to a single viewpoint of a user or developer.
- **Domain Ontology:** Domain ontology is only applicable to a domain with a specific viewpoint. That is, this viewpoint defines how a group of users conceptualize and visualize a specific phenomenon.
- **Core Reference Ontology:** Core reference ontology is a standard used by different groups of users that is often built to catch the central concepts and relationships of the domain. This type of ontology is linked to a domain but it integrates different viewpoints related to specific groups of users.
- **General Ontologies:** General ontologies are not dedicated to a specific domain or field. They contain general knowledge of a huge area.
- **Top Level or Foundational Ontologies:** Foundational or top level ontologies are generic ontologies applicable to various domains. They define basic notions like objects, relations, events, processes and so on.

2.3.1.2 Classification Based on Language Expressivity and Formality

Ontology components can be defined differently, depending on the level of knowledge representation languages used to describe it. The representation differences include difference of textual definition, set of properties and logical definition [43].

- **Information Ontology:** This type of ontology is mostly used by humans and is composed of diagrams to organise project ideas. It is easily editable and scalable and focuses mainly on concepts, instances and their relationships
- **Lingustic/Terminological Ontologies:** These types of ontologies can be taxonomies, lexical databases, glossaries, controlled vocabularies and dictionaries. They mainly focus on terms and their relationships
- **Software Ontologies:** These ontologies are software implementation-driven ontologies that provide conceptual schemata that focus on data storage and manipulation. The main goal of this type of ontology is data consistency.
- **Formal Ontologies:** This type of ontology requires a clear semantic language for describing concepts and rules about these concepts and their relationships for the purpose of logical data description, consistent data storage and reasoning.

Formal ontologies are significant for facilitating knowledge sharing across platforms. Irrespective of the ontologies' type, formalising an ontology with a formal language will make the represented concept clear and consistent. It will also facilitate sharing and re-use of the concept by humans and machines, and across systems, applications and community boundaries.

2.3.2 The Web Ontology Language

The recommended standard ontology language for the Semantic Web is the Web Ontology Language (OWL) which is designed to represent rich and complex knowledge about things, groups of things and relationships between things[2]. OWL is based on formal semantics and is intended to provide a language that can be used to describe concepts and relationships between them that are inherent in Web documents and applications [43].

OWL is a part of W3C semantic web standard stacks which include RDF, RDFS and SPARQL. It was introduced to address the drawbacks of RDF and RDFS, extending them through the

[2] https://www.w3.org/TR/owl2-overview/

incorporation of additional vocabulary for describing properties and classes. Features of OWL include relationships between classes, enumerated classes, cardinality equality and characteristics of properties [48], [49].

OWL is similar to RDF but is more expressive with greater machine interpretability. OWL is widely used for ontology representation [50]. OWL ontologies are typically stored using the XML format, however alternate syntaxes are available including Turtle and the Manchester syntax.

Class, attribute and relationship are represented as class and properties in OWL. *owl:Class* is used to represent class; it is a specialisation of *rdfs:Class*. *rdf:Property* is used to represent property and is divided into *owl:ObjectProperty* and *owl:DatatypeProperty*, while *owl:ObjectProperty* applies to object properties of a class and *owl:DatatypeProperty* applies to literal antetypes.

Description logics (DL) provide the underlying formal framework for OWL and allow for inferences to be performed on the knowledge described with OWL. Description logics provide the underlying formal framework for OWL and RDF. A knowledge base in a description logic framework consists of two parts; the Terminological Box (**TBox**) and the Assertional Box (**ABox**). Declarations about concepts are contained in the TBox and the facts about objects and statements about these facts are contained in the **ABox**. In order to produce additional inferences in the ontology, a reasoner is used to apply rules of the language to the statements contained in both **TBox** and **ABox**.

OWL has been implemented in some desktop editing tools to make it easier for users to build ontology syntaxes. The tools include Protégé-OWL, from Stanford Medical Informatics, and Swoop from the Mindswap laboratory at the University of Maryland. These editing tools also

implement reasoners to facilitate additional inferences. The implemented reasoners in Protégé[3], for example, include Pellet, RacerPro, Fact++, HermiT and KAON2.

There are two versions of the OWL language; OWL 1 and OWL 2. OWL 2 is an improvement of OWL 1. OWL 1 has three major sub-languages with increasing levels of expressivity. The difference between these sub-languages is the trade-off between expressivity and decidability. OWL 1 Lite is the most expressive and least decidable OWL sublanguage. OWL 1 Full is the, on the other hand, least expressive and most decidable. OWL 1 DL is most expressive but still decidable [51]. Grau *et al* [51] stated that although OWL 1 has been successful, there were still certain problems identified in its design that called for revision and led to the development of OWL 2.

Grau et al [51] highlighted the problems with OWL 1 which are resolved in OWL 2, these include and are not limited to, expressivity issues, problems with its syntaxes and deficiencies in the definition of OWL species [51]. OWL 1 DL is the most expressive, however, it lacks particular constructs that are necessary for modelling complex domains. Modellers have been solving expressivity problems such as qualified cardinality restrictions, relational and datatype expressivity with workarounds that are often not sound or complete with respect to the intended semantics. The relationship between the two normative syntaxes of OWL 1; the Abstract Syntax and RDF is complex and causes problems when converting one syntax into the other. Certain design choices in OWL 1's abstract syntax has made it confusing for developers, which resulted in the suboptimal design of OWL APIs. OWL 1 was designed when meta-modelling had not been widely considered, thus, classes, properties and individuals must be disjointed in OWL Lite and OWL 1DL, making it challenging to create a meta-model in OWL 1.

OWL 2 was designed to mitigate the expressivity and modelling challenges of OWL 1 and to provide a robust platform for future development [51]. The resolution of these identified

[3] http://protegewiki.stanford.edu/wiki/Using_Reasoners

limitations marks the major difference between OWL 1 and OWL 2. The expressivity limitation was resolved in OWL 2, through the extension of the DL from SHROIN to SHROIQ. Hence, OWL 2 is more expressive and decidable than OWL 1. Also, several extensions were made on OWL 2 that led to an improved syntax, one of which is the introduction of Functional-Style Syntax which is more verbose than Abstract Syntax. Lastly, the meta-model problem was resolved in OWL 2 by specifying the structure of the ontologies using the Meta-Object Facility (MOF) [51] which is a well-known meta-language.

OWL 2 has three sublanguages further to the two major dialects, OWL 2 DL and OWL 2 Full. The two major dialects are improvements on OWL 1 DL and OWL 1 Full, and their relationship and underlying motivations are still the same as in OWL 1. The sublanguages have favourable computational properties and are easier to implement. While they have restricted expressivity, they are sufficient for a variety of applications. The following are the descriptions of the sublanguages of OWL by Hitzler et al [52].

- OWL 2 EL is one of the sublanguages that was designed with large biomedical ontologies in mind. It has polynomial time reasoning complexity and was based on the common attributes of biomedical ontologies which include complex structural descriptions, huge number of classes, the substantial management of terminologies with classifications, and the application of classified terminologies to vast amounts of data.
- OWL 2 QL is designed to enable easier access and query to data stored in databases. It is a result of extensive research on database integration. It can be tightly integrated with RDBMSs and benefits from their robust implementations and multi-user features. It serves as a translational layer for RDBMS implementation. Lastly, it can represent key features of Entity-relationship and UML diagrams.
- OWL 2 RL is designed to accommodate OWL 2 applications that can trade the full expressivity of the language for efficiency. It can also accommodate RDF(S) applications

that need some added expressivity. It is aimed at applications that require scalable reasoning without sacrificing too much expressive power.

Ontology editing tools have been updated to accommodate the improvements of OWL 2. For instance, the Protégé ontology editor has been extended in its newer versions to support the additional constructs of OWL 2.

2.3.3 Ontology Engineering

According to Noy [14], ontology design is a creative process and no two ontologies designed by different people would be the same. This process is often referred to as ontology engineering. Ontology engineering is a process of building ontology which requires the expertise of knowledge engineers and domain experts. Although there are automated methods of constructing ontologies, expert knowledge is required in the completion, consolidation and validation of the automatically generated ontology.

2.3.3.1 Gruber's Guideline

One of the earliest introductions of the ontology engineering method was the set of criteria proposed by (Gruber) to guide in the building of an ontology. The criteria for designing an ontology, whose purpose is for knowledge sharing and interoperability as given by (Gruber) includes clarity, coherence, extendibility, minimal encoding bias and minimal ontological commitment. Clarity of ontology design requires that the intended meaning of the terms to be defined in the ontology should be effectively communicated. Coherence of the ontology entails the logical consistence of the defined terms and their inferred meanings. For an ontology to be extendable, it should allow for user-defined terminologies based on existing vocabularies without requiring revision of the existing definition. The conceptualization should be specified at the knowledge level without depending on a particular symbol-level encoding to reduce encoding bias to the minimum. Lastly, ontology should make minimal commitments by defining only those

terms that are essential to knowledge communication in a consistent manner and that specifies the concept's weakest theories.

2.3.3.2 Unified Methodology [53]

Uschold [53] proposed a unified methodology for building ontology based on the 3 dimensions along which ontology varies: formality, purpose and subject matter. He observed that the way to build ontologies depends very heavily on the particular circumstances under which an ontology is desired.

Formality of an ontology refers to the degree by which a vocabulary is created and meaning is specified in a formal way. There are 4 kinds of formalities: highly formal, structured informal, semi-formal and rigorously formal. *Highly informal* is a loosely expressed concept in natural language; s*tructured informal* is an expression in a structured form of natural language; *semi-formal* is the use of an artificial, formally defined language for concepts' expression; and *rigorously formal* is the highest formality and refers to the defining of concepts with formal semantics, theorems and proofs of properties as sound and complete.

The purpose of an ontology is concerned with the intended use of the ontology. An ontology is used for various purposes. One purpose is for the facilitation of communication between people. Another purpose is for ensuring interoperability among systems. Lastly, an ontology is used for system engineering in order to achieve system benefits which include reusability, knowledge acquisition, reliability and specification. The variation of an ontology is dependent on the purpose for which it is built, thus, an engineering ontology can be fashioned according to this purpose.

The subject matter of an ontology refers to the nature of the subject matter that the ontology is characterising. The three main categories of subject matters are identified as: the domain ontology which deals with specific domain knowledge representation; the task ontology that deals with problem solving; and the meta-ontology that deals with representing information about the ontology.

The unified methodology [53] proposes that the identification of the purpose of the ontology should be the first step in building an ontology. Afterwards, the scope of the ontology should be defined. These two steps will provide an informal concept of the domain to be represented and will also guide the selection of the approaches to be used to formalise the informal concepts of the domain. The formal ontology can then be evaluated for competence. The whole process is cyclical and iterative, with attention shifting from informal representation to formal representation, as the ontology evolves.

2.3.3.3 MethOntology [54]

MethOntology is a well-structured way to build any kind of ontology or meta-ontology from scratch. In the development of an ontology, one must be aware of the major tasks to be performed and how these will be organised [54]. The MethOntology process involves the following phases: a) specification b) knowledge acquisition c) conceptualisation d) integration e) implementation f) evaluation and g) documentation. These phases will be explained in detail below.

The *specification phase* seeks to produce an ontology specification document that is written in natural language through the use of intermediate representations or competency questions. This can be an informal, semi-formal or formal representation. Information such as the ontology's purpose, formality level for codifying terms etc. and the scope of terms are identified. These processes ensure that synonymous terms and other irrelevancies are taken out of the ontology, leading to a concise and apt ontology specification document.

The *knowledge acquisition phase* is an independent activity in developing the ontology. Knowledge acquisition tools such as books, figures in addition to interviews and informal analysis of texts provide a source of knowledge for the ontology. The *conceptualisation phase* involves the structuring of the domain knowledge using a conceptual model that is produced to describe the problem and how it can be solved. After this phase, a glossary of terms is built and all useful and potentially usable domain knowledge and its meanings are identified and gathered.

To facilitate speed when constructing an ontology, the *Integration phase* is necessary for the creation of an integration document which is a summary of the meta-ontology to be used. It contains the name of the conceptual model's term, the name of the definition, its arguments in the ontology etc. The *Implementation phase* is where the ontology is codified into a formal language. The *Evaluation phase* is where technical judgement of the ontology is carried out. This is the phase where the verification (how correct an ontology is) and validation (representativeness of the ontology) are performed. There are no constituted guidelines on how ontologies are to be documented, thus, the *documentation phase* is, in many instances, the point at which the ontology is documented as its own code.

2.3.3.4 Unified Process for Ontology Building [55]

UPON[4] is the method presented for large scale ontology building and is obtained from the unified software development process (UP) [55], [56]. UPON is aimed at generating an ontology that serves its users and is thus *use-case driven.* The UPON process is severally repeated (*iterative)* and at every cycle is further broadened and developed (*incremental).* It is made up of cycles, phases, iterations and workflows. Each of the cycles[5] consists of 4 phases that result in the delivery of a new ontology version. Phases are further split into iterations and for each iteration, 5 workflows[6] occur [56]. The *inception phase* is where the first iterations capture requirements, including some conceptual analysis where no implementation or test is performed. The *elaboration phase* is where subsequent iteration analysis is performed and fundamental concepts are identified and loosely structured. The *construction phase* encompasses iterations in the design and implementation workflows. The *transition phase* is where testing is performed intensively and the ontology is then released afterwards.

[4] Unified Process for ONtology building
[5] Inception, elaboration, construction and transition
[6] Requirements, analysis, design, implementation and test

The UPON framework's building activities have the involvement level of two main experts; the domain expert (DE) and the knowledge engineer (KE). The DE largely provides information and knowledge about the domain to enrich the concepts to be implemented in the ontology, while the KE provides technical knowledge for the representation of the concepts. The DE contributes in the initial workflows and partly during the *Test* and the KE is focused largely on the *design* and *implementation.* Due to the incremental nature of UPON, significant terms in the domain are identified, gathered in a dictionary and gradually enriched with definitions to produce a glossary. Once basic ontology relationships are incorporated, a thesaurus is created, leading to a more enriched reference ontology.

The W*orkflow* package includes five workflows; requirement, analysis, design, implementation and testing. The workflows are carried out throughout the phases of the ontology with attention shifting from requirement analysis to design and implementation. Each phase produces a slightly completed ontology, with the early phases focusing on establishing the requirement and the later phases resulting in incremental ontology release. Each cycle results in a completed version of the ontology which improves and becomes incremental with new cycles. The five workflows are further explained below.

Requirements Workflow

The *Requirements Workflow* is where semantic needs and knowledge that would be encoded in the ontology are acquired. Knowledge acquisition is a vital component of ontology engineering and is important in this workflow. It is fundamental to the construction of the domain's conceptual model which will be formalised in the ontology. Modellers, knowledge engineers and the final users reach an agreement through the requirements workflow which ensures that the focus is on the appropriate fragment of reality to be modelled. This workflow entails 6 process steps. They are: identification of the scope of the domain of interest; purpose definition; storyboard writing; creating the application lexicon; identifying competency questions (CQ); and use-case identification and prioritisation.

Analysis Workflow

The *Analysis Workflow* entails refining and organizing ontology requirements identified in the requirements workflow. The ontology is extended through the re-use of existing resources and by refining concepts. It entails firstly, the building of the domain lexicon from domain resources. The domain lexicon is then converted into a reference lexicon through the establishment of meanings of the selected terminologies used in the ontology. The latter part of the workflow is focused on the building of the application scenario with a UML tool and the production of a reference glossary encompassing the relevant concepts and their definitions.

Design Workflow

After the identification of processes etc. in the analysis workflow, the *Design Workflow* refines these processes and relationships and models them into a semantic network. At this workflow stage, the concepts are developed into a model that is implementable with the ontology. Modelling concepts are identified to be used for representing the domain concept. The key concepts and the relationships between the concepts are developed into a model that best represents the application scenarios. Likewise, each level of the concept is identified and modelled into the hierarchy. The output of the workflow is a semantic network that is ready for implementation with an ontology language.

Implementation Workflow

The *Implementation Workflow* involves the language formalisation process of the ontology and its implementation with respect to its components. To allow subsequent iterations' integration, use-case prioritisation from the requirements workflow and *packaging* from earlier workflows permits component engineers to work on different parts of the ontology. The conceptual model that has been designed into a semantic network is implemented into a chosen ontology language - OWL is recommended for implementing the model - and the output of this workflow is an ontology representation of the application domain concept.

Test Workflow

The *Test Workflow* allows the verification of the ontology's correct implementation of its requirements. Its purpose is for evaluating the consistency, correctness and completeness, and competency of the ontology. First, the consistency of the ontology is checked with the modelling tool; then the ontology is evaluated against the CQs defined in the requirements workflow to assess the competence of the ontology; and lastly, the ontology is assessed on its coverage of the application domain's concepts.

2.3.4 Comparison of Engineering Methodologies

This section compares the three main ontology engineering methodologies. The Unified Methodology, UPON and MethOntology were compared for their ontology development proach and processes. The comparison criteria were based on the study carried out by Iqbal *et al* [57] in which they developed criteria for comparing ontology engineering methodologies to evaluate their maturity and wide acceptability [57]. An extract of their comparison is presented in Table 2.1 below.

Set Criteria	**UPON**	**MethOntology**	**Unified Methodology**
Type of development	*Evolving prototype*	*Evolving prototype*	*Stage based*
Collaborative construction	*No*	*No*	*No*
Reusability support	*Yes*	*Yes*	*Yes*
Degree of application dependency	*Application independent*	*Application independent*	*Application independent*
Life cycle recommendation	*Yes*	*Yes*	*No*
Strategies for identifying concepts	*Middle-out strategy*	*Middle-out strategy*	*Middle-out strategy*
Methodology details	*Some details*	*Sufficient details*	*Some details*
Interoperability support	*No*	*No*	*No*

Table 2.1: Ontology engineering methods comparison based on study by [57]

Based on the analysis of Iqbal *et al*, all three methodologies are application-independent and have middle-out strategies for identification of concepts; a middle-out strategy involves identification of the most important concepts first, before generalising and specifying for other concepts. All

the methodologies reviewed provided support for ontology reusability, but none of them has a fully developed mechanism for collaborative construction of ontology [57].

UPON and MethOntology recommend a life cycle implementation and follow an evolving prototype model for ontology building. UPON provides an iterative development process. However, it is only MethOntology that provides sufficient details of the strategies, techniques and activities employed in building an ontology. This is one of the reasons why MethOntology has been more frequently adopted for building a number of domain ontologies than other methodologies. Both UPON and Unified methodologies still provide some level details of activities employed for ontology development.

De Nicolas *et al* [55] also carried out a comparative study on the existing ontology engineering methodologies as a process of evaluating the UPON methodology proposed by them. Table 2.2 below shows the outcome of comparing the ontologies based on their development orientation. They affirm that both UPON and MethOntology are found to have established processes at the development stage of the ontology engineering. However, it is UPON that has a partial process developed for the pre-development stage. UPON supports an environmental study of the domain prior to the requirement analysis of the concept to be developed into an ontology. None of the three methodologies has a detailed process for the post-development stage of ontology engineering yet. The post-development stage of ontology engineering involves installation, operation, support, maintenance and retirement of an ontology [55].

Ontology development-oriented processes criteria		**UPON**	**MethOntology**	**Unified Methodology**
Pre-development	Environment study	*Partial*	*No*	*No*
	Feasibility study	*No*	*No*	*No*
Development	Requirements	*Yes*	*Yes*	*Partial*
	Design	*Yes*	*Yes*	*No*
	Implementation	*Yes*	*Yes*	*Yes*
Post-development	Installation	*No*	*No*	*No*
	Operation	*No*	*No*	*No*
	Support	*No*	*No*	*No*
	Maintenance	*Partial*	*Partial*	*No*

	Retirement	*No*	*No*	*No*

Table 2.2: Ontology engineering methods comparison based on study by [55]

2.3.5 Ontology Evaluation

There are several existing methods for evaluating ontologies, some of which are part of the overall methods of building an ontology. A systematic review has been done on the existing methods in an attempt to consolidate them for the development of an appropriate ontology evaluation framework [58], [59]. A comprehensive analysis of existing methods was carried out by [58] in order to develop a theoretical framework that will include the advantages of the existing approaches. Also, [59] made an improved attempt to develop a framework from the assessment of existing approaches, including the framework by[58]. Pak and Zou [59] posit that their proposed framework will provide better theoretical understanding of ontology evaluation, and serve as guidance for ontology evaluation. A recent effort in developing a comprehensive approach to evaluation is provided in [55] through the introduction of a process for evaluating the syntactic, semantic and pragmatic quality of an ontology.

It is important to note that the knowledge of a domain expert is required for ontology evaluation. Pak and Zhou [59] De Nicola *et al* [55] and Gangemi *et al* [58] recognise that the involvement of experts in evaluation processes is highly significant. The knowledge of an expert in specifying the concepts is useful for assessing the coverage and correctness of the ontology in representing the application domain. Even in automated approaches, experts are required to provide contexts and meanings for terminologies. Domain experts and knowledge engineers' input are vital in evaluating some quality attributes, such as clarity, navigability and expandability of an ontology, which can be difficult to evaluate through quantification methods.

2.3.5.1 OQual Ontology Evaluation Methodology

A comprehensive effort for the development of a theoretical framework for ontology evaluation was first made by [58]. Consideration was given to some existing qualitative and quantitative measures of ontologies from previous works before their integration into a single framework. The

framework was developed into a formal model that consists of a meta-ontology *O2* and an evaluation and validation method *oQual*. *O2* characterizes ontologies as semiotic objects while *oQual* complements the meta-ontology evaluation and validation and is implemented as a diagnostic task over ontology elements, processes, and attributes; it also evolves. Based on the models, three main types of measures for ontology evaluation are identified in the framework: structural, functional and usability-related measures. The structural measure is related with the topological and logical properties of an ontology, which may be measured by means of a metric measure. Functional measures relate to the intended use of a given ontology and of its components and the usability measure relates to the level of annotation of a given ontology, the ease of identifying the properties and its suitability.

2.3.5.2 Evaluation with the UPON Methodology

The UPON methodology provides an evaluation process in order to verify and validate the completeness and correctness of an ontology in the application domain. The process is classified into four quality assurance measures: syntactic, semantic, pragmatic and social quality assurance measures [55]. Syntactic quality measures assure the quality of an ontology in respect of the formal style in which it is written. This is verified in the implementation workflow through the choice of quality software for the ontology development. The semantic quality is concerned with the presence of contradictions of concepts. The pragmatic quality relates to the measurement of the quality of an ontology's content and its usefulness for users, irrespective of its syntax and semantics. Lastly, social quality assures the general criteria of an ontology's acceptance, access and usage. This is more applicable during the publication of an ontology for use and can be measured through the assessment of access and usage of the ontology in real time.

Semantic and pragmatic quality are explicitly assessed in the test workflow package in UPON methodology. While semantic quality can be mainly verified by checking the consistency of the ontology using a reasoner from the tool employed in ontology implementation. Pragmatic quality

is related to fidelity, relevance, and completeness of the content of the ontology considering its requirements and goals [55].

In the test workflow package, the ontology is to be checked against the requirement and need for developing the ontology in order to ascertain its competence. This is based on the settings of CQs as criteria for evaluating the initialised goals of the ontology at the *requirement workflow*. The testing of these questions is carried out at the *test workflow* at which the use cases are executed and queries are built for extracting knowledge from the ontology. The output of the querying process is used as a validation for the CQs and decides if the ontology is fit for the purpose for which it was designed. One other process included in ensuring the competence of the ontology is by involving the DE in evaluating the extent to which the ontology has answered the CQs.

2.3.5.3 Other Approaches to Ontology Evaluation

A mixed method for evaluating ontologies was suggested by Bilgin *et al* [60] as most appropriate because most existing ontology evaluation methods focus on functionality-related issues rather than structural ones; very few focus on the structure of the ontology. This may be due to the importance of the ontology usage as, no matter how good the structure of an ontology is, its significance in the domain is highly dependent on its functions, which are closely related to its usability. Furthermore, the functionality of an ontology is mostly measured by evaluating its appropriateness as the semantic backbone of either decision-support or information systems that operate in the domain represented by the ontology [60]. Therefore, the evaluation of an ontology in describing domain concepts should consider multiple approaches that focus on the functionality of the ontology.

Likewise, Pak and Zhou [59] reviewed several ontology evaluation approaches to propose a new ontology evaluation framework. They identified five dimensions for classification and assessment of existing evaluation approaches. These dimensions are scope layer, lifecycle, quality principles and methods. The dimensions are further utilised as guidelines for recommending suitable

approaches for evaluating an ontology. The ontology scope approach is useful for confirming appropriate implementation of the specification and design aspect of ontology engineering. The layer based approach to ontology evaluation provides a means of stratifying an ontology into several layers which can be examined within its context. These include lexicon/vocabulary, structure/architecture, representation/semantic and context/application. The ontology lifecycle approach proposes an evaluation that runs through the entire lifecycle of an ontology, from specification through conceptualisation to integration of an ontology into other ontologies. Various processes of evaluation are applicable to different stages of the ontology's lifecycle. The ontology quality principles approach focuses on the quality elements of an ontology; these are the consistency, completeness, conciseness and reusability of an ontology. Lastly, Pak and Zhou's ontology evaluation methodology is concerned with the process of evaluating an ontology only, whether it be verification or validation that has been used to evaluate the ontology, irrespective of the method employed for the ontology construction.

2.3.6 The Use of Ontologies in Public Health

Ontologies have been used widely in representing common knowledge in the bio-medical and public health domains. This has led to the development of ontologies for healthcare services and also ontology-based information system frameworks. Relationships between nomenclature and concepts invoked in medical procedures and operations are represented and classified using medical ontologies. These medical ontologies promote a common understanding between diverse human experts, different software agents and between human and software agents [61]. Ontologies have been used to support biomedical informatics, including: disease representation and epidemiology [15] [16]; heterogeneous information and system integration [62] [63]; bio-medical information structuring [17] [18]; health information system support [64] [65] [66] [67] [68]; healthcare service support; and patient management [46] [19]. Studies that have successfully used ontology in modelling the public health phenomenon, include the following:

- Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT) is one of the largest clinical terms that is represented as an ontology with OWL [45]
- Kostkova *et al* [46] defined a formal ontological model around TB care pathways to help clinical officers to access and retrieve the best available evidences from underlying medical databases
- Eilbeck *et al* [18] developed an ontology that classifies the terminology used to describe standard laboratory test code, Logical Observation and Identifier Names and Codes (LOINC) and tested this ontology on TB laboratory test codes
- Mabotuwana and Waren [69] used ontologies to describe a framework for assessing adherence to medication that is focused on the development of a generic, extensible framework that can be used to assess patient adherence and persistence rates from the production of EMR data. Through their work, an ontology was developed for representing the different drug and patient information classifications which form the underlying knowledge bank for the assessment
- Lenert *et al* [70] explored the usage of ontologies for modelling patients' behaviour and developed a framework for health counselling dialogue systems, using the behaviour of patients to support diagnosis

2.4 INTEGRATING ONTOLOGIES AND BAYESIAN NETWORKS

Ontologies have significant capability for structuring and classifying complex concepts and providing connections between them in an application domain. However, they lack the capability to represent the uncertain and complex causal relationships that exists between the factors and adherence behaviour. A Bayesian network (BN) on the other hand, is a potentially useful paradigm for modelling the weight or degree of influence of individual factors on adherence behaviour [23], [24].

BNs belong to the family of probabilistic graphical models and can be used to learn causal relationships, gain insight into the various problem domains and predict impending events [27]. A BN is an annotated directed graph that encodes probabilistic relationships among distinctions of interest in an uncertain-reasoning problem. It combines principles from graph theory, probability theory, computer science and statistics to denote knowledge about an uncertain domain. It provides a graphical structure which is intuitively appealing and convenient for the representation of both causal and probabilistic semantics, and is ideal for linking prior knowledge that often comes in causal form [71] [72] [73] [27]. BN models are used to represent systems as networks of interactions between variables from primary cause to final outcome, with all cause-effect assumptions made explicit [74].

Modelling phenomena and systems in complex domains with BNs has several benefits. These include: integration of multiple issues and system components; utilisation of multi-source information; assistance in the handling of missing data and uncertainty, especially for small datasets; provision of structural learning which is explicit and supportive for decision-making analysis; and provision of a platform that can give fast responses to queries passed to domain models [74] [75]. However, there are some challenges in the use of Bayesian networks for complex modelling relating to the environment or public health. There is the difficulty of discretizing continuous variables; BNs have a limited means of dealing with continuous variables. Also, since BNs sometimes rely on expert knowledge, the collection and structuring of such knowledge into an acceptable structure for BNs tools is challenging. Lastly, temporal and dynamic models are tedious to represent because BNs are acyclic graphs and do not provide support for feedback loops [75].

2.4.1 Formal Definition of Bayesian Networks

A BN is formally defined as a pair $\mathcal{B} = (G, \Phi)$. G is a finite directed acyclic graph whose nodes represent Boolean random variables and is represented as $G = (V, E)$. V is the set of vertex (nodes/variables) and E is the set of edges connected to the vertices. For every $x \in V$, a

conditional probability distribution $P_{\mathcal{B}}(\mathrm{x} \mid \pi(\mathrm{x}))$ of a node x , given its parents $\pi(\mathrm{x})$. If V is the set of nodes in G, we say that $\mathcal{B}$ is a BN over V. Intuitively, $G = (V, E)$ encodes a series of conditional independence assumptions between the random variables, i.e. every variable $x \in V$ is conditionally independent of its non-descendants, given its parents [76]. So, every BN defines a unique joint probability distribution over V and is defined as:

$$P_{\mathcal{B}}(V) = \prod_{x \in \mathrm{V}} P_{\mathcal{B}}(\mathrm{x} \mid \pi(\mathrm{x}))$$

Figure 2.2 shows a simple BN graph that consists of 5 nodes. The vertices of the graph represent variables and are referred to as nodes. These nodes are represented as circles containing the variable name and states which may be Boolean. The arrow connections between the nodes are called edges and they represent dependence between the variables. Any pair of nodes indicates that one node is the parent of the other so there is no independence assumption. In other words, unless there is an edge from one node to another, there is an independence assumption. For instance, there is no edge linking node F to any other node in Figure 2.2. This implies that F is independent of all other nodes in the graph.

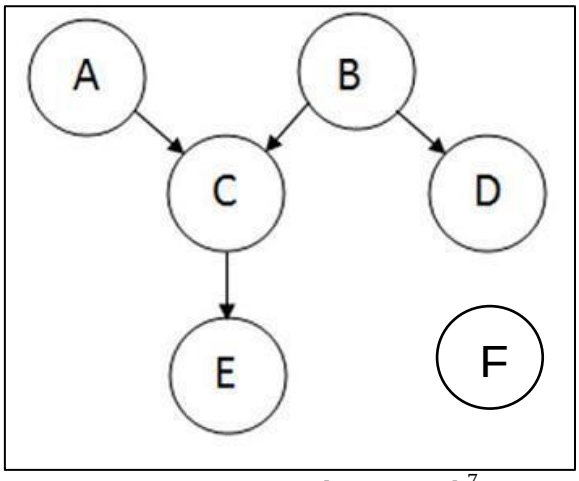

Figure 2.2: A simple BN graph[7]

[7] https://controls.engin.umich.edu/wiki/index.php/Bayesian_network_theory

Every node of the graph has an associated probability distribution table. In the case of "A" and "B" nodes that do not have a parent node, their probability distribution is an unconditional probability. As for the other nodes that have parents, the local probability distribution of these nodes is conditional on the parent nodes. For the network, the probability is derived as [77]:

$$P(A,B,C,D,E,F) = P(A)\ P(B)\ P(C|A,B)\ P(D|B)\ P(E|C)\ P(F)$$

Conditional probability distributions are specified either as posterior or prior probability. While prior probability is the probability assigned to a variable that reflects the original belief of the variable before evidence is introduced, posterior probability is the probability of a variable built on the collected evidence. In other words, posterior probability is assigned according to given data or evidence while prior probability is not based on any known evidence but on knowledge.

2.4.2 The Use of Bayesian Networks in Public Health

BNs have been used for applications in various areas; these include machine learning, text mining, cellular networks, bioinformatics and medical diagnosis. BNs have been used in several ways to resolve biomedical challenges, including disease analysis, modelling, diagnosis and prediction [78] [79] [80] [81] [82]. They have also been used to represent bio-medical knowledge [83] [84] [85] and are used as a modelling tool for medical decision support systems [86] [87].

For TB monitoring, BN has been used for diagnosis, predictions and analysis of the disease. A conformal BN was used to classify strains of mycobacterium tuberculosis complex [88] [84]. It was used to exploit background knowledge about MTBC biomarkers and predict the major lineage of isolates genotyped by any combination of the PCR-based typing methods. BNs were used in another study by Ma *et al* [78] for detecting pulmonary tuberculosis in hospitalized non-HIV patients, proving that it is a promising paradigm for timely TB diagnosis [78]. Lastly, BNs were used for creating models to analyse tuberculosis epidemiology and identify the distribution of tuberculosis patient attributes [85].

There is not an abundant amount of information available on the use of BNs to model adherence behaviour in patients. The only paper found was that of Nordmann *et al* [89] which explores the use of BNs to identify and analyse non-compliance in glaucoma patients as well as the factors that motivate their poor adherence. No previous studies were found that used BNs to model and analyse the relationship between causal factors and TB patients' adherence behaviour.

2.4.3 Current Approaches to Ontology and Bayesian Networks Integration

BNs are a potentially useful modelling paradigm to model factors that influence treatment adherence behaviour and their cause for the purpose of prediction. BNs are used to represent vague and probabilistic causal relationships between different variables [90] [24]. They can potentially be adopted for representing a belief network that is useful for predicting adherence risk and may be used as the basis for decision support tools to help TB programme coordinators identify and/or predict potential treatment default behaviour. Although, BN is a strong tool for modelling uncertainty, it lacks the capability to represent the semantics of variables and their states. Also, developing such networks for adherence behaviour requires significant modelling efforts, including identification of influencing factors, formalizing these factors to form the network's structure, determination of the weighting for the conditional probabilities, and consolidating evidence for learning the network. Expert knowledge and primary data sources are important requirements for BNs' construction and they are difficult to harmonise, particularly when dealing with unstructured data [73].

Ontologies, on the other hand, can be useful for consolidation and representation of categorical knowledge from an unstructured source of data as they have significant capability for structuring and classifying concepts and providing connections and relationships between concepts in an application domain [14]. Although an ontology is very useful for the conceptualization of an adherence knowledge base system, some ontology languages such as OWL 2 lack the capability to represent uncertainty, which is an integral part of adherence risk prediction.

There have been earlier efforts to integrate the dimension of uncertainty into semantics by trying to combine ontologies and BNs for various purposes. Larik and Haider [20] classified these efforts into four main categories based on the purpose of the ontologies and BN integration. The categories identified by Larik and Haider [20] are: ontology mapping enhancement; ontology reasoning enhancement with BNs; semi-automated construction of Bayesian networks; and ontology language enhancement [20]. Some of the existing approaches to ontologies-BN integration are discussed below.

2.4.3.1 Ontology Mapping Enhancement

The aim of an Ontology Mapping Enhancement (OMEN) [91] approach is to resolve the semantic heterogeneity of similar ontology concepts. OMEN [91] was designed specifically for mapping two similar ontologies using BNs. It uses a pre-specified threshold to match the initial probability of two ontologies being merged. The probabilistic constraints that are used for the enhancement will be defined in an OWL file. The constraints are used to generate nodes for all the matches found as well as the mapping between the pairs of matching concepts. A set of meta-rules are then defined for the construction of the CPT [91].

2.4.3.2 BayesOWL

BayesOWL is a probabilistic framework developed for modelling uncertainty in the Semantic Web [49] [20] [92]. In order to describe uncertainty in a consistent manner, Ding *et al* (2006) [92] proposed BayesOWL for extending OWL's capability to handle probabilistic reasoning. BayesOWL is a probabilistic extension to OWL and defines the probabilistic relatedness of distinct classes [92]. BayesOWL was developed to enhance probabilistic constraints and has been used to map concepts between similar ontologies.

2.4.3.3 SWAP Uncertainty Ontology

The SWAP-Uncertainty ontology is an extension of the BayesOWL ontology that was specifically developed for managing uncertainty associated with sensor observations in the Sensor Web [49].

The extension was made to address some of the shortfalls of BayesOWL in representing the uncertainty of the sensor web [49]. The extension includes an extension of BayesOWL classes for handling complexities of sensor observations. For instance, the influence relationship between variables was extended for building BN graphs automatically from the variables. The state class was also extended to allow for capturing of discrete range states and explicit declaration of all variable states. The condition class was extended to facilitate declaration of multiple states of influencing variables when declaring condition probability for a node in the network.

2.4.3.4 Ontology Reasoning Using Bayesian Networks

This is an approach introduced by Andrea and Franc, 2009 [93] for performing reasoning on an ontology using BNs [20]. The approach is not to extend an OWL file with BNs, it only uses information stored in the domain ontology for constructing the corresponding BN, which is in turn used as a probabilistic reasoner for the ontology [93] [20]. It comprises three basic steps: structure construction; CPT construction; and probabilistic reasoning with the BN inference. The first step is to construct a structural, two level BN from the TBox of the ontology by creating a two level BN for the reasoning. The second step is to construct the CPT from the ABox of the ontology. The third and last step is to perform probabilistic ontological reasoning, using BN inference.

2.4.3.5 Semi-automated Construction of Semantic Bayesian Network

An approach for a semi-automated construction of a semantic BN was introduced by Fenz and Hudec [94] as a means of representing domain concept uncertainty in order to provide a structured representation of the knowledge required to construct a BN model. The approach was introduced because of the recognition of the knowledge requirement challenges in constructing a BN [95], which include the determination of the factors/ variables, the relationship between the variables, and the generation of the condition probability required for the network. The steps in the approach include mapping of domain concepts, implementing the concepts as an ontology, applying

experts' intuitive methods for transforming the ontology into BNs primitives and construction of CPT by modellers [94], [95].

2.4.3.6 Probabilistic Extension to the Web Ontology Language (PR-OWL)

The Probabilistic extension to OWL (PR-OWL) [90] approach was developed to provide a principled means of modelling uncertainty that is lacking in the OWL technologies. PR-OWL was developed to aid the semantic web vision to actualise its aim of providing a sound and principled means of representing and reasoning with uncertainty. PR-OWL seeks to remedy the incapability of OWL in handling uncertainty by developing a BN framework for probabilistic ontologies and a reasoning service [23]. PR-OWL is a general framework that was based on Multi-Entity Bayesian Networks logic which integrates first order logic with BNs [90] [20]. It was designed as a full first-order probabilistic logic in an attempt to address the deterministic classical logic's current limitations [23]. PR-OWL provides support for any application that can benefit from ontology-based probabilistic inference, using an ontology-based BN description UnBBayes[8]. The weakness of PR-OWL lies in the fact that modellers first have to understand the concept of MEBN theory [20].

2.4.3.7 Bayesian Description Logic

Bayesian Description Logics (BDLs) are extensions of classic Description Logics (DLs) with contextual probabilities encoded in a BN [76]. BDL is designed to handle uncertainty that is expressed through a BN. The reasoning tasks of a DL are extended to consider contextual and probabilistic information [76]. BDL is based on the light-weight description logic, EL, which was extended to express uncertainty. BDL was developed on the assumption that certain knowledge is dependent on an uncertain situation or context. That is, every axiom is associated with a context with the intended meaning of being true if the context holds [96]. BDL approach can be applied for automated mapping of information integration in order to avoid human intervention [97].

[8] http://unbbayes.sourceforge.net

2.5 SUMMARY

In this chapter, poor adherence to prescribed treatment is described as a complex phenomenon that has a significantly negative impact on the success of a TB disease control programme, especially in SSA. The complexity of adherence behaviour was seen to hinge on the diverse personal, cultural and socio-economic factors that vary between communities, as highlighted in section 2.2. These factors can be structured and used for decision support in disease control programmes and patient management. Current systems that categorise these factors were described in section 2.2.1. However, none of these systems provide a concrete unambiguous computational representation of factors that influence adherence behaviour (section 2.2.2).

A review of the ontology, as an approach for bridging the gap of adherence representation, was discussed in sections 2.3. Ontologies can be used to overcome the highlighted challenges of existing categorisations, and model adherence with a formal language to facilitate knowledge sharing among experts. However, ontologies are deficient in representing causal relationships and the uncertainty of adherence behaviour. Bayesian Networks were reviewed as paradigms that can be integrated with ontologies for this purpose (see section 2.4).

Lastly, various existing engineering and evaluation methodologies that can be adopted for delivering competent domain ontology were discussed and compared in section 2.3. Existing approaches that have successfully integrated ontologies and Bayesian Networks for complex domain representation and reasoning were also highlighted in section 2.4.3.

Chapter 3

AN ONTOLOGY-DRIVEN APPROACH FOR ADHERENCE BEHAVIOUR MODELLING

In this chapter, an ontology-driven approach for structuring the knowledge of factors that influence adherence behaviour and for constructing adherence risk prediction models for specific communities is presented. The approach extends the UPON ontology engineering methodology and integrates Bayesian Networks (BN) to design, construct and evaluate an ontology for predicting treatment adherence risks.

As described in Section 2.3.3, many methodologies exist for ontology development. The UPON and MethOntology methodologies were both found to be suitable candidates for developing an ontology for factors influencing adherence. The UPON methodology was eventually chosen over MethOntology

The benefits of using UPON methodology for the study are as follows:

- It supports the pre-development stage of an ontology development-oriented process which is not provided by MethOntology. It includes an environmental study which is a pre-development stage activity for examining the domain prior to the development of a conceptual model requirement. This activity is very useful for initial consideration of existing and current knowledge about adherence behaviour modelling.
- It follows an evolving prototype method for developing an ontology which is suitable when requirements are initially not clear and a continuous refinement of the ontology is required over time. This is appropriate for creating an approach for adherence behaviour ontology development. Adherence behaviour is broad and complex, and the requirement for initial design of an ontology in this domain may need refinement with exposure to more knowledge about adherence.

- It supports the use of a middle-out strategy in identifying concepts. This is very useful for developing ontologies for a broad domain that contains numerous concepts and complex relationships among these concepts. The middle-out strategy involves the identification of the relevant concepts first before generalising and specifying them. Initial identification of relevant adherence concepts, which can be generalised or specified, is a feasible approach for constructing concept hierarchies for adherence behaviour ontology.
- Lastly, it encourages ontology reuse. The use of existing ontologies guides against 're-inventing the wheel' and the creation of disconnecting ontologies, thus providing synergy in ontologies. It also reduces the overall ontology development time and effort [57].

3.1 OVERVIEW OF THE ONTOLOGY-DRIVEN APPROACH

The ontology-driven approach entails six steps that can be followed to develop a computational representation of adherence behaviour. The six steps of the approach are: definition of design purpose, knowledge acquisition, model design, model analysis, model formalisation, and ontology evaluation. The output of each step serves as an input into the following step. Figure 3.1 shows the steps of the ontology-driven approach as well as the activities contained in these steps.

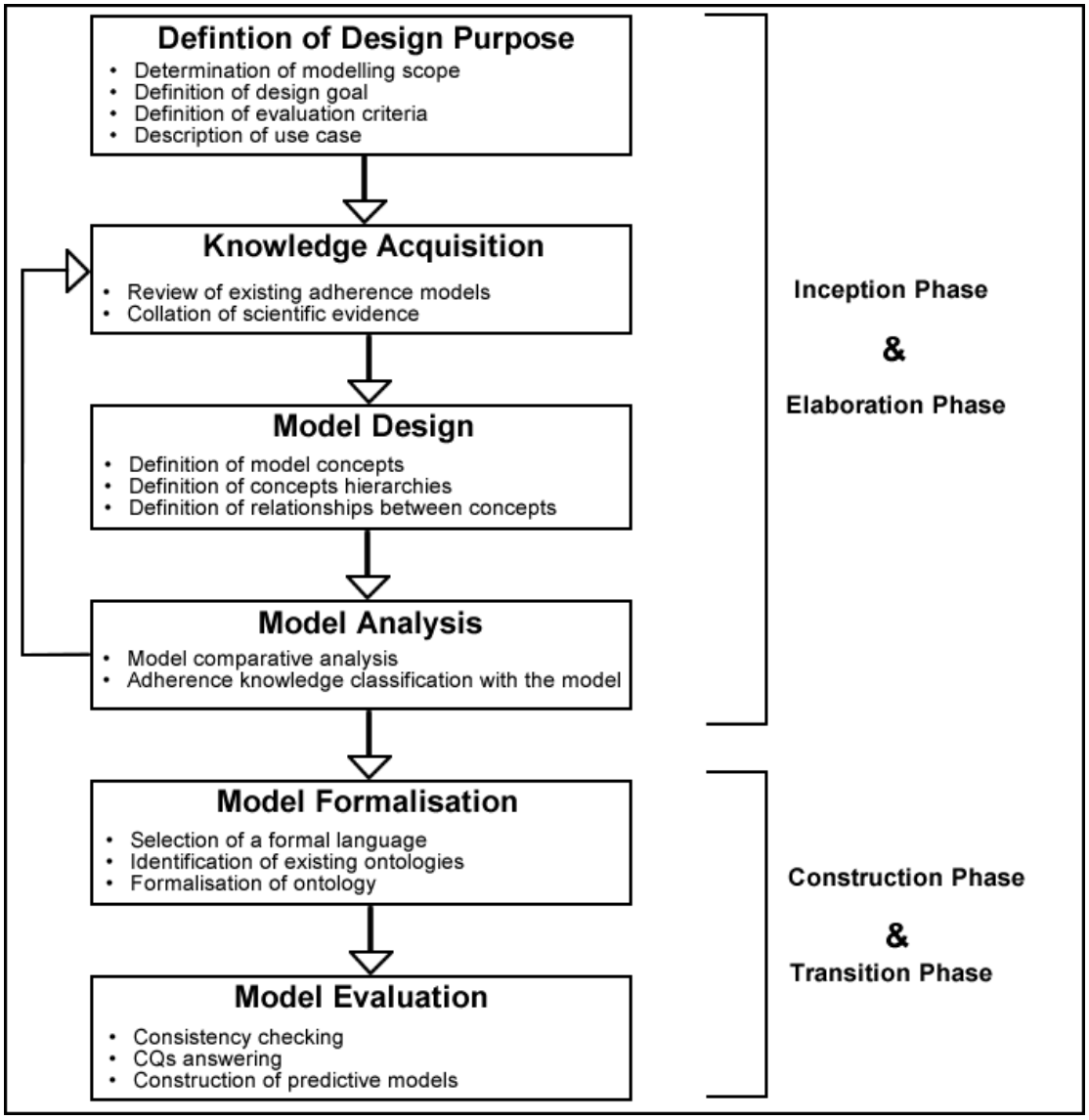

Figure 3.1: Ontology-driven approach for developing an adherence behaviour ontology

The first four steps of the approach are aligned with the activities that are involved in the first two phases and the last two steps are aligned with the last two phases of the UPON methodology (see Figure 3.1). The four phases of the UPON methodology were discussed in chapter 2, see section 2.3.3.4.

The approach provided an iterate step to refine the designed adherence conceptual model before it is formalised as an ontology. The important iterative step that is explicitly stated in the approach is the feedback loop from the Model Analysis to the Knowledge Acquisition step. This loop takes the process back to knowledge acquisition in cases where the model requires additional refinement. This allows for incremental knowledge acquisition for the gradual evolution and refinement of the conceptual model before moving to the formalisation step.

3.2 DESCRIPTION OF THE STEPS INVOLVED IN THE APPROACH

3.2.1 Definition of Design Purpose

The first step is the definition of the goal or purpose for developing the adherence behaviour ontology. This step involves four activities: (i) determination of modelling scope (ii) definition of business purpose (iii) definition of the competency questions (CQs) and (iv) description of use cases.

- **Determination of modelling scope:** Since adherence behaviour is broad and complex, there is a need to first constrain the scope of the ontology. This is done by constraining the patient's disease pertaining to adherence behaviour and also the geographical region of the communities to be considered. Both the geographical region and the selected disease will constrain the scope for developing and evaluating the adherence ontology.
- **Definition of design goal:** This activity defines the business purpose or overall design goal of the adherence behaviour ontology. The design goal of the adherence ontology has to conform to at least the following three broad purposes for representing knowledge of adherence behaviour.
    - The first purpose is that the adherence behaviour ontology should enable the capturing of factors from scientific papers that have been found to influence adherence behaviour in a consistent manner. For example, the negative influence of adverse drug effects on adherence behaviour of patients in a given community can be captured in the ontology
    - The second purpose is that the captured findings should provide support for the construction of predictive models for adherence behaviour
    - The third purpose is that the ontology facilitates the access, query and navigation of the factors that were captured from scientific papers
- **Definition of evaluation criteria:** The next activity is to establish criteria for evaluating the design goals of the adherence behaviour model. The purpose of setting evaluation criteria is to

validate the conceptual model to be designed for conformity and fitness for the purpose for which it was designed, i.e. the three design goals stated above. Firstly, the characteristics and functions of the adherence behaviour ontology must be aligned with these goals. The evaluation criteria are used to analyse the model before and after its formalisation. Secondly, competence questions (CQ) are defined to test the competency of the adherence ontology after its implementation. A CQ is defined in the form of a question that will be answered using the resultant adherence ontology. CQ definition is significant for assessing the semantic quality of the adherence ontology and for ensuring that scientific knowledge captured in the ontology can be accessed and navigated. The CQs are only defined in this step but are tested later during the ontology evaluation step.

- **Description of use case:** Lastly, one or more use case scenarios are defined for demonstration of the application or usage of the adherence ontology. First, potential users of the adherence ontology are identified and grouped to create categories or classes of users. Second, the process through which the ontology is to be used is described as a narrative. The usage process should be tied directly to the initially defined CQs in order to ground the usefulness of the adherence ontology in the achievement of the set goals, that is, the usage of the ontology by potential user groups will also justify the achievement of the design goal of the ontology. The support provided by the ontology to aid in the construction of predictive models is one important usage of the adherence ontology to be kept in mind.

3.2.2 Knowledge Acquisition

Knowledge acquisition is a crucial and pivotal step in ontology engineering. Adequate knowledge that is useful for the construction of the adherence conceptual model can only be obtained by the collection of background information about adherence behaviour. Through the knowledge acquisition step, insights into adherence concepts to be modelled and relationships between the concepts can be identified. Knowledge acquisition will help modellers to be familiar with existing ways of representing adherence, and evaluate their fitness for construction of the ontology. Similarly, this step plays a vital role in the initial identification and definition of the terminologies that will be included in the ontology.

For the knowledge acquisition step, an extensive literature review is proposed as the most viable source of expert domain knowledge about adherence behaviour. Extraction of scientific knowledge about adherence behaviour from existing literature is recommended for this approach because:

- Scientific publications provide access to the depth of adherence complexities that is not obtainable from a single human expert. Scientific papers provide a wider and more objective perspective on adherence behaviour. The complexities of adherence with regard to various diseases and communities are beyond a single human expert. Scientific papers will provide comprehensive insight into adherence behaviour for a particular disease area, as well as a specific perspective of community adherence situations that may not be obtainable from a single expert.
- Scientific publications have presumably been validated through the scientific method, and have gone through at least one rigorous process of peer-review. These publications contain validated and accepted results of scientific research on adherence across various diseases and communities. Therefore, the concepts obtained from the scientific review process are of good quality, coherency and conceptual clarity. Also, concrete findings on adherence behaviour are rich enough to be used as base knowledge on which to design the ontology.
- Scientific publications provide access to adherence knowledge across various geographical locations. Involving experts from these diverse geographical areas requires huge amounts of time and financial resources and are challenging for the ontology building process. Also, the collaboration of multiple experts is a tedious process and not properly catered for in most ontology engineering methodologies, including UPON.
- Conflicting and complementing views of several adherence behaviour experts can be found in scientific publications. These will provide a better view of the complexities of adherence behaviour for model design.
- Knowledge emanating from clinical studies routinely informs medical practice and decision-making and this will improve the potential adoption and usage of the ontology.

There are two types of reviews proposed for knowledge acquisition for the construction of adherence ontology.

- **Review of existing adherence models:** This activity involves the identification of scientific papers that describe the design or assessment of models for representing adherence behaviour. A review method that can be employed for this activity may either be a narrative review or a full systematic review [98]. In the case where no explicit adherence model papers are found, it is advisable to start with review papers of the adherence behaviour in a specific disease area. The aim of the review is to examine the concepts that experts have used to describe aspects of adherence behaviour which will be useful for designing a conceptual model for adherence. A comparative analysis can also be carried out on the models from these papers to determine gaps in the existing representations of adherence concepts. The review should also be used to create a reference glossary. This is carried out by identifying domain terminology that will be included in the model, which should be properly defined as domain lexicons. From the domain lexicons, the relevant terminologies to be included in the ontology should be identified and documented as a resource reference glossary to be used in constructing the ontology.
- **Collation of scientific evidence:** Based on the identified concepts for the adherence model, a search for clinical research publications should be conducted to collate papers that have documented findings about patient adherence for specified communities. This review should be focused on the disease and the geographical regions that have been specified in the definition of the purpose step above. A quick scoping review or a rapid evidence assessment method [98] is recommended for this activity. Furthermore, the application lexicon can be developed for the adherence ontology through this activity. The application lexicon, in the case of adherence ontology, should include the scientific findings that will be captured with the ontology. The application lexicon developed from this process should also be included in the reference glossary that is to be used in constructing the ontology

3.2.3 Model Design

The model design step entails using the knowledge acquired from the previous step to design a conceptual model for representing adherence behaviour. The components that will be represented in the conceptual model and their relationships will be established at this step. The construction of a conceptual model is vital to the development of an adherence ontology because it helps define a concrete model that can then be formalised. This step initiates the design process of a tangible adherence behaviour artefact which will be produced by following the approach. The activities included the following:

- **Definition of model concepts:** Firstly, the concepts of the existing adherence models identified in the previous step will be restructured and modified to constitute the adherence conceptual model. The restructured concepts are to be concretely defined to eliminate overlaps and reduce ambiguity of concepts. The restructured concepts that will be included in the new conceptual model should be listed at the end of this activity. Secondly, a concept for representation of scientific evidence should always be considered in designing an adherence behaviour conceptual model. This is to ensure that knowledge about adherence behaviour from clinical studies is captured in the ontology. The concept is important for consistent knowledge representation to facilitate access, query and navigation of scientific knowledge about adherence. Thirdly, a concept that can be used to extend the ontology for constructing a predictive model should be identified and listed as a component of the conceptual model. BNs is a proposed technology to be considered for this purpose.
- **Definition of concepts hierarchies:** Some of the adherence behaviour concepts are hierarchical owing to their complexities. Such hierarchical relationships should be determined and structured. The concept hierarchies should be presented as a nested list to show the relationship between abstract and concrete concepts identified for the adherence model.
- **Definition of relationships between concepts:** After the concepts of the adherence model have been listed and a hierarchy of relationships between concepts established, other forms of relationships between these concepts should be established, based on the relationships

identified from the review. Relationships to be listed include the links between adherence behaviours, scientific evidence and predictive modelling concepts. The transformation of adherence behaviour concepts should be designed to elaborate on the relationship between the core adherence behaviour components of the model and the probabilistic extensions that will support the construction of the BN models.

3.2.4 Model Analysis

The fourth step is to subject the conceptual model to analysis in order to assess its comprehensiveness and also to identify the aspects of the model that need improvement before the commencement of the formalisation process. This step is introduced as an initial evaluation of the model before going into the formalisation process. Analysis will be carried out to evaluate the comprehensiveness, clarity and ambiguity of the model with regard to structuring knowledge of adherence behaviour.

The two analysis activities that should be carried out at this step are:

- **Model comparative analysis:** The designed adherence conceptual model should first be compared with any existing models found in the review. The comprehensiveness of the model should be validated against that of the existing models. The comprehensiveness of the model is defined as the complete and correct expression of the conceptual model over the scope of the adherence concept that is being modelled. Testing for comprehensiveness of the adherence model involves the measurement of the extent to which a conceptual model represents the adherence concepts that are being modelled. The comparative analysis involves identifying the number of concepts that are included in the conceptual model compared with the existing ones. It also involves analysing how the concepts are represented, the relationship between the concepts and the expressivity of adherence behaviour nuances. The conceptual model should be at least as comprehensive as the existing models for it to be considered appropriate for formalisation.
- **Adherence knowledge classification with the model:** The designed conceptual model should be used to classify findings from selected scientific papers from those collated at the knowledge

acquisition step. This activity verifies the coverage and representativeness of the conceptual model. At this step, the model is not formalised yet, therefore the classification of the findings will be done without the use of an ontology editing tool.

It is important to include the model analysis step in order to make sure that the concept to be implemented reflects the purpose for which it was designed and to ensure that the model properly covers adherence behaviour concepts that are to be represented. The model analysis step will serve as a way to first verify that the model is directed at achieving its set goals. It will help to ensure that the designed model represents the nuances of treatment adherence behaviour that are intended to be represented before proceeding to the formalisation step. It will also help to identify aspects of the model that may need refinement before implementation.

3.2.5 Model Formalisation

The fifth step is to formalise the conceptual model into an ontology using a formal ontology language. The ontology is developed from the conceptual model by following three activities:

- **Selection of a formal language:** The first activity is the selection of a formal language that will be used for the formalisation process. The Web Ontology Language (OWL) is the recommended language for formalising the adherence behaviour ontology. OWL is the recommended W3C standard that is widely used in several domains, including public health. There are several desktop and web tools for editing, querying, publishing and sharing ontologies that have been formalised with OWL.
- **Identification of existing ontologies:** Some existing ontologies that can be used to build parts of a new ontology should be identified at this step. This will prevent ‘re-inventing the wheel’ in the representation of adherence knowledge and would also reduce the effort required to build a new ontology from scratch. These ontologies can be existing adherence- related ontologies which can be used as base concepts for building the classes and relationships for the ontology. The existing ontologies can either be directly incorporated into the adherence ontology or used as a base concept for implementing the ontology classes. One important ontology that is

recommended for the extension of an adherence ontology for probabilistic reasoning is BayesOWL. BayesOWL is an extension of OWL with BNs to present the concepts represented in the ontology as a predictive model network structure [92]. Other recommended ontologies include the Evidence Ontology for representing scientific evidence [99] and FabiO work ontology for representing scientific publications[9]

- **Formalisation of the ontology:** This is where the conceptual model is formalised as an ontology, using OWL. Firstly, the concepts of the model are formalised as classes in the ontology, while the relationships between the concepts are represented as properties of the classes. Secondly, findings from the scientific publications are captured as assertions in the adherence ontology. Ontology editing tools, such as Protégé-OWL[10], SWOOP[100] and TopBraid Composer[11], are recommended for the construction process. These tools provide interfaces for easy construction, navigation and querying of the ontology.

3.2.6 Ontology Evaluation

The sixth and last step is the evaluation of the adherence ontology in terms of the design goals and semantic quality. This evaluation process is used to validate the fitness of the adherence ontology for the purpose for which it was created and to ensure that the ontology is consistent. The activities are:

- **Consistency checking:** The first activity is to check the consistency of the ontology. Consistency checking is frequently used as part of modelling. The reasoning module of ontology editing tools, such as Hermit[12], RacerPro and Pellet[13], can be used for checking the logical consistency of the ontology. The reasoners usually highlight the source of consistency errors. Any logical errors detected by the reasoner should be corrected until the ontology is logically consistent.

[9] http://www.essepuntato.it/lode/http://purl.org/spar/fabio
[10] http://protege.stanford.edu/
[11] http://www.topquadrant.com/tools/ide-topbraid-composer-maestro-edition/
[12] http://www.hermit-reasoner.com/
[13] http://protegewiki.stanford.edu/wiki/Using_Reasoners

- **CQs answering:** The second activity is the answering of the CQs to evaluate the semantic quality of the ontology. First, ontology queries targeted at answering the CQs must be developed. These queries are then executed on the ontology to produce results which will be regarded as answers to the questions. These answers are evaluated manually for correctness and comprehensiveness against what was expected, given the knowledge at hand. This step validates the expected behaviour of the system in terms of its intended purpose. Ontology editing tools, such as Protégé, provide a query interface for assembling and executing queries. Queries can also be constructed using the widely used ontology querying language, SPARQL, which is supported by most ontology editors.
- **Construction of Bayesian networks:** The last activity in this step is to demonstrate the usefulness of the ontology for constructing a predictive model structure. The criteria for evaluating this purpose must have been defined at the first step of the approach and at least one use case should be defined for it. The output of this activity should be a predictive model of a specific community that is stored within the adherence ontology. BN is recommended for this activity, since there have been several approaches of integrating BN with ontology for probabilistic reasoning (see section 2.4.3). SWAP-uncertainty ontology [49] can also be considered for the extension of the adherence ontology, formalised as OWL.

3.3 COMPARISON WITH THE UPON METHODOLOGY

The ontology-driven approach is based on the UPON methodology. However, not all the UPON workflow activities were included directly in the approach. Table 3.1 below shows the UPON workflow activities as included in the ontology-driven approach. While some of the UPON workflow activities were directly included in the approach, others are modified and used as base knowledge to build activities included in the approach. Several activities were modified into steps that were found to be more appropriate for the representation of knowledge about adherence behaviour. However, there are some activities in the approach that are not explicitly included as activities in UPON methodology.

Determination of domain interest and scope was modified to determination of modelling scope. This is because the domain of interest, which is adherence behaviour, is already determined. The scope of the model to be developed is further constrained by the modeller in terms of disease and region of interest.

The use case description was simplified in the approach. The two activities of the *Requirement workflow*; writing one or more story boards and modelling the related use cases, were merged and simplified into one single use case description activity. The use case description activity for domain ontology development is not necessarily focused on application development. Adherence behaviour ontology does not require elaborate use case modelling, thus, a descriptive narration of the use case is the only detail required. Modelling of the use cases with a UML activity diagram was excluded from the approach. The usage scenarios were static single step activities without multiple actors and steps, as found in business processes. The narrative description of the use cases was sufficient for building the adherence ontology.

The building of the reference glossary was simplified and incorporated into the activities of the knowledge acquisition step. The UPON has elaborate activities for building reference glossaries are. However, the required lexicons for the adherence ontology are identified and properly refined into a reference glossary through the two types of literature reviews in the knowledge acquisition step.

The review activities in the knowledge acquisition step are extensions made to UPON. Although UPON recognises the use of documented knowledge for the support of domain expert knowledge, the responsibility to establish domain concepts to be represented is based on the knowledge of an expert in the domain. The use of a single expert as the main source of reference knowledge was found to be inappropriate for adherence behaviour modelling. Adherence domain differs significantly from the business domain, where business processes and applications are explicit and well understood by single human expert. Hence, the knowledge acquisition step in the approach is based on a review of existing scientific literature which is used in the place of domain experts, as recommended by UPON. The motivation for using a literature review is described in detail in Section 3.2.2 above.

There are activities contained in the steps of the approach that led into the construction of a BN model for adherence: these activities are extensions to the UPON methodology. For instance, the BN concept and SAWP-Uncertainty ontology were included in the implementation of the ontology specifically for generating and representing a BN model. Also, an activity to demonstrate BN models construction was also included under the Ontology Evaluation step as a means to validate the usefulness of the ontology for predicting adherence risk. The ontology-driven approach takes into consideration the fitness of the adherence ontology for supporting predictive model construction and provides integrated activities that will guide researchers in developing an adherence ontology for this purpose. The construction of predictive models with the ontology is targeted at validating the usefulness of the ontology for predicting adherence risk.

UPON Workflows Activities		**Corresponding Activities in Ontology-driven Approach**	**Summary of Change**
Requirement	Determine the domain of interest and the scope	Determination of modelling scope	The activity includes specifying disease and region of interest
	Define business purpose	Definition of design goals	The goals must fit the purposes: capturing and representing specific factors, querying captured factors, building predictive models
	Identify the competency questions(CQs)	Definition of evaluation criteria	The evaluation criteria include the criteria for model analysis and the CQs for the ontology evaluation
	Writing one or more story boards	Description of use case	The UPON activities were combined and simplified into a single narrative of the ontology's use case
	Modelling the related use cases.		
	Creating an application lexicon	• Review of existing adherence models • Collation of scientific evidence	The knowledge acquisition step covers the whole process of producing the reference glossary through a literature review
Analysis	Acquire domain resources and build domain lexicon		
	Building Resource Reference Lexicon		
	Building reference glossary		
	Modelling application scenario with UML		Modelling with UML is not included in the approach
Design	Modelling Concepts	Definition of model concepts	Concept for representing scientific findings and BN were recommended for consideration
	Modelling Concept hierarchies and domain relationship	Definition of concept hierarchies	
		Definition of relationships between concepts	
Implementation	Selecting a formal language	Selection of a formal language,	OWL and SWAP-Uncertainty ontology are recommended as the formalisation of the adherence conceptual model and the BN concept respectively
	Formalising ontology	Identification of exiting ontologies	
		Formalisation of ontology	
Test	Consistency Checking	Consistency checking	
	Answer competence questions (CQs)	CQs answering	
	Verify coverage	Comparative analysis with other models	Coverage verification process is moved to the Model Analysis step and is comprised of these activities
		Adherence knowledge classification with the model	

Table 3.1: UPON Workflow and Ontology-driven Approach activities

3.4 SUMMARY

In this chapter, an ontology-driven approach for representing adherence behaviour knowledge was presented. Six steps were introduced to guide modellers in developing an ontology that captures and structures adherence behaviour that can be accessed, queried, navigated and, most importantly, used for constructing predictive models to determine adherence risk in specific communities.

The approach is demonstrated and evaluated for developing an ontology for factors influencing tuberculosis adherence behaviour in sub-Saharan Africa and its effectiveness for constructing risk prediction models for communities in this region.

Chapters 4, 5 and 6 describe the results of the application case study.

- The first four steps of the approach were applied to produce a conceptual model for the factors that influence TB adherence behaviour. This is described in chapter 4.
- The conceptual model is then used as the input into the formalisation step, which involves the development and evaluation of an OWL ontology for factors that influence TB adherence. The results of the formalisation and evaluation of the ontology are presented in chapter 5.
- The ontology for factors that influence TB adherence was extended for probabilistic reasoning. This extension is presented in chapter 6 along with a demonstration of its use in constructing a BN model.

Chapter 4

A CONCEPTUAL MODEL FOR TB ADHERENCE FACTORS

The ontology-driven approach for modelling adherence behaviour, as presented in chapter three, is validated using Tuberculosis adherence behaviour in sub-Saharan Africa as a case study to validate the approach. This chapter describes the application of the first four steps of the approach, i.e. the definition of purpose, knowledge acquisition, model design, and model analysis. The outcome of these steps is a conceptual model for structuring adherence factors that influence TB treatment adherence behaviour in sub-Saharan Africa.

4.1 DEFINITION OF PURPOSE

4.1.1 Determination of Modelling Scope

The disease of focus is TB and the geographical region to be considered is SSA. The motivation of selecting TB adherence in SSA has already been discussed in section 1.4.1 and section 2.1.2.

4.1.2 Design Goals for TB Adherence Factors Ontology

The main goal of designing the TB Adherence Factors Ontology is to capture explicit knowledge about factors that influence TB adherence behaviour in a manner that can support construction of a predictive model for predicting adherence risk for TB communities. This goal includes the following objectives:

- To capture, consolidate and structure explicit knowledge about adherence factors as an evidence-base for decision-making in public health
- To present a computational representation of adherence behaviour that can be queried, navigated and shared among experts and is understandable by machines

- To develop a knowledge base for determining the community-specific adherence factors and to support the predictive model's construction
- To capture findings from the current and future scientific publications on adherence behaviour.

4.1.3 Evaluation Criteria for TB Adherence Factors Ontology

The ontology should have the following characteristics in order to validate that it achieves the above set design objectives:

- It should be comprehensive, consistent, clear and unambiguous
- It should allow categorisation of factors and represent their effect on adherence behaviour
- It should permit structuring, curating and exposing scientific knowledge emanating from clinical studies about factors that influence adherence
- It should be a representation that is understandable by machines and can form the basis of a shared, computer-based knowledge repository for treatment adherence behaviour
- It should be able to be extended, navigated and queried, and be useful for computer-based prediction
- Lastly, it should enable the linking of factors to clinical studies that provide evidence for their predictive value

4.1.3.1 Competence Questions

Three sets of CQs are proposed to evaluate the TB adherence factors ontology. The first set is to determine the possibility of generating output from the ontology. This is to evaluate the capability of the ontology to produce results about adherence behaviour when queried. The second set is to identify the parameters that can be used to query the ontology successfully. This is to evaluate the usefulness of the adherence factor categories for querying and navigating the ontology. The last set is to evaluate the usefulness of the outputs from the ontology for constructing a predictive model. The CQs are:

CQ1: What are the possible outputs that can be derived from the TB adherence factor ontology?

- CQ1a: Is it possible to search the ontology for factors that influence specific TB communities in sub-Saharan Africa?
- CQ1b: Is it possible to search the ontology for evidence that asserts specified factors that influence the adherence behaviour of TB patients?
- CQ1c: Can the ontology provide location information about the influence type, influence period and interrelationship between two or more factors?

CQ2: What are the categorisation dimensions that can be used as parameters to query the ontology?

- CQ2a: Can the ontology be queried using a combination of some or all of the dimensions of the influencing factors?
- CQ2b: Can the ontology be queried using the community characteristics as the only query parameter?
- CQ2c: Can the ontology be queried using any of the influencing factors' categories and properties as the only query parameter?
- CQ2d: Can the ontology be queried using the evidence characteristics as the only query parameter?
- CQ2e: Can the ontology be queried using publication characteristics as the only query parameter?

CQ3: Is the ontology useful for predictive model construction?

- CQ3a: Can the ontology be used to generate the variables and states for a BN model?
- CQ3b: Can the ontology be used to generate the probability tables for a BN model?
- CQ3c: Can the ontology be used to generate the BN model structure?

4.1.4 Use Case Description

Two types of user groups, community and global users, are identified to test the ontology with the CQs stated above. The main concern of both groups of users is to identify community-specific influencing factors. Additionally, global users are concerned with knowing broader factors pertaining to multiple communities in a region or country. Typical examples of such users are:

- A TB programme officer (community user) is planning a new intervention plan for her community. The data he/she collected at the point of care show that there is a high number of defaulters in the communities but she does not understand the reason for this high rate. Thus, she wishes to identify a list of potential factors that are influencing TB patients in her

community. He/she requires this knowledge for the development of a proper community intervention plan that will reduce the rate of treatment defaulting in the community. Additionally, he/she wishes to develop a predictive model that can help in predicting which community or individual is as risk of poor adherence.

- A TB researcher (global user) is saddled with the task of understanding the most common factors for certain countries in SSA. This information will help in her proposal for an alternative treatment plan for TB endemic communities in the region. Hence, she wishes to identify factors that have been established as risk determinants in specific communities of interest and the type of influence they have on patients. She also wishes to identify the existing scientific studies that have identified these factors.

The users described above represent groups of users who can use the ontology to support their tasks. Based on the level of their knowledge, these users can make requests to the ontology and the result will be the required output that is needed to further carry out expected tasks. In the case where a user is interested in establishing influencing factors, the result from the ontology will contain influencing factor classes and instances as the information required. Other influencing factor-related information can also be obtained from the ontology. Such information includes evidence that shows a factor and the location where the studies were carried out.

4.2 KNOWLEDGE ACQUISITION

A review of the literature was conducted to provide the background knowledge required for the TB adherence factors model. The review is aimed at examining existing models in order to identify categorisation dimensions of influencing factors that can be represented in the model. Another purpose of the review is to provide background knowledge about factors that influence TB adherence behaviour. Lastly, the review was used to create the list of factors that will be used for the evaluation of the model.

A review of the literature was conducted to provide the background knowledge for the ontology development process. The repositories searched included Google Scholar, Science Direct (Elsevier), SCOPUS, Web of Science, EBSCO and PubMed. Keywords such as “Tuberculosis Treatment

Adherence Predictors" or "Tuberculosis Medication Adherence Factors" were used to carry out searches for related literature. The word "treatment" was also substituted with "drugs" and "medication". The word "adherence" was substituted for "compliance", and the word "factor" was substituted for "predictor". Some of the search phrases used for the search included the following:

- Factors influencing (medication/treatment) (compliance/adherence) behaviour of tuberculosis patients
- Factors influencing tuberculosis patients' (poor/non) (compliance/adherence) with prescribed (medication/drug)
- Predictors of (drug/medication/treatment) (compliance/adherence) behaviour of tuberculosis patients
- Predictors of tuberculosis patients' (poor/non) (compliance/adherence) with/to prescribed (drug/medication/treatment)

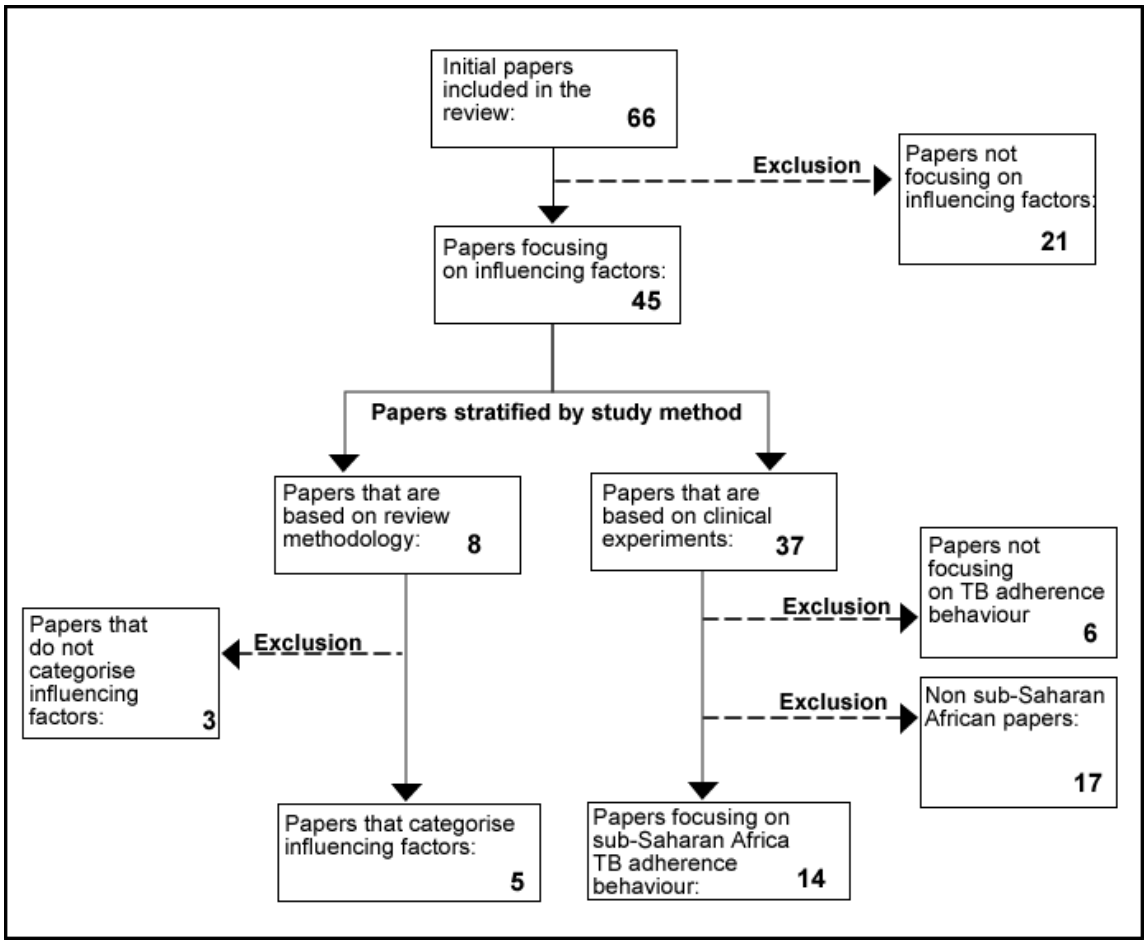

Figure 4.1: Methodology for knowledge acquisition

Scientific papers were collated and analysed iteratively as base knowledge for the development of the model. A total of 66 papers were initially identified in the review. Twenty one of these were excluded because they did not focus on determining the influencing factors (predictors) of TB treatment adherence behaviour. The remaining 45 papers were classified into clinical studies or review papers.

Eight review papers were selected and used as a basis for formulating the classification dimensions. Five papers explicitly proposed categorization systems or identified categories, while the remaining three papers supplemented the general formulation of the final categories.

Thirty-seven papers that reported on clinical studies were used to identify factors that influence adherence for specific communities that can be included in the model. Six of these papers were excluded because they did not focus on factors that influence TB patient adherence. Of the remaining 28 papers, only 14 focused on TB patients in SSA countries. These 14 were later used to evaluate the model.

4.2.1 Existing TB Adherence Factors Categorization Models

Several categorizations of factors contributing to adherence behaviour have been published [8], [1], [28]. These earlier studies carried out an assessment of the factors for the purpose of providing a better understanding of the relationship between the factors and patients' adherence, and for proposing appropriate intervention strategies. The studies include a World Health Organization (WHO) study[1], a systematic review and study by Munro *et al* [8], and a quantitative literature review by Jin *et al* [28]. These three studies present dimensions for categorizing influencing factors. Additional categorization concepts that are not evidence-based, but nonetheless are useful for categorizing influencing factors, have been proposed, e.g. temporal variation proposed by Castelnuovo [39], and Kruk *et al* [40].

4.2.1.1 The World Health Organization Model

A study by WHO was aimed at structuring appropriate intervention plans for several infectious and chronic diseases [1]. This is the earliest known attempt to consolidate knowledge about the influencing factors for comprehensive intervention plans for different types of diseases. The study draws on several qualitative and quantitative studies to present a categorization that was then used to propose disease-

specific intervention approaches. It presented a conceptual model that includes two dimensions for classifying factors that influence adherence behaviour of several chronic disease patients, including TB and HIV/AIDS [1].

Firstly, the factors were grouped into five major categories. These are: *patient-related*, *socio-economic*, *health system*, *therapy-related* and *condition-related*.

- *Patient-related*: This category is based on the characteristics and demographic attributes of patients, such as gender, marital status and age group
- *Socio-economic*: This category contains all social or economic factors, such as stigmatization, social support network, employment status, poverty and transportation cost
- *Health system*: This is a group of factors that result from poor healthcare services, practices and policies that have an effect on patients' adherence. It includes the behaviour of healthcare workers, unfavourable opening hours of the healthcare facility and unavailability of drugs
- *Therapy-related*: This is the category of factors that are directly related to medication and treatment taken by patients. It includes factors such as medication side effect, symptom persistence and long treatment duration.
- *Condition-related*: This category is based on circumstantial behaviour, such as abuse of substances, alcoholism, emotional states and personal beliefs of patients

Secondly, two categories were presented, based on the type of effect: *positive factors*, which stimulate patients to adhere more, and *negative factors* that cause a decrease in adherence [1].

4.2.1.2 Jin et *al*'s Model

Jin *et al* [28] identified some categorizations for representing influencing factors through a systematic review of 102 articles that focused on all types of therapy for several chronic and infectious diseases. The study focused on all types of therapy for several chronic and infectious diseases. A literature search was conducted on the Medline database using medical subject headlines that indicate non-adherence to treatment and their influencing factors. The search was streamlined by means of an age restriction on

patient population and, more importantly, using the context of the study. Only articles focusing on identifying the influencing factors were included.

The study examined common factors causing therapeutic non-adherence from the patient's perspective and identified three dimensions for classifying these factors: factor type, types of effect and impact measurement difficulty.

Firstly, they presented five categories based on factor type: *patient-centred*, *therapy-related*, *healthcare system*, *social and economic*, and *disease-related*.

- *Patient-centred*: is a collection of demographic and psychosocial factors, including age, ethnicity, gender beliefs, literacy, substance abuse and compliance history
- *Therapy-related*: is a collection of factors that are peculiar to the disease treatment process, including treatment complexity, duration of the treatment period and medication side effects
- *Healthcare system*: represents the group of factors associated with the failure of a healthcare provider to meet treatment requirements, leading to poor adherence by patients. It includes lack of accessibility long waiting time and unhappy clinic visits
- *Social and economic*: represents all socio-economic circumstances that make it difficult for patients to adhere to treatment, including inability to take time off work, cost and income, and social support
- *Disease-related*: represents factors relating to patients' experiences of diseases that translate into a belief that results in adherence or non-adherence to treatment. Persistence and severity of disease symptoms are typical factors under this category

Secondly, they presented three categories based on the type of effect: *compliance increment*, *compliance decrement* and *no-effect*. *Compliance increment* refers to the group of factors that improve patients' adherence. *Compliance decrement* implies the group of factors that motivate poor adherence. Where there is neither an increase nor a decrease in compliance to treatment, the factor is regarded as a *no-effect*.

Thirdly, they presented two categories based on difficulties encountered in measuring the effect and counter-intervention of the factors. They are *hard factors* and *soft factors*. *Hard factors* are those whose impact is more quantifiable and can be addressed to an extent through counselling and communication. *Soft factors* are those whose effects are difficult to counter and measure. Soft factors are interrelated and dependent on other factors. However, the study has no clear classification of factors under these categories.

4.2.1.3 Munro et al's Model

Munro *et al* [8] conducted a systematic review of the literature from 1999 to 2005 and developed a model for categorizing influencing factors. The review was aimed at understanding which factors are considered important by TB patients, caregivers and healthcare providers.

The focus of this study is the factors that influence TB patient adherence. A search was carried out on electronic databases for qualitative studies using the terms *adherence*, *concordance* and *compliances* are used as keywords for the search. The literature was further screened with pre-specified inclusion criteria that were provided by an expert in the domain. A total of 44 articles drawn from different regions of the world were reviewed. From the study, four main categorization themes were developed.

Eight relevant themes were pre-identified for both patient and caregiver's perspectives and were used to determine the relevance of the selected studies for the review. These themes are organization of treatment and care for TB patients, interpretation of illness and wellness, financial burden, knowledge, attitudes and beliefs about treatments, law and immigration, personal characteristics and adherence behaviour, side effects, and family, community and household influence.

Munro *et al* developed a model for categorizing factors that influence TB patient adherence behaviour which consists of four main themes: structural factors, personal factors, social context factors and health service factors.

- *Structural factors*: These are factors that exist in society over which a patient has little personal control. These factors relate to economic, social, policy-related, organizational or other aspects of the environment
- *Personal factors*: These consist of a group of factors based on the choices and beliefs of the patient shaped by the psychological and physiological impact of diseases and by the social and cultural structures surrounding the patient. They include motivations, knowledge, beliefs, attitudes and interpretation of wellness and illness
- *Social context factors*: These consist of factors that relate to the social situation of the patient under treatment. They includes factors such as the support from the patient's family in fighting against the reproaches of the disease, the attitude of family members - either positive or negative, and the availability of a strong social network in the community to support patients
- *Health service factors*: These are factors that emanate from poor healthcare services or failure of the healthcare system. They include factors such as unavailability of drugs and the patient experiencing difficulties in consulting healthcare providers.

Munro *et al* also classify the factors according to the region where the studies were carried out. Countries and continents are the geographical areas that were used to stratify the studies included in the review. The highest number of studies included in the review was from Africa, followed by North America, South America and East Asia.

4.2.1.4 Castelnuovo's Temporal Variation: Phase of Treatment

Two categories were identified through a review of six studies carried out by Castelnuovo [39] to depict the period of effect of factors. The categories relate to the treatment phases of an anti-TB treatment plan. The first is the *intensive phase*, which is the first two months of anti-TB treatment after the patients are diagnosed with TB. The second is the *continuation phase*, which starts immediately after the intensive phase and continues for four to six months [39]. Other temporal representations are the weekly and monthly categorizations introduced by Kruk *et al* [40] who reviewed 14 studies that focused on the timing of default in low income countries' TB treatment.

4.2.2 Challenges with Existing Categorisations

Variations in the models presented in existing studies pose challenges for the common and sharable representation of the factors. For instance, the factor type categories identified across the papers may appear similar, but the description of the categories and the factors belonging to each category vary. There are variations in the number of categories presented under the same dimensions. The WHO [1] study proposed five categories, Munro *et al* [8] developed a model of four categories and Jin *et al* [28] identified five categories which are similar to WHO's categories. Similarly, the types of effects proposed by WHO and Jin *et al* are different. While WHO proposed three categories, Jin *et al* proposed two. See Table 4.1 for a comparison of the different categorization systems.

Additionally, the naming and definition of existing categories are inconsistent. There are no generally accepted names for the categories. For instance, patient-related factors have different names and meanings across the three models. They are named as personal factors in Munro *et al* and patient-related factors in WHO and Jin *et al*. WHO's patient-related factor category focuses on patients' demographic information and excludes certain lifestyle and psychological attributes of the patient, which are included in Jin *et al'*s category.

There is also no uniformity in the classification hierarchy; some of the existing models introduce sub-categories while others do not. In the absence of sub-categories, factors are directly grouped under the main categories. Jin *et al* introduced only two sub-categories in their classification for the patient-centred category: demographic and psychological factor categories. Munro *et al* used the eight themes as the intermediate groups, but the relationships with the four themes are not clearly defined. The WHO report did not provide any sub-categories in its classification.

Lastly, none of the categorization systems represent all the categorization dimensions identified in Table 4.1. While some represent more than one dimension in their studies, others concentrate on only one dimension. Three of the five studies, WHO [1] Munro *et al* [8] and Jin *et al* [28], focused on categorizing factors , i.e. the Factor Type dimension. Two studies classified factors according to the type of effect and two studies focused solely on the period of effect.

Dimension	**WHO** [1].	**Munro et al** [8]	**Jin et al [28]**	**Castelnuovo** [39]	**Kruk et al** [40]
Factor type	Patient-related	Personal factors	Patient-centred factors		
	Therapy-related	Health service factors	Therapy-related		
	Health system	Social context factors	Healthcare system		
	Socio-economic	Structural factors	Social and economic factors		
	Condition-related		Disease-related factors		
Type of effect	Positive factors		Compliance increment		
	Negative factors		Compliance decrement		
			No-effect		
Measurement			Hard factors		
			Soft factors		
Temporal				Intensive phase	Weekly/Monthly
				Continuation phase	

Table 4.1: Existing influencing factor categorization systems

Some dimensions are not incorporated across all categorizations. One of these is the cross-dependency between influencing factors. Some clinical studies have established cross-dependencies among factors, that is, a factor's influence is dependent on another factor [41].

4.2.3 Reference Lexicon

A reference lexicon was developed for TB adherence behaviour concepts. This is a guiding reference for the concepts that are included in the designed conceptual model. The terminologies defined in the lexicon include the five dimensions for classifying the factors as well as the evidence concepts that are useful for describing the factors. Table 4.2 shows the description of some of the terminologies that are included in the model.

Main Terminology	**Description**
Influencing Factor	An influencing factor is anything that has the power to have an important effect on something or someone. In the case of adherence behaviour, an influencing factor is the physical or perceived state of a TB patient that has been identified as influential on treatment adherence behaviour.
Theme of Factors/ Factor Type	A theme is defined as "The subject of a talk, piece of writing, exhibition, etc.; a topic"[14] or as "The main subject that is being discussed or described in a piece of writing, a movie, etc."[15] Categorisation of influencing factors by theme is the grouping of the factors based on the main subject or topic that defines their similarities. Seven themes have been developed from the review of existing categorisations from the literature.
Type of Effect	An effect is defined as a change that is a result or consequence of an action or other cause[16]. The type of effect represents the grouping of the influencing factors based on the kind of consequential patient's adherence behaviour.

[14] http://www.oxforddictionaries.com/definition/english/theme
[15] http://www.webster-dictionary.org/definition/theme
[16] http://www.oxforddictionaries.com/definition/english/effect

Region	This dimension represents the peculiarity or prevalence of influencing factors to a particular region. The classification could be done using the geopolitical and administrative boundaries as the categorising elements.
Treatment phase	The treatment phase is a stage of treatment where a particular regimen is administered to a patient for a duration of time. Some factors are peculiar to a specific treatment phase of the treatment. While some have influence at the early stage of the treatment plan, others have influence on the continuous and later stages of the treatment plan.
Evidence	Evidence is a type of information that is used to support an assertion. In this study, evidence is specifically a manual, literature curation of research studies performed or expert knowledge about TB communities that specifies any influencing factor as influential in an area. Evidence can assert the subject as an influencing factor, can assert the degree, period and type of influence that the factor has, or identify an object on which the factor has an effect.
Publication	A publication is a written document that is published or potentially publishable, and that contains or is referred to by bibliographic references or entities used to define bibliographic references. For the purpose of this study, it is regarded as a written and published document about evidence that asserts influencing factors.

Table 4.2: Domain key concepts lexicon

4.3 TB ADHERENCE FACTORS MODEL DESIGN

The categorisation dimensions identified from the review were restructured to form components that were used to design the new conceptual model. Each component of the model was defined with set boundaries to accommodate specified concepts. The design also expresses the relationship between the components that will be included in the model. This design is static and not a computational representation of the model.

Five dimensions were identified from the review of existing categorizations. They are restructured in order to have a complete and unique representation of the influencing factors and their application to TB patients in SSA. The key elements of the classification, as drawn from the review, are: *factor type*, *type of effect*, *treatment phase*, *region* and *cross-dependency*.

Three of the four studies focused on categorization according to the Factor Type dimension. They are the WHO adherence report, the systematic review of Munro *et al*, and the qualitative review of Jin *et al*. Two of the studies focused on classifying the factors according to the type of effect. Only one focused on the period of effect. Several SSA studies used region categorization, such as geo-political and socio-economic regions, for categorizing the factors.

4.3.1 Factor Type

Factor Type represents the grouping of influencing factors according to similarity of common terms as presented in the literature. This type of grouping enables the creation of a category, sometimes in a hierarchy, to assist in distinguishing terms. It is a common dimension for categorizing influencing factors.

The classifications found in the three existing studies were used to develop unique and specific Factor Type categories. The existing categories were restructured to eliminate concept overlaps and misrepresented factors. They were iteratively checked in terms of their effectiveness to classify factors found in scientific publications.

The process of restructuring the categories involves matching existing categories based on similarity of names and meaning. Similar Factor Type categories were merged to produce a comprehensive category. Also, some of the broad categories that represent heterogeneous factors were split to produce unique categories without unnecessary overlap. Through this process, seven Factor Types were defined and their boundaries were set to facilitate the inclusion of factors from scientific evidence. They are *patient-centred*, *social*, *economic*, *therapy-related*, *health system*, *lifestyle* and *geographical access*.

A hierarchical model was introduced to capture the Factor Type in a consistent manner. The top level of the hierarchy includes the main categories while the second level represents sub-groups of factors. This second level is generated from ad-hoc groupings found in existing studies. The lowest level in the hierarchy will represent concrete and measurable influencing factors.

4.3.1.1 Patient Centred

The new *Patient-Centred* category of this conceptual model was created by merging related categories and was redefined. The term "*Patient-Centred*" was taken from the study by Jin *et al* [28] as against "*patient-related*" in WHO [1] and Munro *et al. 's* [8] "*personal character*". This category also reflects the definition given by Munro *et al*. The new *Patient-Centred* category is defined as the category of influencing factors based on the demographic attributes of patients and the attitudes that define the characteristics of the patients. Table 4.3 shows the list of factors identified from SSA studies that were included in the category.

Main Class	Middle Class	Bottom Class
Patient centered	Demographic	Age group
		Gender
		Marital Status
	Knowledge	Knowledge of TB
		Education level
	Psychology	Emotional state
		Psychiatric condition
		Depression

Table 4.3: Three level hierarchy of patient-centred influencing factors

The *Patient-Centred* category of this conceptual model includes demographic and psychological factors, but excludes social-related factors from the definitions presented by Jin *et al* and Munro *et al*. Demographic information and knowledge/literacy of patients, as included by Jin *et al* and Munro *et al*, fits into the category of patient-centred factors. Interpretation of wellness and illness, motivation and beliefs [8] [28] were excluded because they align more with the social perspectives of the patient. Compliance history and substance abuse, included in Jin *et al*, were excluded because they are therapy and lifestyle-related factors respectively.

4.3.1.2 Social and Economic

The studies of Jin *et al* and WHO group social context factors and economic factors into the socio-economic category. The example of Munro *et al*. was followed by separating economic factors from the social factors. This will allow for a unique representation of the factors in a specific category and reveal the potential of a factor to belong to more than one category.

The *Social Factor* category of the conceptual model represents the social context and situation of a patient, while the *Economic Factor* category of the conceptual model relates to the economic status and condition of the patient. The *Social Factor* category includes stigma, social network and belief-related factors. *Economic Factors* include financial burden, employment status, and basic amenity-related factors (Table 4.4).

Main Class	Middle Class	Bottom Class
Economic	Finance	Income class
		Poverty
	Employment	Job class
		Employment status
	Basic amenities	Lack of food
		Homelessness
Social	Social network	Family support
		Community network
	Stigma related	Perceived stigma
		Experienced stigma
	Belief	Wellness perceived as cured
		Treatment efficacy belief

Table 4.4: Three level hierarchy of economic and social influencing factors

4.3.1.3 Therapy Related

The *Therapy-related* factor category of the conceptual model was adopted from WHO and Jin *et al*. It represents the category of influencing factors that relate to therapy difficulties faced by patients and clinical procedures that facilitate or hinder patients from adhering to treatment. It also forms part of the disease-related factor presented by Jin *et al* and the health service category of Munro *et al*. See Table 4.5.

Main Class	Middle Class	Bottom Class
Therapy	Therapy effect	Drug adverse effect
		Symptoms persistence
	Co-morbidity	HIV co-infection
	Treatment	Defaulting history
		Treatment alternative

Table 4.5: Three level hierarchy of therapy-related influencing factors

Co-morbidity with other chronic diseases is an important factor included in the therapy category because it deals with patients' concurrently undergoing treatment for multiple diseases. These patients face many challenges which could be a clash of clinical appointments and the burden of medication.

4.3.1.4 Health System-Related

The *Health System* category of the conceptual model consists of influencing factors that relate to the performance of healthcare providers and the accessibility of healthcare services to patients at the health facilities, as shown in Table 4.6. The *Health System* category is directly represented in categorizations by Jin *et al* and WHO. This category partially covers the system-related factors represented in the health service category, as defined by Munro *et al*.

Main Class	Middle Class	Bottom Class
Health system	Healthcare facility	Opening hour favorability
		Drug availability
	Healthcare staff	Staff friendliness
		Communication gap experience

Table 4.6: Three level hierarchy of health system-related influencing factors

4.3.1.5 Lifestyle Related

Some influencing factors are directly associated with the lifestyle of the patient, e.g. substance abuse, diet and exercise. These factors are grouped into a new category of the conceptual model termed "*Lifestyle*", see Table 4.7. These are circumstantial factors related to habits developed by patients and are subject to change. They have been represented under various categories. Jin *et al* classified some of these factors as *patient-centred*, while WHO classified them as *condition-related* factors. Separating

these factors into different categories will allow for a clear identification of unhealthy lifestyle-related factors. The *Lifestyle* factor category distinctly covers those factors related to a patient's lifestyle.

Main Class	Middle Class	Bottom Class
Lifestyle	Substance abuse	Alcohol consumption
		Tobacco usage
		Hard drug usage
	Healthy living	Diet
		Exercise

Table 4.7: Three level hierarchy of lifestyle-related influencing factors

4.3.1.6 Geographic Access Related

A *Geographical Access* category was also introduced in the conceptual model to represent the category of influencing factors that relate to the location of healthcare facilities, the house/workplace of patients and accessibility-related costs in terms of distance, time and effort, and financial expenses (Table 4.8). This will help in understanding both the financial and non-financial burden that relate to a patient's geographical access to health facilities.

Main Class	Middle Class	Bottom Class
Geographical access	Location	Distance to facility
		Dwelling region
	Transportation	Travel time
		Transportation cost

Table 4.8: Three level hierarchy of geographical access influencing factors

4.3.2 Type of Effect

This category is the type of effect a factor has on patients' adherence; the degree of effect represents the intensity of influence on a TB patient. The type of effect is based on that of the WHO study. Another type that was included was based on the "no effect" type identified in Jin *et al*. The three types of effect included in this model are the positive, negative and neutral effects.

Positive influencing factor represents a group of factors that show a significant motivating influence on the improvement of good adherence behaviour. These factors are known to encourage patients to adhere to the medication prescribed by a

healthcare officer. This category corresponds to the positive effect [1] and compliance increment.

Negative influencing factor represents factors that show a significant demoralizing influence on patients' attitudes and that cause poor adherence behaviour. This category corresponds to the negative effect of WHO and the compliance decrement of Jin *et al.*

Neutral influencing factor represents a group of factors that show no significant effect or correlation on a patient's attitude towards adhering to treatment. This category corresponds to the no-effect category in the WHO study.

The patient's state, perception or experience in relation to these factors makes the factors negative or positive. The gender-related factor is based on whether being a male patient is a negative influencing factor or being a female is a positive influencing factor. Therapy-related factors are mostly based on patient experience. Drug adverse effect for example, is based on the treatment experience of the patients under treatment and is seen to cause poor adherence. Belief-related factors are based on the perceptions of patients about circumstances or conditions. An example is a patient who has a strong belief in treatment efficacy (positive influencing factor); the lack of such belief is regarded as a negative influencing factor.

4.3.3 Treatment Phase

The treatment phase factor refers to the stage during which a factor is influential during treatment. Some SSA clinical cohort studies has considered measuring adherence and defaulting rate over different treatment phases. For example, the two main TB treatment phases are the intensive and continuation phases of treatment. Previous studies have concluded that there is an increasing trend in poor adherence as patients go into the continuation treatment phase, and that more patients tend to default at the continuation phase than at the intensive phase [40] [30] [31].

Other treatment phases can be included, e.g. the *drug resistance phase factor* represents the category of factors that are influential during a drug-resistance treatment phase for the treatment of patients who are resistant to first-line regimen drugs, and can be as long as 2 years.

4.3.4 Region

The regional variation of the influencing factors describes the existence of a factor with significant influence on socio-economic regions in particular. Although there is no existing regional model for influencing factor classification, several studies have used geographical regions for their classification. The results of several clinical and review studies reveal that influencing factors can vary across regions. Regions can be delineated according to socio-economic or geographical similarities. The administrative area is commonly used for classification, which represents geographical regions with internationally recognized administrative boundaries and governance, e.g. countries and provinces. The geographical region is a representation of regions with physical boundaries or that have common geographical/physical features, not recognized political boundaries and governance, and represents the communities where the clinical studies were carried out. Lastly, the socio-economic region is a collection of regions with social and economic similarities.

4.3.5 Cross-dependency

Although cross-dependency relationships between influencing factors are not represented in current categorizations, they are common in the findings of clinical studies that focus on influencing factors. A cross-dependency relationship implies that a certain factor was found to influence adherence behaviour only if another factor was present. Cross-dependency relationships are represented in the way that they link *the "trigger factor"* to the factors that are dependent on the trigger and are caused by the trigger factor. A *"dependent factor"* is only triggered when another factor is present.

For example, if a study found that being male contributes to negative adherence behaviour only when there are unfavourable conditions at work [41], then, Male Gender would be represented as a factor that is triggered by unfavourable working conditions.

4.4 TB ADHERENCE FACTORS MODEL ANALYSIS

Analysis was carried out on the TB adherence factors model in order to test the extent to which it could adequately accommodate and classify factors influencing adherence behaviour. The first two criteria that are set in the first step of the approach are validated at this step. These criteria are:

- It should be comprehensive, consistent, clear and unambiguous
- It should allow categorisation of factors and represent their effect on adherence behaviour
- It should permit structuring, curating and exposing of scientific knowledge emanating from clinical studies about factors that influence adherence

Two forms of analysis were carried out on the TB adherence factors model. The first form of analysis entails comparison of the model with the existing categorizations, to verify its representativeness. This process is aimed at validating the coverage of the factor categorisations included in the model, compared with the existing models. The comparison is based on the number of dimensions and categories represented in the model as well as the extent to which the categories are represented under the dimensions.

The second form of analysis is aimed at testing the comprehensiveness of the model in representing factors associated with TB patients in SSA, as identified in various published clinical studies of the region. This analysis validates the ability of the model to accommodate the complexity between factors and to capture existing domain knowledge (from the literature) objectively, without giving preference to any particular study. The 14 scientific papers that focused on TB patients in SSA countries were used for the analysis. These papers were identified at the knowledge acquisition step. The factors reported in the cohort studies that were presented in these papers were classified using the categorisation dimensions represented in the model.

4.4.1 Comparative Analysis with Existing Categorizations

Table 4.9 compares the adherence ontology in terms of its coverage with existing categorizations. The developed ontology is more comprehensive than the existing categorizations. It includes five out of six of the identified dimensions for influencing factor categorization extracted from the extensive literature

review. Jin *et al's* categorization covers four of the dimensions. Both WHO's categorization and Munro *et al*'s models cover two dimensions. Castelnuovo's categorization only covers the treatment phase category.

Dimensions	**WHO** [1]	**Munro *et al*** [8]	**Jin *et al*** [28]	**Castelnuovo** [39]	**Conceptual Model**
Factor Type	✓	✓	✓		✓
Type of Effect	✓		✓		✓
Treatment Phase				✓	✓
Degree of Effect					
Region		✓ (gp)			✓ (exp)
Difficulty of measurement			✓ (imp)		
Cross-dependency			✓ (imp)		✓ (exp)
Percentage total	2	2	4	1	5

gp = geopolitical; imp = implicit; exp = explicit.

Table 4.9: Coverage of the ontology compared with existing categorizations

One important feature that makes the ontology more comprehensive than the existing categorizations is the explicit representation of the region and the cross-dependency dimensions. Both the geographical region and the interdependency between factors have not been explicitly modelled by existing categorizations.

4.4.2 Representing Findings from Sub-Saharan African Communities

The comprehensiveness and effectiveness of the conceptual model in representing the "nuances" of factors found in communities in SSA was tested. Factors and their characteristics were extracted from clinical cohort studies that focused on adherence in TB communities in SSA. A total of 14 clinical studies on the SSA region were used in the identification of factors which were then classified and captured in the ontology. The coverage of these factors by the model was analysed.

4.4.2.1 Factor Type Analysis

The new categories of the conceptual model provide a comprehensive range of factors that have been identified in SSA (Table 4.10). Firstly, the newly created *Patient-Centred* category covers 10 (71%) of the factors identified in relation to TB patients in SSA. This matches the *Personal Character* category defined by Munro *et al*, although named differently. This is because the definition of *Patient-Centred* factors is similar to that of *Personal Character* as it includes demographic and psychological factors.

Patient-centred category by Munro *et al* [8] covers 86% of the factors which is higher than the new *Patient-Centred* category of the conceptual model. *Patient-Related* [1] categories only cover 43% and show a very narrow representation of the category.

Influencing factor Classifications	**No. of studies in sub-Saharan Africa (14)**
Patient-related [1].	6 (43%)
Personal factor [8]	10 (71%)
Patient-centred [28]	12 (86%)
****Patient-Centred***	***10 (71%)***
Socio-economic [1].	9 (64%)
Social context [8]	2 (14%)
Social and economic [28]	10 (71%)
****Social***	***6 (43%)***
Condition-related [1]	10 (71%)
Structural [8]	9 (64%)
****Economic***	***6 (43%)***
Therapy-related [1]	8 (57%)
Therapy-related [28]	8 (57%)
****Therapy- related***	***8 (57%)***
Health system [1]	3 (21%)
Health service [8]	2 (14%)
Healthcare system [28]	6 (43%)
****Health System***	***4 (26%)***
Disease-related [28]	2 (14%)
****Lifestyle***	***6 (43%)***
****Geographical access***	***5 (36%)***

WHO [1]*; Munro et al*[8]*; Jin et al* [28] ****Conceptual model***

Table 4.10: Analysis of Existing and New Categories

The new *Economic* and *Social* categories of the conceptual model have a wider coverage than the *socio-economic* category presented by WHO and Jin *et al*. Eighty-six percent of the studies identified factors belonging to these classes. *Economic*-related factors are identified in 6 studies, even with the exclusion of transportation-related factors. *Socio-economic* category by WHO [1] covers 64%, *Social and Economic* category by Jin *et al* [28] covers 71% of the factors, while the *Social* context [8] covers 14%. The newly created *Social category* covers 43% of the factors. Similarly, the newly created *Economic*

category covers 43%, due to the fact that most factors in the *Structural* and *Condition-related* [1] categories are incorporated into the two new categories: *Geographical Access* and *Lifestyle*.

The new *Health System* category of the conceptual model covers 26% of the factors, which is less than Jin *et al*'s *Healthcare System* [28] which covers 43%. This is because not all factors in Jin *et al*'s category are represented in the new *Health System* category. For instance, lack of accessibility to a healthcare facility was included under *Healthcare System* [28] and under *Geographic Access,* but was excluded from the new category. The new category covers more factors than both the *Health System* [1] (21%) and *Health Service* [8] (14%) categories.

The coverage of *Therapy-Related* of the conceptual model matches those from the 2 studies which cover 57% of the factors extracted from the SSA studies. The *Geographic Access* category has 36% coverage on influencing factors identified for SSA. *Lifestyle* category has 43% coverage on influencing factors identified for SSA.

The new Factor Type categorization offers a more complete representation than the existing ones. The categories are distinct from one another and cover the factors uniquely. However, certain factors from SSA studies, such as the existence of a direct observation therapy (DOT) centre within the district [101], False/Unknown Address [102] and Out-Patient Method [31] did not fit into any of the new categories.

4.4.2.2 Regional Variation Analysis

Regional classification of the influencing factors was carried out using countries in SSA with the aim of identifying influencing factors specific to each of these regions. This classification revealed knowledge about varying, prominent influencing factors for different countries (Table 4.11). Geographical classification of the influencing factors was carried out using countries in SSA with the aim of identifying influencing factors specific to each of these countries. This classification revealed knowledge about varying influencing factors for different countries. Cohort studies are usually carried out within geographical regions enclosed within countries.

Although, there is wide variation in the range of factors identified for different countries, the most common categories across all countries are patient, therapy- and social-related factors. There are some influencing factors that cut across many SSA countries, irrespective of the socio-economic state of the region. Gender, alcohol abuse, stigmatization, income class and employment status are factors that are common to many SSA countries.

Regions	**Influencing Factors**
Burkina Faso [103]	Alcohol abuse; Defaulting history; TB knowledge
Cameroun [31]	Stigmatization; Wellness perceived as cured
Ethiopia [30] [104] [29]	Wellness perceived as cured; Age group; Geographic access; Education level; Drug adverse effect; Social network (Family support); TB knowledge; Finance-related; Alternative treatment
Kenya [12]	Healthcare system-related; Social and economic; Patient-centred; Alcohol abuse; Therapy-related
Madagascar [102]	Transportation time; TB knowledge; Gender; Communication gap experienced
Namibia [6]	Distance to healthcare facility; Wellness perceived as cured; Gender; Marital status; Education level (literacy); Social network (family support); TB knowledge; Drug adverse effect; Symptoms persistence; Long waiting time; Lack of food; Substance abuse; Lifestyle
Nigeria [41]	Co-infection (HIV); Gender; Unfavourable working condition
South Africa [32] [25] [11]	Stigmatization; Wellness perceived as cured; Alcohol abuse; Tobacco usage (smoking); Poverty; Incentive expectation at clinic; Symptoms persistence; Drug adverse effect; Gender; Co-infection; Psychological distress
Tanzania [101]	Gender; Age group; Distance to facility; Geographic access
Zambia [105]	Wellness perceived as cured; TB Knowledge; Drug availability; Drug adverse effect

Table 4.11: Regional comparison of influencing factors

4.4.2.3 Temporal Variation Analysis

There is variation of TAB between the two phases of an anti-TB treatment plan. Patients adhere less to treatment in the continuous phase of treatment than in the intensive phase, which is evident in the increase in treatment defaulting rate during the continuation phase [12] [39] [41] [30] [31] [106] [107]. Also, temporal variation analysis by Kruk *et al* [40] reveals that earlier studies of patient adherence behaviour show an increased trend in the treatment default rate during the continuation phase.

Many clinical studies that considered the temporal dimension of TAB, measured the defaulting rate between the intensive and the continuation phase. However, the predictors of TAB were generally viewed over the entire period of treatment and were not linked to only one phase of the treatment. Only a few clinical studies considered the variation of the TAB influencing factors in the intensive and continuation phase; these are the studies by [106] and [107]. The Table 4.12 below shows the list of influencing factors at various stages of treatment plan.

Intensive phase only	**Continuation phase only**	**Intensive and continuation**
• Negative perception of healthcare facilities and services • Low treatment efficacy belief • Smoking	• Symptoms persistence • Lack of treatment knowledge • Lack of family support • Low education • History of illness • Financial burden or lack of material support • Alcohol abuse • Non-availability of drugs	• Lack of self-confidence on completing treatment • Experience and perceived stigmatization • Lack of geographical accessibility to facility

Table 4.12: Identified TAB influencing factors at different treatment phases

Patient-centred factors are identified to be the motivator of poor adherence at the intensive phase [106]. Social and economic factors do not have a significant influence on TAB during the intensive phase of treatment, although stigmatization is identified by [107] to be one of the motivating factors at the intensive phase. One further group of factors that has a significant influence at the intensive phase is geographical accessibility to healthcare facility.

At the continuation phase, a combination of several factors' categories play an important role in determining TAB. Some of these factors include lack of understanding of treatment defaulting effect, lack of family support or social network, medical history of patients and lack of improvement in health status after starting medication. Accessibility to facility was identified by [106] as affecting only the intensive phase but was identified by [107] as affecting only the continuous phase. This showed that

geographical accessibility to healthcare facility could affect both the intensive and continuous phase of treatment.

4.5 SUMMARY

In this chapter, the application of the first four steps of the ontology-based approach for representing factors influencing TB adherence behaviour was presented. These steps are part of the process that was introduced in the previous chapter (Chapter 3). The output is a validated conceptual model of factors that influence TB adherence behaviour.

The process started with defining the purpose of the ontology. The knowledge acquisition step was then successfully carried out through an extensive review of literature. This was followed by the process of designing the model, based on key elements of the existing categorisation models found in the literature. Five categorisation dimensions were identified from the existing models and are used as key elements of the conceptual model.

Lastly, the model was analysed to validate the comprehensiveness and representativeness of the factors identified in experimental studies. The key findings of the analysis are:

- The conceptual model represents more categorisation dimensions than existing models found in the literature
- The model explicitly represents two categorisation dimensions that are only implicitly represented in existing models. They are the Region and the Cross-dependency dimensions. The explicit representation of the Region dimension in the model makes it possible to link the factors to the communities where they are identified.
- Most factors derived from the reviewed scientific publications in SSA were successfully expressed in the model. The analysis shows that most of the factors identified were categorised under the Factor Type dimension

The application of the remaining two steps is described in the next chapter (Chapter 5).

Chapter 5

AN ONTOLOGY FOR TB ADHERENCE FACTORS

This chapter describes the application of the last two steps in the approach, i.e. the model formalisation and the ontology evaluation steps. The resultant conceptual model (see chapter 4) from the first four steps formed the basis for the last two steps. The conceptual model is the input for the model formalisation step. The output of the formalisation is an ontology that will be evaluated for fitness for its design purpose.

The recommended ontology language for the formalisation process is the Web Ontology Language (OWL). The ontology was developed using combinations of two ontology development tools:

- Protégé-OWL tool version 4.3.2[17] is used to implement the ontology in OWL, including design of the ontology and populating the ontology with instance data
- Apache Jena API for implementing SPARQL queries is for querying the ontology.

Concepts from the following ontologies were reused:

- Evidence ontology (ECO) [99] for formalising the evidence concept
- FaBiO ontology [108] for representing scientific publication
- Geonames ontology [109] for representing geographical regions

[17] http://protege.stanford.edu/

The chapter also describes the implementation of a prototype web portal to facilitate querying and navigating the ontology by potential users.

5.1 OVERVIEW OF THE ONTOLOGY

5.1.1 Main Classes and Properties

The ontology consists of five main classes that are based on the reference lexicon defined in section 4.2.3: **`TABInfluencingFactor`**; **`Evidence`**; **`Work`**; **`Interdependency`**; and **`Place`**. These classes determine the structure of the adherence factors knowledge repository and are linked with various object properties. These are: ***`assertsInfluencingFactor`***; ***`assertsInterdependency`***; ***`isDocumentedAs`***; ***`isAtRegion`***; and ***`hasInfluencingFactor`***. (See Figure 5.1)

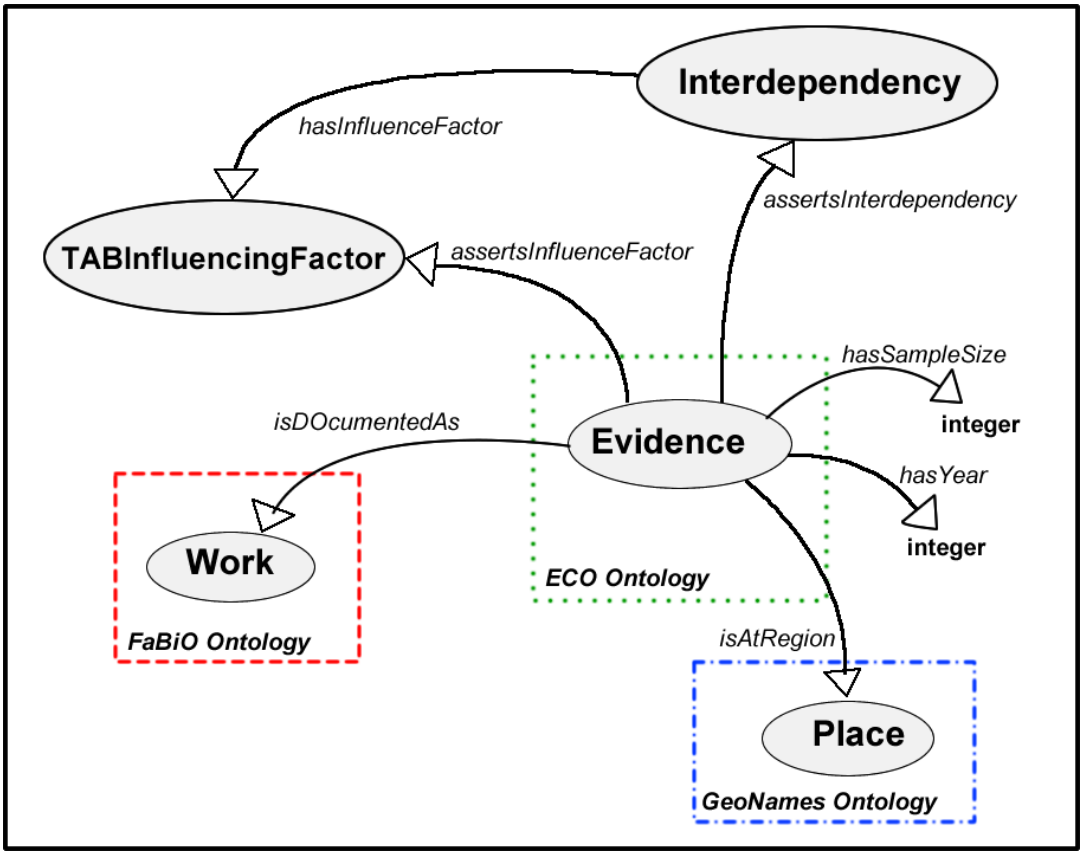

Figure 5.1: Overview of the key concepts and relations in the ontology

`TABInfluencingFactor` class is a hierarchical class with 3 levels of hierarchy to represent different levels of factory type themes from the literature. **`Evidence`** class represents existing scientific knowledge about influencing factors that will be stored in the repository, which stores scientific facts about their theme, type of effect, treatment phases and places where the factors are identified.

The key classes and properties captured in the ontology are shown in Figure 5.1. The classes represent key concepts, while properties represent relations between concepts. Figure 5.2 below shows classes of the ontology in the Protégé ontology editor. See Appendix 1 for the complete OWL representation of the TB adherence factors ontology.

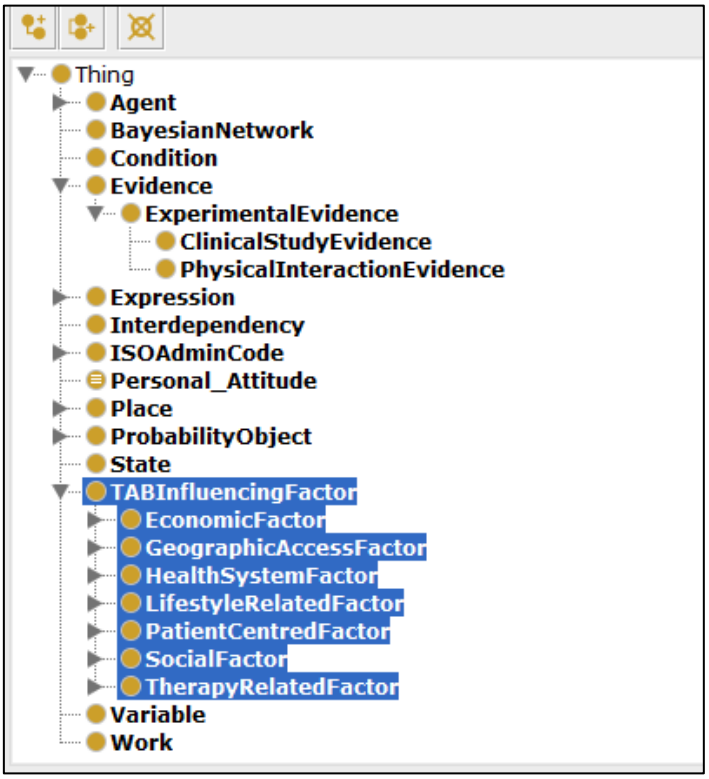

Figure 5.2: High level classes of the ontology

5.1.2 The Adherence Factor Ontology Classes

5.1.2.1 TABInfluencing Factor

The **`TABInfluencingFactor`** class represents a characteristic or a group of characteristics of a TB patient that have been identified as influential on adherence and is informed by research studies on one or more communities. **`TABInfluencingFactor`** is the representation of the *theme/factor type* dimension of the model. The new factor type theme categorisation that was developed into the conceptual model (see section 4.3.1) is implemented as **`TABInfluencingFactor`** class hierarchy. The reformed categories are implemented as a three level sub-class hierarchy under the **`TABInfluencingFactor`** class. The hierarchical classes are used to represent factors as categories and sub-categories.

It is important to note that a specific factor may belong to multiple *theme* categories (**`TABInfluencingFactor`** sub-classes) in order to allow for ambiguity and different stances to be taken in the literature to be considered. Although the theme categories from these were reformulated to eliminate concept overlaps and misrepresented factors, there is still the possibility of a factor belonging to more than one theme. Formalising the model with an ontology allows for multiple association of factors with more than one class. The hierarchical representation of the **`TABInfluencingFactor`** with the 7 themes (factor type) is shown in Table 5.1 below.

Main Class	Middle Class	Bottom Class
Patient-centred	Demographic	Age group
		Gender
		Marital status
	Knowledge	Knowledge of TB
		Education level
	Psychology	Emotional state
		Psychiatric condition
		Depression
Economic	Finance	Income class
		Poverty
	Employment	Job class
		Employment status
	Basic amenities	Lack of food

		Homelessness
Social	Social network	Family support
		Community network
	Stigma related	Perceived stigma
		Experienced stigma
	Belief	Wellness perceived as cured
		Treatment efficacy belief
Health system	Healthcare facility	Opening hour favourability
		Drug availability
	Healthcare staff	Staff friendliness
		Communication gap experience
Therapy	Therapy effect	Drug adverse effect
		Symptoms persistence
	Co-morbidity	HIV co-infection
	Treatment	Defaulting History
		Treatment Alternative
Lifestyle	Substance abuse	Alcohol consumption
		Tobacco use
	Healthy living	Diet
		Exercise
Geographical access	Location	Distance to facility
		Dwelling region
	Transportation	Travel time
		Transportation cost

Table 5.1: Three level hierarchy of TB adherence influencing factors

In representing the **`TABInfluencingFactor`** class, a design decision was made to represent influencing factors as the main subject of the model and not as characteristics of a person. This decision is to facilitate structuring of the facts from scientific publications for construction of a predictive model. This is also in line with the approaches taken by all three existing categorisation systems [1] [28] [8], which have been proposed by domain experts in this area. The three hierarchy levels under the **`TABInfluencingFactor`** class represent sub-categories of factors, while the bottom classes represent the concrete observable factors. For example, **`Gender`** falls under the **`Demographic`** sub-category and **`Patient-Centred`** the main category (see Figure 5.3). The instances of the **`Gender`** factor that can be observed in patients are "**`Male`**" and "**`Female`**". This design decision is also significant for the conversion of the factors into useful primitives for mapping to Bayesian Network variables (see Chapter 6).

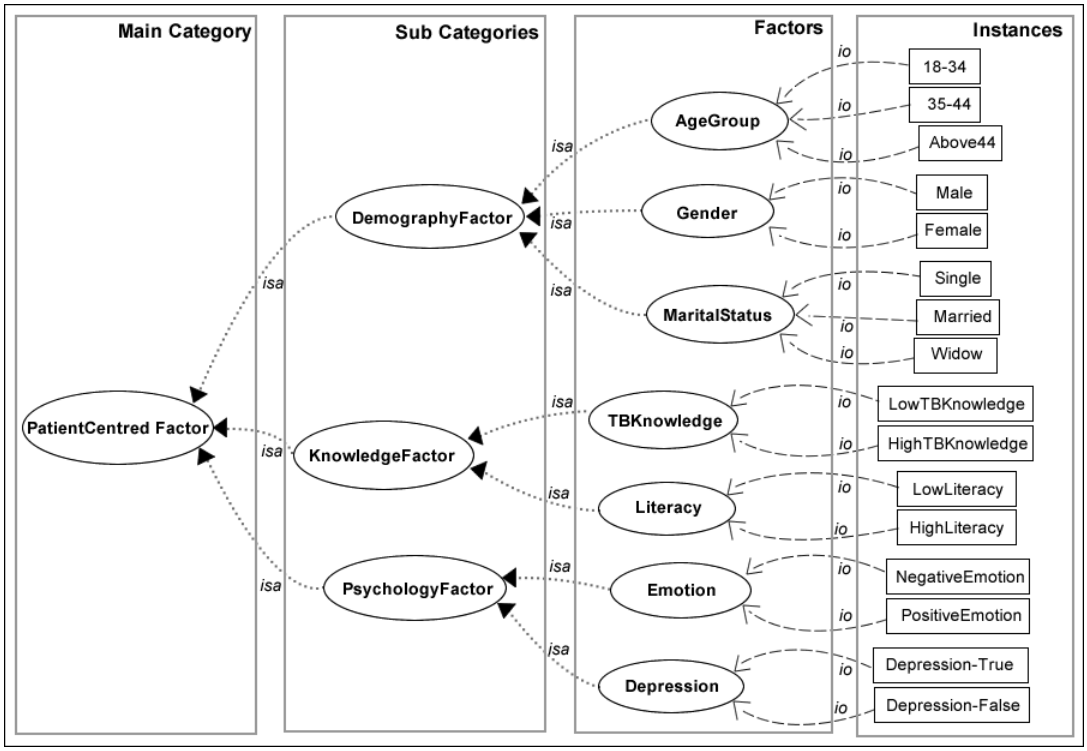

Figure 5.3: Example of hierarchical class of the ontology

5.1.2.2 The Evidence

`Evidence` is formal or informal information supporting the influence of a factor on adherence behaviour. It includes expert knowledge from scientific studies and other scientific documents. **`Evidence`** is key to the identification of influencing factors and their interrelationships. It provides information about the characteristics of factors that influence TB adherence in various communities. **`Evidence,`** in this concept, refers to studies carried out to identify significant factors and their associated properties. The types of properties evidence asserts are described as the assertion relationship between the evidence and influencing factors.

The Evidence Ontology (ECO) was adopted as the base ontology for describing the **`Evidence`** class. ECO is a controlled vocabulary that describes types of scientific evidence within the realm of biological research that can arise from laboratory experiments, computational methods, manual literature curation and other means [99].

ECO consists of several evidence classifications, some of which were used as a base concept for designing the **Evidence** class for the ontology. Figure 5.5 shows the classes that are included in the **Evidence** class as sub-classes. ***ClinicalStudyEvidence*** is an empirical scientific study/research carried out in a region on a certain population and is a useful representation of the studies that assert the influencing factors.

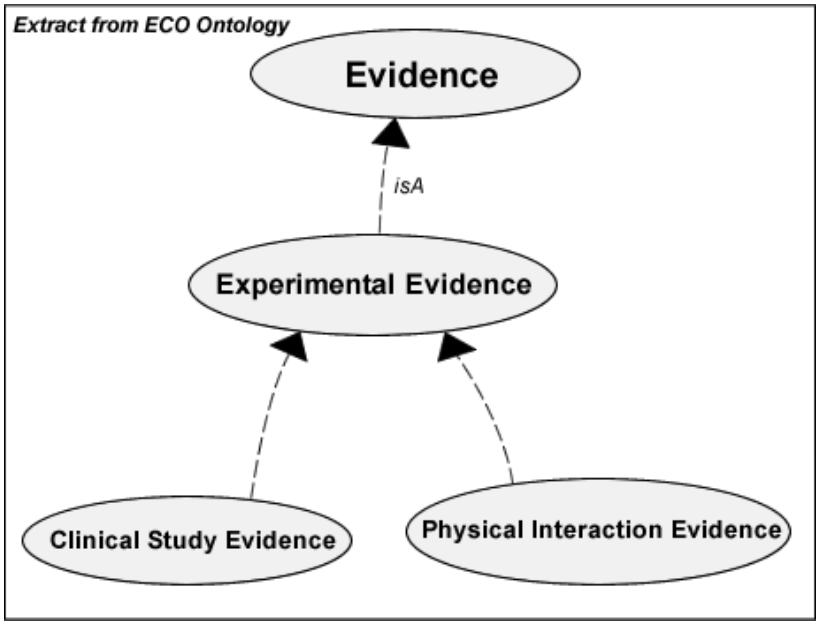

Figure 5.4: Extract of ECO ontology used as a base concept for the ontology

Data properties are associated with the **Evidence** class for validation of evidence to be stored in the ontology. They are **hasYear** which defines the manifestation year of the **Evidence** and **hasSampleSize** which describes the sample size of the cohort or survey. The **isCarriedOutAt** property is a sub-property of **isAtRegion**, which describes the region that the study area represents. Lastly, the **isDocumentedAs** property is for the purpose of including the information about the scientific publication of the study.

5.1.2.3 The Work

A **Work** class is included in the ontology to include additional information for the **Evidence** class in the ontology. It represents any published document that is produced from a scientific study or other scientific work. Its properties include the name of the author(s), year of publication, URL

of the document online, and the digital object identifier (doi) for the document (See Figure 5.6 below).

The **`Work`** class is based on the concept of FaBiO[18] ontology [108], which is an ontology for recording and publishing bibliographical records of scholarly endeavours on the Semantic Web. The **`Work`** object-properties such as ***`hasPublicationYear`***, ***`hasIdentifier`***, ***`hasAuthor`***, ***`hasRealisation`***, ***`hasResourceLocation`*** were modelled on the FaBiO ontology.

The ***`hasRealisation`*** is an important property of the **`Work`** class as it links the study to the kind of expressions of the work; an **`Expression`** can be an article, a conference proceeding, a conference paper or technical report.

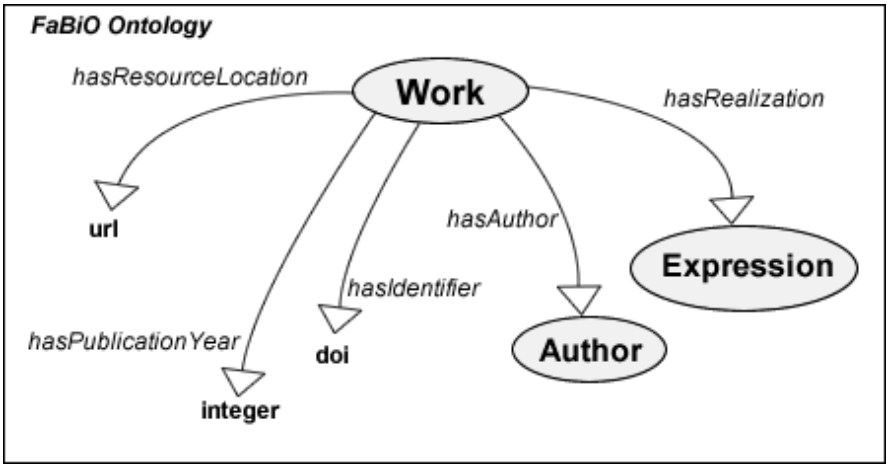

Figure 5.5: Extract of FaBiO ontology used as a base concept for the ontology

5.1.2.4 The Place

A **`Place`** refers to the region where the study was carried out (study location), and may be the town, city, province or country of the study. It is the formal representation of the *region* dimension of the model. The **`Place`** class is related to the **`Evidence`** class and was designed according to the object properties and classes from the GeoNames ontology [109].

[18] http://www.essepuntato.it/lode/http://purl.org/spar/fabio

The **`Place`** class was extended to include socio-economic properties than can be used to describe the characteristics of the study location. This allows for users to search for a place of interest, using the characteristics as a guide. Some of the data properties that were included are the economic classification, population characteristics and spatial information. Also included are data properties to describe the incidence and prevalence of TB and HIV/AIDS in various places or locations.

The spatial relationship among the place entities was enhanced using GeoVocab[19] ontology as base concept. GeoVocab ontology specifies the regional connections between spatial entities. This is useful for the refinement of spatial searches for influencing factors in the ontology. The hierarchy of the administrative boundaries was based on the concept of GeoVocab ontology. For instance, the *parentFeature* property allows for an individual place to be identified with its parent administrative boundaries.

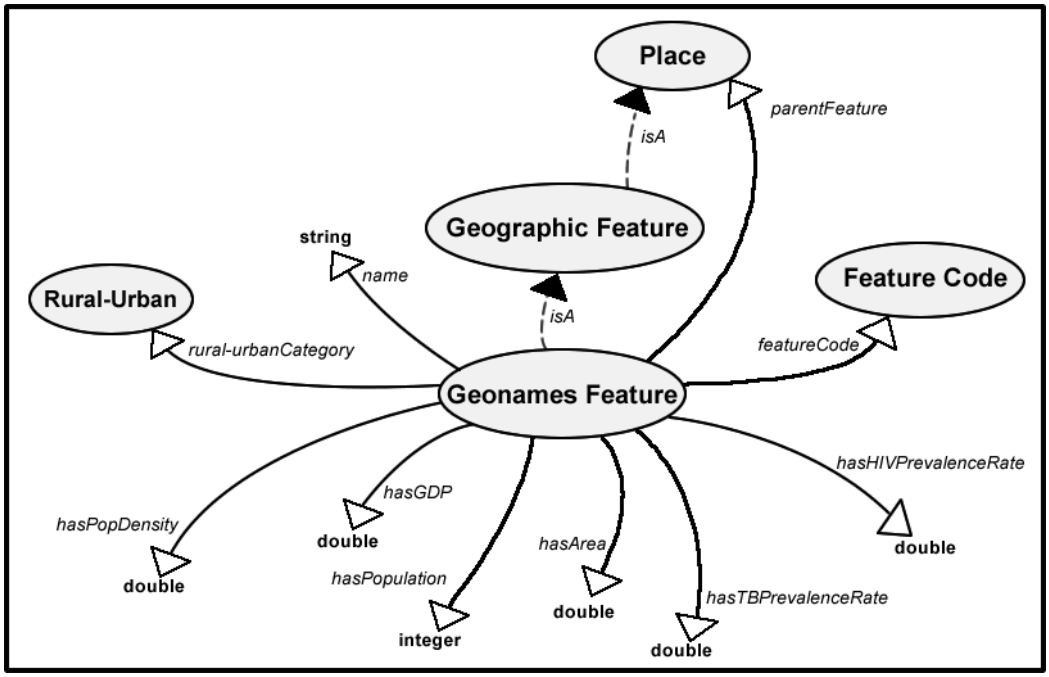

Figure 5.6: GeoNames ontology extract used as a base concept for the ontology

[19] http://geovocab.org/

The **`Place`** class is also extended to include socio-economic properties than can be used to describe the characteristics of the study location (see Figure 5.4). This allows for users to search for a place of interest using the characteristics as a guide. Some of the data properties that were included are the economic classification, population characteristics and spatial information. Also included are **`hasTBprevalence`**, and **`hasHIVprevalence`** data properties to describe the prevalence of TB and HIV/AIDS in various places or locations.

5.1.2.5 The Interdependency

The **`Interdependency`** class is used to represent a finding of interdependency between factors. Suppose, for example, a scientific publication finds the following: "Being male is a negative influencing factor that is influenced by the unfavourable working conditions that most males experience at work." This would indicate a causal relationship between gender-related influencing factors and working condition.

Representing interdependency as a class provides the possibility of relating it to the evidence (studies) that asserts (finds) the existence of any interdependency. It also allows for multiple dependency relationships between influencing factors and different interdependencies found in different studies.

5.1.3 Key Relationships in the TB Adherence Factors Ontology

The TB Adherence model is tied together by the relationship links between the classes. The relationships define the structure of the ontology and the manner in which the factors are stored. The relationships between the classes define the concept of adherence in a way that influencing factors can be retrieved for particular communities by an individual with minimum knowledge of the area.

The key concepts are linked by relationships between the classes. There are 5 major object properties that define relationships: ***assertsInfFactor, hasInfFactor, isDocumentedAs, assertsInterdependency, isCarriedOutAt***.

5.1.3.1 Evidence-TABInfluencingFactor

An assertion relationship exists between **`Evidence`** and **`TABInfluencingFactor`** and is defined as ***`assertInfluenceFactor`*** object-property. The assertion relationship that exists between the two classes is defined as follows: "a subject is asserted as an influencing factor with a specific influence characteristic by one or more evidence". The relationship defines an influencing factor's existence as asserted by some evidence, e.g. a published study. An **`Evidence`** is independent of **`TABInfluencingFactor`** but **`TABInfluencingFactor`** is dependent on **`Evidence`**. This implies that a **`TABInfluencingFactor`** only exists as a factor in the ontology if it is asserted by at least one **`Evidence`**.

The ***`assertInfluenceFactor`*** object-property has sub-properties that qualify the type of influence that is asserted (see Table 5.2). The properties are designed in hierarchical form with the main property being the generic assertion of influencing factor. There is a total of six sub-properties, three influence types and three influence periods. These are based on the dimensions identified in previous steps from the existing models [1] [28] [40] [39]. The influence type dimension was classified into two categories: positive and negative [1] which were similar to the increment and decrement influence respectively [28].The third influence type category is the "no effect" as identified by [28], and is termed a "neutral" influence type. The development of the period of influence was based on the treatment phases identified by [40] and [39].

Asserts influence factor property	
Influence Type	Asserts positive influence factor
	Asserts negative influence factor
	Asserts neutral influence factor
Influence Period	Asserts intensive phase influencing factor
	Asserts continuous phase factor
	Asserts drug-resistance phase factor

Table 5.2: TB adherence influencing factor's property types and periods

The different ***assertInfluenceFactor*** sub-properties are described below:

- Influence Type
  - ***assertPositiveInfluenceFactor*****:** The property states that the **Evidence** confirms a significant positive **TABInfluencingfactor**. Positive influence implies that the factor motivates good adherence behaviour.
  - ***assertNegativeInfluenceFactor*****:** The property states that the **Evidence** confirms a significant negative **TABInfluencingfactor**. Negative influence implies that the factor motivates poor adherence.
  - ***assertNeutralInfluenceFactor*****:** The property states that the **Evidence** confirms a neutral **TABInfluencingfactor**. Neutral influence implies a non-significant or unknown influence of the factor.
- Influence Period
  - ***assertIntensivePhaseFactor*****:** The property states that the **Evidence** confirms that a **TABInfluencingfactor** is influential at intensive phase.
  - ***assertContinuationPhaseFactor*****:** The property states that the **Evidence** confirms that a **TABInfluencingfactor** is influential at the continuation phase.
  - ***assertDrugResistancePhaseFactor*****:** The property states that the **Evidence** confirms that a **TABInfluencingfactor** is influential at drug resistance phase.

It is to be noted that the use of the specific sub-property is not compulsory, i.e. the **assertInfluenceFactor** property may still be used if the user does not wish to qualify the influence of a factor.

5.1.3.2 Evidence-Work

The relationship between **Evidence** and **Work** associates an evidence with its documentation in a publication repository. It links evidence that was reported in a **Work** with its documentation. This relationship strengthens the reliability of the evidence in order to guide users in the selection of influencing factors. This is useful for **ClinicalStudyEvidence** published as **Work** in various forms of expression, such as journals and conference proceedings. It, in turn, builds more confidence in influencing factors asserted by the **Evidence**.

The relationship is denoted by ***isDocumentedAs*** object-property. It shows whether a **ClinicalStudyEvidence** is specific or/and has been published as a research output. This relationship allows users to discover the influencing factors that are supported by published studies. The **Work** also serves as a reference for factors discovered in specific studies.

5.1.3.3 Evidence-Place

The ***isAtRegion*** property depicts the relationship between the **Evidence** and **Place** classes. The relationship indicates the location of the **Evidence**, for instance the community of the cohort or survey study population. All **Evidence** must have only one location for consistency of the information. An item of evidence is valid only for the place to which it is related. However, several items of evidence may be related to a single place.

The relation is very important since it can be used to find specific factors that are prevalent within a particular region. The ***isCarriedOutAt*** property is a sub-property of the ***isAtRegion*** which is specific to **ExperimentalEvidence**. This indicates the location (town, region or country) where the experiment is carried out.

5.1.3.4 Evidence-Interdependency

The ***assertInterdependency*** relation is used to represent the relationship between the **Evidence** and **Interdependency** classes and it defines the existence of interdependency between influencing factors, as asserted by one or more items of evidence. An evidence asserts the existence of interdependency between certain factors and the ***assertInterdependency*** property facilitates this association.

5.1.3.5 Interdependency-TABInfluencingFactor

The relationship between the **Interdependency** and **TABInfluencingFactor** classes points to the factors that depend on one another. It defines an influencing factor as either a dependent or an independent factor in an interdependency relationship that has been asserted by evidence.

The relationship is represented by ***hasInfluenceFactor*** object-property. There are two sub-properties, ***hasDependentFactor*** and ***hasIndependentFactor.*** The ***hasIndependentFactor*** indicates factors that influence other factors and the ***hasDependentFactor*** indicates factors that are influenced by other factors in an **Interdependency** class.

5.2 USE CASES

The ontology can be explored either by navigation or by searching through the ontology to discover and select potential factors that are appropriate for a specific community. Furthermore, significant uses of the ontology's classes and properties include creation of user-defined categories and searching for factors. Three use case examples are defined in this section for the purpose of evaluating the TB adherence ontology and demonstrating the potential use of the ontology by the user groups described in section 4.1.4.

5.2.1 Example 1: Extending the Ontology

Although the ontology is reasonably comprehensive in the hierarchical representation of the factors, it should still be extended if there is need to create user defined classes. An example is a user (TB adherence expert) who needs to create a new category of factors in the ontology called "**`Personal_Attitude`**" to represent groups of factors that are associated with TB patient's adherence behaviour. The patient attitude category consists of factors that are related to patient demographic information and social factors. The principle behind the personal attitude factor category is that each patient has their normal daily attitude that contributes to their treatment adherence decision. The study already identified five factor classes that are represented in the ontology and which can be combined to form the personal attitude class. These classes are gender, age-group, emotion, depression and stigma. Hence, the ontology should enable the user to create new classes of factors, either by combining existing factors categories or by defining an entirely new one.

5.2.2 Example 2: Reasoning with the Ontology

This use case example is for a TB control officer who has a TB community in mind and wishes to find out which factors can be used to profile such a community. Considering a scenario where a TB control officer wishes to find specific influencing factors of a known community, he/she will have to specify in detail parameters for his/her search. The control officer wishes to uncover negative influencing factors related to the TB patient's personal attitude to help create an adherence profile for South Africa. He/she also wants these factors to be grounded by study evidence that has been carried out on South African communities and the studies should not be older than the year 2013. For assurance on reliability of the study evidence, the modeller only wants those studies that have been published in any formal publications. As additional information to the influencing factors, the modeller wants the list of the evidence that asserts the factors and the work in which the studies are published as output from the ontology. When the

ontology is queried, using defined classes and properties, it should be able to produce lists of factors and other related information.

5.2.3 Example 3: Construction of a BN Model

This use case example is about a TB adherence modeller who is concerned with predicting adherence risk for a specific community of interest. Suppose that a modeller wishes to develop a treatment adherence BN model to predict adherence risk for South Africa using the influencing factors. Based on the familiarity of the modellers with adherence papers in South Africa, he/she discovers that certain influencing factors relating to the personal attitude of patients have been identified by Naidoo *et al* [25]. He considers these factors useful and adequate to model a BN for his/her TB community. The modeller decides to use the personal-attitude related factors, as identified by this paper, for modelling and testing an initial BN for a TB community. The ontology should be able to support identification of these factors, conversion of the factors into BN primitives and representation of the BN model with the ontology.

5.3 A PROTOTYPE WEB PORTAL FOR ADHERENCE FACTORS ONTOLOGY

A web portal was developed in order to facilitate open access to the ontology to aid public use and update of the ontology. An initial web portal prototype was implemented using a client-server architecture model; the client side requests a service and the server side provides the service. The client side consists of the web interface and the web client, while the server side consists of the web server, query engine and the ontology repository, see Figure 5.7. The request is collected on the client side, the service request is performed at the server side and the result is sent to the client

side for visualisation. The implementation is done using the Google Web Toolkit (GWT)[20] framework.

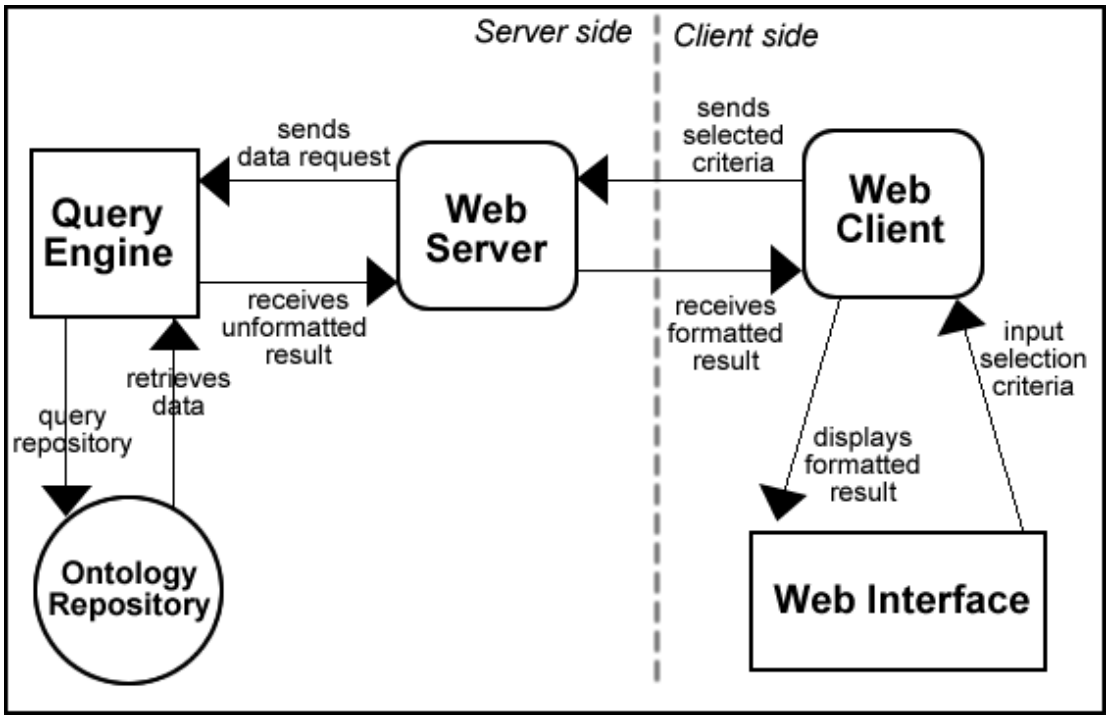

Figure 5.7: The client-server architecture for the prototype web portal

The Web Interface: A user interface was developed to provide filtering capability that will help users to navigate through the ontology (See Figure 5.8). The interface is designed with Hyper Text Markup Language (HTML) and Cascade Style Sheet (CSS). The interface is divided into two parts; the request and the result sections. The request is on the left hand side and provides a filter for users to select criteria which are sent through to the web client to the web server. The result of the search is displayed on the right hand side of the interface.

The Web Client: The client side application was built with XMLHttpRequest and JavaScript to enable fast request posting and reception of service to and from the server. XMLHttpRequest provides a good client functionality that helps to transfer data between a client and a server. The

[20] http://www.gwtproject.org/?csw=1

AJAX front-end was programmed in the Java programming language. This was compiled by GWT API into optimized JavaScript which automatically works across all major browsers.

The Web Server: The web service was programmed to handle the requests from the client side and pass it to the query engine for implementation. The web service wrapped the request from the web client into the function that is run in the query engine. This was also implemented in the Java programming language.

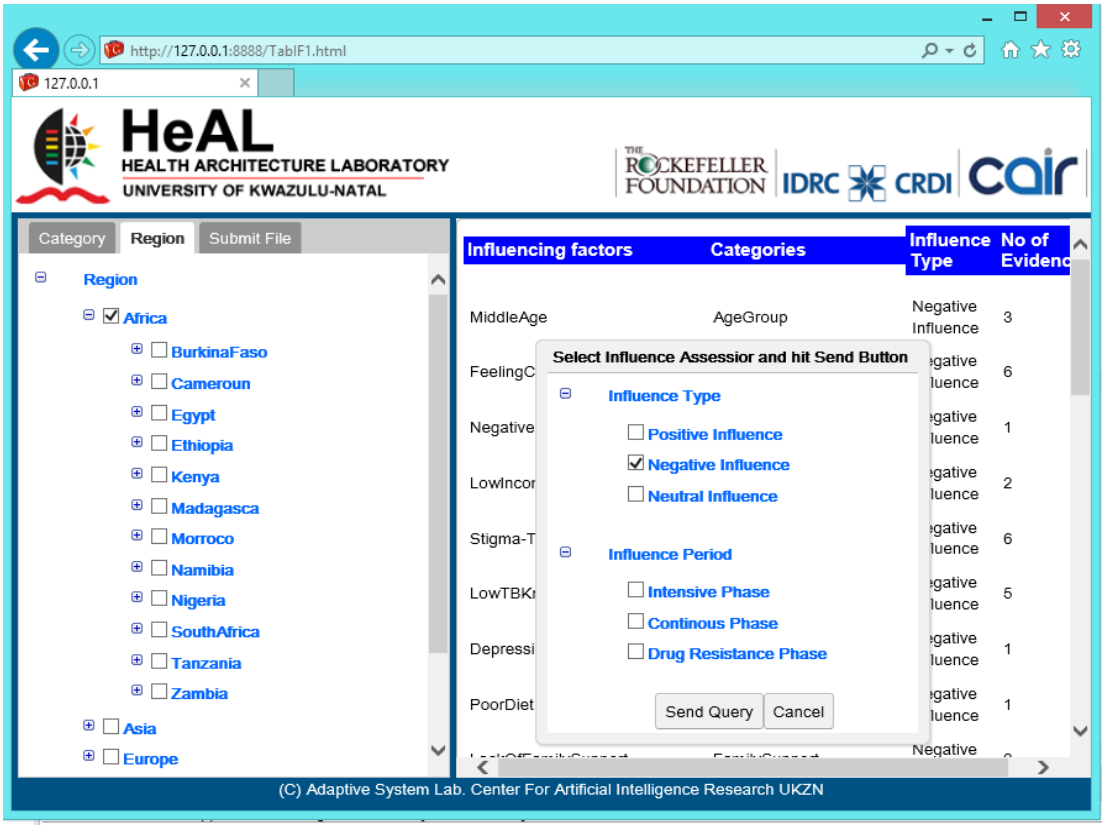

Figure 5.8: Web Portal Interface for Adherence Behaviour Factor Ontology

The Query Engine: The query engine enabled the user's request to be received and converted into queries which were written in SPARQL. SPARQL is a semantic querying language that can be used to express queries across diverse data sources stored natively as RDF or viewed as RDF via middleware. Other semantic querying languages for OWL include OWL-QL [110], Semantic Query-enhanced web rule language (SQWRL) [111], and OWL Schema and instance query language (OWL-SAIQL) [112]. SPARQL was selected because it is the W3C standard semantic

querying language. Furthermore, SPARQL was currently being used for other research projects within the group at the University of KwaZulu-Natal, South Africa, which made upskilling easier.

There are two APIs, OWL API[21] and Apache Jena API[22], which are both Java based and have the capability for parsing and rendering the functional syntax defined in the W3C specification standards. Apache Jena API, was selected to programme the query engine for the prototype web-portal because it is the suitable tool for explicit exploitation of OWL layering in RDF with SPARQL queries. Apache Jena provides a platform for automating the transformation of the classes into lists, which are sent back to the client side for visualisation. See Appendix 3 for the extract of the generic query implemented for the web portal.

The Ontology Repository: For the prototype implementation, the OWL file in RDF format formed the ontology repository. There are different ways to implement ontology repositories which can be classified as either native or database stores [113]. Native stores are built directly on the file system, whereas database based repositories use relational or object-relational databases as the backend store [113]. For this prototype implementation, which is not large in scale, a single OWL file was used for demonstration purposes.

5.4 EVALUATION OF THE TB ADHERENCE ONTOLOGY

The evaluation step involves satisfying the criteria stated in section 4.1.3. The first three criteria have been evaluated in section 4.4, and the remaining three criteria will be validated in this section. The evaluation of the ontology was carried out by testing the use case examples defined in section 5.2 and answering the CQs defined in section 4.1.3.1.

[21] http://semanticweb.org/wiki/OWL_API.html
[22]https://jena.apache.org/

The example queries presented in this section seek to show how the ontology processes the requests from users. They represent the OWL statement of natural language requests from users. The queries are implemented using the Protégé tool and are shown in the Manchester OWL Syntax [114], a user-friendly version of a description logic (DL) query. All the example queries can be executed via the DL query tab in the Protégé tool. Additionally, Protégé has built-in reasoners that were used to check the consistency of the ontology.

5.4.1 Extension of the Ontology

Based on the use case example 1, described in section 5.2.1 above, the extension of the classes can be done either by creating a new main category or through sub-classes in the existing class hierarchy. A method of doing this with existing classes is by combining and refining them with properties to provide a new category of influencing factors. The output can then be established as another class by declaring an equivalent class with the query. Thus, user-defined classes can be created for selections that match the specific interest of the user.

The ontology can be used for the dynamic creation of user-defined influencing factor categories from existing categories. For example, the "**Personal_Attitude**" category will be created as an equivalent to the collection of existing categories or factors. This category will comprise the category of factors that are related to the daily attitude of TB patients which contribute to their treatment adherence decision.

Query 1 below, is used to generate the new class from the ontology. **DemographicRelatedFactor, Emotion, Depression, IncomeClass, SubstanceAbuseFactor** and **Stigmatisation** are existing classes in the ontology that are selected with **Query1** and assigned into a new class called **"Personal_Attitude**".

Query 1:

DemographicRelatedFactor *or* Emotion *or* Depression *or* Stigmatisation *or* IncomeClass *or* SubstanceAbuseFactor

The result of **`Query 1`** is a list of personal attitude-related influencing factors, as defined by the user. They are: *Single; Widowed; Married; Young; MiddleAge; Elderly; AlcoholAbuse; NonAlcoholUse; PostiveEmotion; NegativeEmotion; Depression-False; Depression-True; LowIncome; AverageIncome; HighIncome; Male; Female; TobaccoAbuse; NonTobaccoUser; Stigma-False; Stigma-True.*

It is important to note that the result from the query not only included the factors that are directly associated with the classes specified, those of the sub-classes are also included. This is made possible by the "***`isA`***" relationship between the categories. With the hierarchical representation, users do not need to specify every factor to be included. They only have to specify the top level category of interest and all related sub-categories will be automatically included.

5.4.2 CQ1: Outputs of the TB Adherence Ontology

CQ1 is focused on determining the possible output that can be derived from the ontology. Three sub-questions of CQ1 are evaluated in the following sections.

5.4.2.1 Search for Influencing Factor with the Ontology

CQ1a: Is it possible to search the ontology for factors that influence specific TB communities in sub-Saharan Africa?

The main function of the ontology is to be able to produce lists of factors that influence TB adherence behaviour. A user should be able to query the ontology and obtain factors of interest. The usage of the ontology to produce a list of adherence influencing factors will be demonstrated using use case example 2 (see section 5.2.2). The user is interested in patient attitude-related factors which consist of demographic, emotion, depression, stigmatisation, income class and substance abuse, as described in use case example 1.

A refined query to search for influencing factors can be written using the "**`Personal Attitude`**" class that has been created in section 5.4.1 above. The properties associated with the

TABInfluencingFactor class provides an opportunity to fine tune the above query used to search for the factors. Influencing factors' categories can be refined by extending **Query 1** to include the influence type, period of influence and interdependencies, as asserted by any evidence. **Query 2** is used to identify factors that are known to be negative factors which have influence at the continuous phase of TB treatment. Note that the adjoining properties of evidence class are only used to extend **Query 1** above to give **Query 2**. Also "**Personal_Attitude**" class was used instead of listing all the sub-classes it contains.

Query 2:

Personal_Attitude *and* (isAssertedContinuousPhaseFactorBy some Evidence) *and* (isAssertedNegativeInfluenceFactorBy some Evidence)

The result of **Query 2** is "*AlcoholAbuse*", which is the only attitude-related influencing factor that has a negative influence on patient adherence and has been identified to be influential at the continuous phase of TB treatment.

Query 2 demonstrated that the ontology can be used to search for an influencing factor. By using some of the properties of the **TABInfluencingFactor** class, lists of factors that influence adherence behaviour were obtained from the ontology.

5.4.2.2 Search for Clinical Evidence with the Ontology

CQ1b: Is it possible to search the ontology for evidence that asserts specified factors influencing adherence behaviour of TB patients?

In order to find the evidence that asserts certain influencing factors, as described in use case example 2, **Query 1** and **Query 2** are rewritten to request for evidence rather than the factors. In this case **Evidence** will be the subject to find with **asserstInfluenceFactor** property.

Query 3 and **Query 4** (below) request for any clinical study that asserts factors contained in the **Personal Attitude** class as an influencing factor on TB adherence behaviour.

Query 3:

ClinicalStudyEvidence *and* assertsInfluenceFactor some Personal_Attitude

Query 4:

ClinicalStudyEvidence and (assertsContinuousPhaseFactor some Personal_Attitude) and (assertsNegativeInfluenceFactor some Personal_Attitude)

The result of **Query 3** and **Query 4** are sets of evidence that assert the influencing factors that are selected with **Query 1** and **Query 2** respectively. **Query 3** produces a list of studies that have been carried out that assert the list of factors. They are: *AndaraStudy; TanzaniaStudy; EthiopiaStudy; YaoundeStudy; SouthAfricaStudy1; MoroccoStudy; TamataveStudy; AlexandriaStudy; SouthernEthiopiaStudy; SouthAfricaStudy2; NairobiStudy; SagamuStudy; BurkinaFasoStudy*. **Query 4** produces only one result, namely "*SouthAfricaStudy1*". The result of both queries shows that the ontology can be searched for clinical studies that have been captured in the ontology as evidence that asserts TB adherence influencing factors.

5.4.2.3 Search for Other Influencing Factor-Related Information

CQ1c: Can the ontology provide location information about the influence type, influence period and interrelationship between two or more factors?

The ontology can be used to produce other information relating to adherence influencing factors. For instance, a specific community where studies about adherence behaviour have already been carried out can be obtained from the ontology. Location information captured in the ontology can be used to query the ontology for a specific community. **Query 5** (below) shows how the ontology can be queried for finding a specific community. The query consists of a specific

location description. The attributes used to describe the location include geographical coverage/area, population size, gross domestic product, population density and HIV prevalence rate. The description of the community used matches South Africa which is the specified community in use case example 2.

Query 5:
Place *and* ((hasPopulation some integer [>50000000]) *and* (hasGDP some integer [>1000000]) *and* (hasPopDensity some double [>40.0]) *and* (hasHIVPrevalenceRate some double [>=15.0]) *and* (hasTBPrevalenceRate some double [>=0.5]) *and* (hasArea some double [>100000.0])) *and* (*inverse* isCarriedOutAt some (Evidence *and* (assertsInfluenceFactor some TABInfluencingFactor)))

The result of query 14 is *South Africa*. This shows that the ontology can be used to search for other influencing factor-related information that has been captured in the ontology.

5.4.3 CQ2: Reasoning with the Ontology

The focus of CQ2 is on determining the categorisation dimensions that can be used as parameters to query the ontology. Five sub-questions of CQ1 are discussed in the following sections.

5.4.3.1 Reasoning with Influencing Factors' Categories and Properties

CQ2a: *Can the ontology be queried using any of the influencing factors' categories and properties as the only query parameter?*

The hierarchical classification in the TB adherence ontology provides a medium for traversing through the facts captured in the ontology. Searching through the ontology is made possible through the use of names of factor categories. The **TABInfluencingFactor** class hierarchy provides the needed parameters for searching for the factors. The use of the factor categories to query the ontology has been demonstrated in section 5.4.1. For instance, **Query 1** and **Query**

2 are constructed using the factors' categories and properties that are already described to search for an influencing factor with the ontology. See sections 5.4.1 for these queries.

5.4.3.2 Reasoning with Location Information

CQ2b: *Can the ontology be queried using the community characteristics as the only query parameter?*

In order to have a community-specific influencing factor, the location information of the study is highly important. The location information, as modelled in the ontology, represents the location of the evidence that asserts influencing factor and its property. The idea is to be able to link location information to the evidence that provides information about the influencing factor. This provides an indirect link between the influencing factor and the communities in which they are identified. However, there is the possibility to search for a community-specific influencing factor using the location of the evidence that asserts it.

Following use case example 2, presented in section 5.2.2, the queries below are used to provide influencing factors which use the location information alone. **Query 6** uses only the name of the location to search for factors. **Query 7** uses location characteristics to search for factors. The characteristics of the location were defined to match a South African community which was stated in the use case example 2.

```
Query 6:
  Personal_Attitude and (isAssertedInfluenceFactorBy some
  (Evidence and (isCarriedOutAt value SouthAfrica))

Query 7:
  Personal_Attitude and (isAssertedInfluenceFactorBy some
  (Evidence and (isCarriedOutAt some (Place and (hasPopulation
  some integer [>50000000]) and (hasGDP some integer
  [>1000000]) and (hasPopDensity some double [>40.0]) and
  (hasHIVPrevalenceRate some double [>=15.0]) and
```

(hasTBPrevalenceRate some integer [>=0.5]) *and* (hasArea some double [>100000.0])))))

Both **Query 6** and **Query 7** produced the same result. The factors that were selected with the queries are: *AlcoholAbuse; NegativeEmotion; Depression-True; InceptiveExpected; SymptomsPersistence; HIVC-True; FeelingClinicallyBetter; Male; PsycoC-True; TobaccoUser; HighPovertyLevel; Stigma-True; LackOfFood; MediumPovertyLevel; Female*.

Similar to the above queries, location information can be used to find the corresponding evidence for the influencing factors. **Query 8** and **Query 9** use location name and characteristics respectively to search for clinical studies that assert influencing factors for a specific community.

Query 8:
Evidence *and* (assertsInfluenceFactor some TABInfluencingFactor) *and* (isCarriedOutAt value SouthAfrica)

Query 9:
Evidence *and* (assertsInfluenceFactor some TABInfluencingFactor) *and* (isCarriedOutAt some (Place *and* (hasPopulation some integer [>50000000]) *and* (hasGDP some integer [>1000000]) *and* (hasPopDensity some double [>40.0]) *and* (hasHIVPrevalenceRate some double [>=15.0]) *and* (hasTBPrevalenceRate some integer [>=0.5]) *and* (hasArea some double [>100000.0])))

The results of both queries are 3 studies that focused on South African communities: *SouthAfricaStudy; SouthAfricaStudy1; SouthAfricaStudy2*.

The result of the above queries have shown that location information can be used to reason over the ontology to produce community-specific influencing factors as well as for identifying the studies that assert these factors.

5.4.3.3 Reasoning with the Evidence

CQ2d: Can the ontology be queried using the evidence characteristics as the only query parameter?

The purpose of the ontology is to specify a wide range of influencing factors, supported by published scientific evidence. Evidence form the basis for reliability check on the selected influencing factors for any community. The knowledge of evidence is useful to query the ontology in order to produce good and reliable results. The ability to search and retrieve community-specific influencing factors that are useful for supporting their decisions, lies in the usage of evidence to query the ontology.

The **`Evidence`** class can be used as a set of selection criteria, instead of viewing it as a black box, by specifying a scientific paper or criteria for studies as parameters in the query. Various properties of **`Evidence`** class can be used for querying the ontology; they include: number of supporting studies, year that the study was carried out, and cohort (sample) size. Another important property of **`Evidence`** that provides more reliability for the output is the relationship of **`Evidence`** class with **`Work`** class. For instance, further refinement can be made to the selection using the information that confirms whether a **`ClinicalStudyEvidence`** has been documented as a peer-reviewed publication or not.

For use case example 2, the ontology is queried for influencing factors that have been asserted by this study by using either the name or the properties for **`ClinicalStudyEvidence`**. Typically, users only know studies by their properties and not by their identified name. This makes the second query more valid.

```
Query 10:
 TABInfluencingFactor and (isAssertedInfluenceFactorBy value

 SouthAfricaStudy1)
```

```
Query 11:
  TABInfluencingFactor and (isAssertedInfluenceFactorBy some
  (ClinicalStudyEvidence and ((isCarriedOutAt value
  SouthAfrica) and (hasSampleSize some integer [>= 500]) and
  (hasYear some integer [>=2013]) and (isDocumentedAs some
  Work))))
```

The result of **Query 10 and Query 11** are: *DrugSledomAvailable; LowIncome; HIVC-True; PsycoC-True; Male; UnfavourableClinicalHour; Female; Stigma-True; Illiterate; LackOfFood; LowTBKnowledge; DrugAdverseEffectExperienced; FeelingClinicallyBetter MiddleAge; AlcoholAbuse; Elderly*. The two queries produced the same results because simply the characteristics of SouthAfricaStudy1 were used in **Query 11** instead of the name of the location in **Query 10**.

The queries in this section show that evidence can be used to reason over the TB adherence ontology. It can be used to produce a list of influencing factors for a specific community.

5.4.3.4 Reasoning with Publication Characteristics

CQ2e: Can the ontology be queried using publication characteristics as the only query parameter?

The properties of the **Work** class (publication) can be used instead of **ClinicalStudyEvidence** class properties to reason over the TB adherence ontology. Properties of scientific publications are sometimes the information users have for carrying out a search for influencing factors. The ontology provided a means of searching for factors with the properties of the scientific publications. The query below shows how to search for influencing factors using properties of **Work** class.

```
Query 12:
  TABInfluencingFactor and (isAssertedInfFactorBy some
  (ClinicalStudyEvidence and isDocumentedAs some (Work and
```

```
((hasYear some integer [>=2013]) and (hasCreator some Agent)
and (hasRealisation some Expression)))))
```

The result of Query 12 are factors that were identified by Naidoo *et al* [25] for South Africa. They are: *MiddleAge; FarToFacility; Young; Elderly; NegativeEmotion; NearToFacility; Depression-True; HighTBKnowledge; LowIncome; HIVC-True; Male; TobaccoUser; Female; HighPovertyLevel; LowTBKnowledge; PsycoC-True; AlcoholAbuse; PoorCommunication; UnfavourableClinicalHour; UnplannedSettlementArea; MediumPovertyLevel*.

5.4.3.5 Reasoning with Multiple Parameters

CQ2e: Can the ontology be queried using a combination of some or all the dimensions of influencing factor?

The purpose of the ontology is to provide users with a community-specific influencing factor. A specific factor can be selected by using a query that consists of properties or names of specific locations, properties of evidence class, and category of influencing factor. The combination of properties of two or more classes in the ontology will provide a more specific, accurate and reliable result for users. Although the queries 6 to 12 presented above produced a lists of factors, they did not produce factors that meet the criteria given in the use case example 2. These queries did not use all the criteria given in the use case example to construct the query.

Query 13, **Query 14** and **Query 15** show how multiple parameters can be used to search for influencing factors with the ontology. The three queries show the inclusion of the criteria given in the use case example 2 and they are constructed to reflect the region of interest. The knowledge influencing factor categories and properties are merged with those of the evidence and community of interest. **Query 13** is used to search for the influencing factors, **Query 14** is used to search for the evidence that asserts these factors, and **Query 15** is used to search for the papers in which the studies are published.

```
Query 13:
  PersonalAttitude and (isAssertedNegativeInfluenceFactorBy
  some (ClinicalStudyEvidence and ((isCarriedOutAt value
  SouthAfrica) and (hasYear some integer [>=2013]) and
  (isDocumentedAs some Work))))

Query 14:
  ClinicalStudyEvidence and (assertsNegativeInfluenceFactor
  some PersonaAttitude) and ((isCarriedOutAt value
  SouthAfrica) and (hasYear some integer [>=2013]) and
  (isDocumentedAs some Work))

Query 15:
  Work and inverse isDocumentedAs some (ClinicalStudyEvidence
  and (assertsNegativeInfluenceFactor some PersonalAttitude)
  and ((isCarriedOutAt value SouthAfrica) and (hasYear some
  integer [>=2013])))
```

The result of **Query 13** is a list of influencing factors: *Male; TobaccoUser; AlcoholAbuse; NegativeEmotion; Depression-True*. These factors are the only identified personal attitude-related factors that meet the criteria set in the use case example 2. By using multiple parameters to query the ontology, a more accurate and specific result can be obtained. The result of **Query 14** is the study carried out in South Africa by Naidoo 2013 [25]. Although the title is not reflected in the query result, it is already a property of the **Work** class. The title of the article is *"Predictors of tuberculosis (TB) and antiretroviral (ARV) medication non-adherence in public primary care patients in South Africa: a cross sectional study"*.

Query 13, **Query 14** and **Query 15** can be combined into one query to give a result that will contain the list of factors, the clinical study and the publication. The **Combined Query** below shows how these three queries are combined into one single query. The result of the **Combined Query** is the same as the results of the three queries described above.

```
Combined Query:
  (PersonalAttitude and (isAssertedNegativeInfluenceFactorBy
  some (ClinicalStudyEvidence and ((isCarriedOutAt value
  SouthAfrica) and (hasYear some integer [>=2013]) and
  (isDocumentedAs some Work))))) or (ClinicalStudyEvidence
  and (assertsNegativeInfluenceFactor some PersonaAttitude)
  and ((isCarriedOutAt value SouthAfrica) and (hasYear some
  integer [>=2013]) and (isDocumentedAs some Work))) or (Work
  and inverse isDocumentedAs some (ClinicalStudyEvidence and
  (assertsNegativeInfluenceFactor some PersonalAttitude) and
  ((isCarriedOutAt value SouthAfrica) and (hasYear some
  integer [>=2013]))))
```

5.5 SUMMARY

The outcome of the engineering process, presented in this chapter, is the ontology for factors that influence adherence. The ontology formally represents the key elements of the conceptual model and the relationship between these elements. It describes the model in a manner that is sharable by human experts and understandable by machines. Some existing ontologies were used to create the ontology, and they include the Evidence ontology (ECO) [99], FaBiO [108] and Geonames [109].

5.5.1 Summary of Evaluation

In Chapter 4, the underlying conceptual model of the ontology was evaluated in terms of its clarity and unambiguous delineation of classification categories, and the extent to which it could adequately accommodate and classify factors pertaining to communities in sub-Saharan Africa. The evaluation process presented in this chapter verified and validated the quality of the ontology. Use case testing and competence questions were used as the primary evaluation mechanisms to check whether the ontology met the purpose for which it was developed.

Table 5.8 below shows the list of CQs and the example queries that were used to answer the questions. The output of the queries has been able to provide answers to the CQs. Lists of community-specific influencing factors can be generated by querying the ontology, irrespective of the knowledge level of the user. Although the output may differ from the input parameter, the ontology was able to provide community-specific factors and link them to the clinical studies as the evidence base.

Competence Questions	**Answered? (Yes/No)**	**Example Query Number**
CQ1a: Is it possible to search the ontology for factors that influence specific TB communities in sub-Saharan Africa?	Yes	Query 1, Query 2
CQ1b: Is it possible to search the ontology for evidence that asserts specified factors influencing adherence behaviour of TB patients?	Yes	Query 3, Query 4
CQ1c: Can the ontology provide location information about the influence type, influence period and interrelationship between two or more factors?	Yes	Query 5
CQ2a: Can the ontology be queried using any of the influencing factors' categories and properties as the only query parameter?	Yes	Query 1, Query 2
CQ2b: Can the ontology be queried using the community characteristics as the only query parameter?	Yes	Query 6, Query 7, Query 8, Query 9
CQ2c: Can the ontology be queried using the evidence characteristics as the only query parameter?	Yes	Query10, Query 11
CQ2d: Can the ontology be queried using publication characteristics as the only query parameter?	Yes	Query 12
CQ2e: Can the ontology be queried using a combination of some or all the dimensions of the influencing factor?	Yes	Query 13, Query 14, Query 15
CQ3a: Can the ontology be used to generate the variable and states for a BN model?	No	

CQ3b: Can the ontology be used to generate the probability tables for a BN model?	No	
CQ3c: Can the ontology be used to generate the BN model structure?	No	

Table 5.3: Summary of use case test for competence question answering

However, CQ3 was not answered in this chapter. Use case examples 1 and 2 are described to answer CQ1 and CQ2, and use case example 3 is described specifically for answering CQ3. CQ3 and use case example 3 are defined for evaluating the use of the ontology for constructing a BN model for predicting adherence. CQ3 was not answered because the ontology in its current state does not include the probabilistic reasoning representation required to express the uncertainty of the influence of the factors on patient adherence behaviour. The support of the ontology for representing uncertainty and for constructing predictive models is discussed in Chapter 6.

Chapter 6

CONSTRUCTING MODELS FOR PREDICTING ADHERENCE RISK

One of the main purposes of the adherence ontology is to capture scientific knowledge about adherence behaviour for constructing models that predict adherence risk, specifically Bayesian Networks (BNs). The ontology presented in Chapter 5 did not support the construction of a BN mode and was not able to answer the CQ3 (see section 5.4 and 5.5). This chapter describes the extension of the ontology to incorporate a mechanism that transforms the factors into BN primitives and generates a BN model.

Although the ontology presented in Chapter 5 adequately captures expert knowledge about influencing factors in a consistent manner, it is not structured for building BN models for specific communities. Section 6.1 of this chapter describes a transformation mechanism which allows for automatic generation of a Bayesian Networks (BN) primitives from selected factors in the ontology. Section 6.2 describes the extension of the ontology with SWAP-Uncertainty ontology for representing the generated BN model. A demonstration of how to use the ontology to generate a BN model is presented in section 6.3.

6.1 GENERATING BAYESIAN NETWORK PRIMITIVES

A transformation algorithm is required to generate BN primitives, such as variables, states and probabilities, from the adherence ontology which will be used to construct a BN model for predicting adherence behaviour. There is also a need to identify the links between the variables that form the structure of the BN model. The influencing factors, as captured in the ontology, do not translate into a community-specific BN model in their current forms. Hence, the

transformation algorithm is designed for translating selected influencing factors from the ontology into primitives that are useful for constructing a BN model.

The transformation mechanism involves two steps: the conversion of the influencing factors into nodes (variables) and states, and the transformation of the interdependencies between factors into links between nodes. The design of the ontology allows for direct mapping between classes, and instances in the ontology to nodes and states in a BN. Also, the interdependency class has the properties required to construct the links between nodes represented in the network.

The mapping shown in Figure 6.1 below reveals a direct conversion of the influencing factor classes into nodes, and instances into states. The selected influencing factor classes from the ontology are translated into BN nodes, and their respective instances translated into the states of the nodes. For instance, the Age-group node and its three discrete states are a direct translation of the "**`AgeGroup`**" influencing factor class and the instances "`18-34`", "`35-44`"and "`Above 44`".

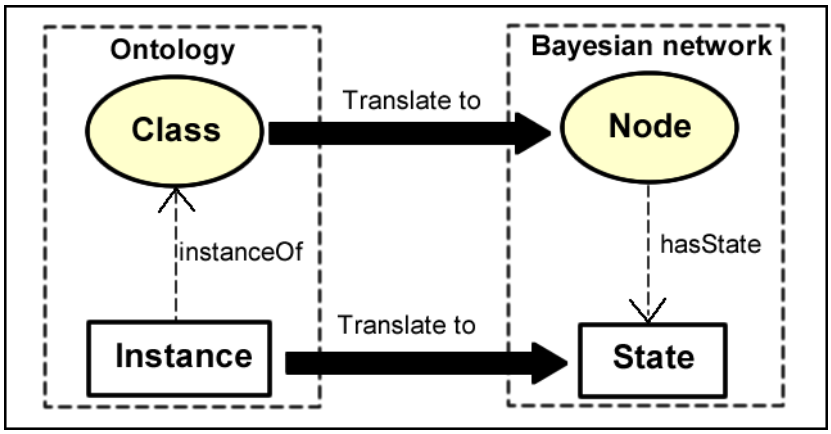

Figure 6.1: Transformation of ontology primitives into BN primitives

In order to translate the interdependency into arcs, the parent-child node relationship approach was employed. This approach viewed the relationship from the perspective of the role each node plays in a bilateral relationship. A node that has some sort of influence over another node is referred to as the *parent* node, and the node influenced by another node is referred to as the *child* node. This parent-child relationship describes the direction of the arc in the network.

There are some basic rules for obtaining parent and child nodes using the **Interdependency** class. Firstly, a **TABInfluencingFactor** that is a dependent factor through the inverse of **hasDependentFactor** relationship is a child node to another factor which is associated with the inverse of **hasIndependentFactor** relationship of an **Interdependency** class. Secondly, a **TABInfluencingFactor** that is not a dependent factor of any **Interdependency** class, or is not associated with any **Interdependency** class, is automatically a leaf node. A leaf node is a node without children in the entire BN model, while a root node is a node without a parent.

A class can be created to define the types of node for the factors captured in the ontology. For instance, in order to obtain the parent and child nodes that will be used to define causality in a BN network, an equivalent class of both nodes was created with the queries below.

ParentNode:

TABInfluencingFactor AND inverse hasIndependentFactor (Interdependency AND hasDependentFactor *some* TABInfluencingFactor)

ChildNode:

TABInfluencingFactor AND inverse hasDependentFactor (Interdependency AND hasIndependentFactor *some* TABInfluencingFactor)

By replacing the **TABInfluencingFactor** at the end of the query with a specific influencing factor instance, the parent or child node of a factor can be retrieved. The query below shows how to generate the child node for a **WorkingCondition** class. The factor is used as a parent node to query for its child nodes.

WorkingCondition's ChildNode:
TABInfluencingFactor AND inverse hasDependentFactor (Interdependency AND hasIndependentFactor *value* "UnfavourableWorkingCondition") OR TABInfluencingFactor AND inverse hasDependentFactor (Interdependency AND hasIndependentFactor *value* "FavourableWorkingCondition")

Similarly, the parent node of an influencing factor can be retrieved with the query below. The factor is used as a child node to query for its parent nodes.

```
Gender's ParentNode:
   TABInfluencingFactor AND inverse hasIndependentFactor
   (Interdependency AND hasDependentFactor value "Male") OR
   TABInfluencingFactor AND inverse hasIndependentFactor
   (Interdependency AND hasDependentFactor value "Female")
```

The result of queries above shows that the **WorkingCondition** class is the parent node for the **Gender** class, which means that the degree of influence of gender on treatment adherence is dependent on the working condition. Figure 6.2 below shows the relationship between the parent node (**WorkingCondition**) and child node (**Gender**). **WorkingCondition** is shown as the parent node, while **Gender** is shown as the child node. For instance, adherence behaviour of a male patient is highly influenced by poor (unfavourable) working conditions, while the adherence behaviour of a female patient is less likely to be influenced by poor (unfavourable) working conditions.

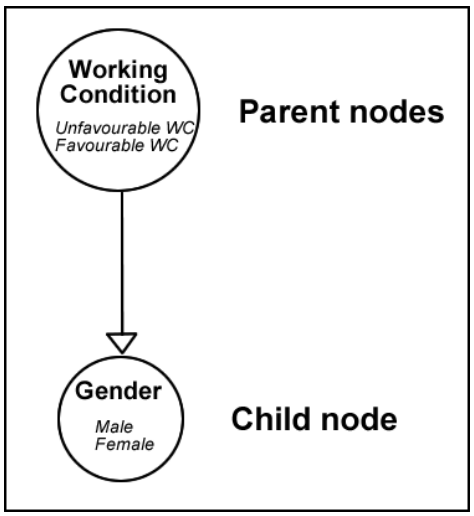

Figure 6.2: Example of a BN structure showing Parent-Child node relationship

6.2 EXTENDING THE ONTOLOGY WITH SWAP-UNCERTAINTY ONTOLOGY

The SWAP-Uncertainty ontology [49] is proposed for extending the TB adherence ontology to support the construction of a BN model. The classes and properties from SWAP are used to extend the ontology presented in Chapter 5. This provides support in the ontology for representing and generating a BN models.

6.2.1 Overview of the SWAP Ontology

The SWAP-Uncertainty ontology is an extension of a BayesOWL ontology to manage uncertainty in observations on the Sensor Web [49]. Moodley (2009) proposed the SWAP-Uncertainty ontology as an essential part of the SWAP framework, which was developed for the purpose of representing and managing uncertainty in Sensor Web applications [49]. In order to describe uncertainty in a consistent manner, Ding et al (2006) [92] proposed BayesOWL for extending OWL's capability in handling probabilistic reasoning. BayesOWL defines the probabilistic relatedness of distinct classes in OWL [92]. The extension was made to address some of the shortfall of BayesOWL in representing uncertainty in the Sensor Web [49]. Some of the most important extensions of BayesOWL implemented in SWAP-Uncertainty ontology are:

- Introduction of object property "**`isInfluencedBy`**" to create the influence relationship between variables. This extension improves BayesOWL for building BN graphs automatically from the variables
- The "**`state`**" class was improved to allow for a discrete range state and property "**`hasState`**" was attached to the probability object class to allow for explicit declaration of all variable states for probability representation
- Lastly, the "**`condition`**" class was extended to allow declaration of multiple states of influencing variables when declaring condition probability for a node in the network.

6.2.2 Implementation of SWAP in the TB Adherence Ontology

The SWAP-uncertainty ontology was selected to represent Bayesian Networks in the TB Adherence Ontology. SWAP proposes the use of four key concepts to fully describe a BN which will be implemented in the ontology. These are **`BayesianNetwork`**, **`ProbabilityObject`**, **`Variable`**, **`State`** and **`Condition`** classes. Also, the properties proposed by SWAP to be incorporated into the ontology are ***`hasVariable`***, ***`hasState`***, ***`hasCondition`*** and ***`hasProbValue`*** which is implemented as ***`double`*** data type. The structure of the extension is shown in the Figure 6.3 below.

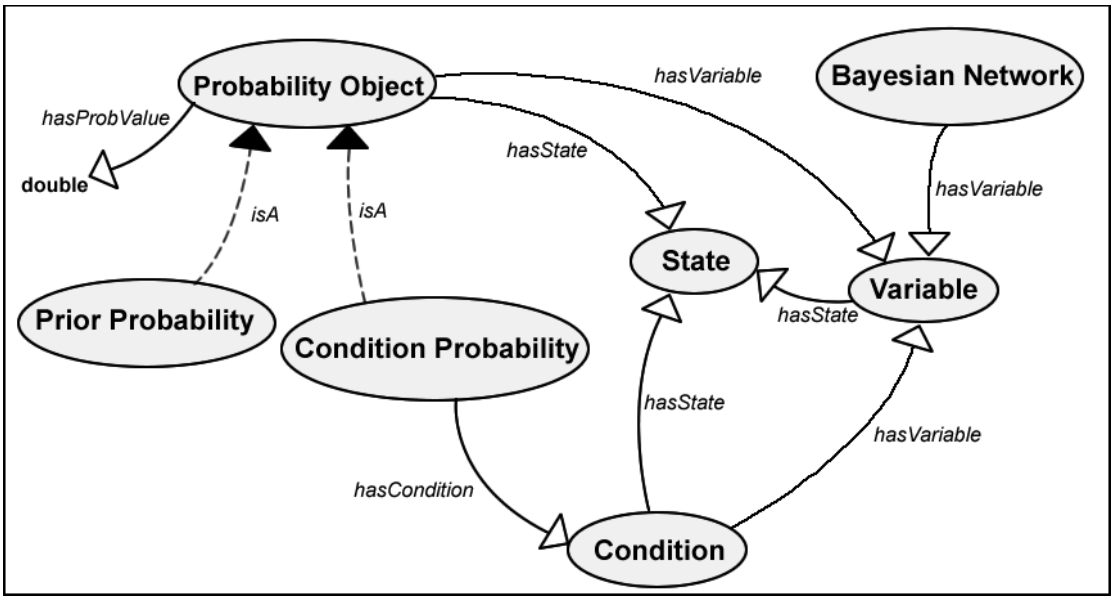

Figure 6.3: The SWAP uncertainty ontology

6.2.2.1 The BayesianNetwork Class

A **`BayesianNetwork`** class is a representation of a BN model. The nodes in the network are represented by variables that are linked to the **`BayesianNetwork`** class by ***`hasVariable`*** object property. A new **`BayesianNetwork`** can be created to contain the list of factors that are generated from querying the TB adherence ontology. The variables that will be linked to the **`BayesianNetwork`** will be the class of factors that are seen in Table 6.1. In addition, a default variable **`TAB`** (Treatment Adherence Behaviour) can be created that will function as the default

node for the **TAB** hypothesis. The default node represents the final effect of the factors on patient adherence behaviour, which can either be positive or negative.

6.2.2.2 The Variable Class

The **Variable** class represents a group of selected factor classes to be used for the construction of a predictive model. It represents a node in a BN model. For instance, if **Gender** is selected as a factor class with a query for a specific community, it is going to be represented as an instance under the **Variable** class. It is to be noted that creating an instance with a class name within the same ontology is supported in OWL 1 full and OWL 2. A default variable instance can be declared to serve as the hypothesis node for the BN.

6.2.2.3 The State Class

The **State** class is implemented in the adherence factors ontology in a different way to how it was implemented in the SWAP-Uncertainty ontology. The **State** class is not specified as a Boolean class or as specific discrete scales, as earlier studies proposed [49] [115]. The **State** class in the adherence factors ontology consists of instances of the **TABInfluencingFactor** class. These instances will be translated to instances of the **State** class that is linked with the instance of the **Variable** class For instance, **Gender** class has two instances: **Male** and **Female**, as seen from Table 6.1. While **Gender** becomes an instance under the **Variable** class **Male** and **Female** becomes instances of the **State** class.

6.2.2.4 The Probability Object Class

For every **Variable** instance, there is the need to have a defined probability. **ProbabilityObject** class is the declaration class for the probability that is attached to every variable. **ProbabilityObject** has two subclasses: **PriorProbability** and **ConditionProbability** classes. **PriorProbability** is defined for a variable that is not dependent on any other variable, while **ConditionProbability** is defined for any variable that is dependent on another variable. (See Table 6.1)

Prior Probability Class	
hasProbValue	data Double
hasVariable	instance of Variable
hasState	instance of State
hasCondition	instance of Condition
Condition Probability Class	
hasProbValue	data Double
hasVariable	instance (*Variable*)
hasState	instance of State
hasCondition	instance of Condition

Table 6.1: Prior Probability class description

6.2.2.5 The Condition Class

The **`Condition`** class was introduced in the SWAP-Uncertainty ontology [49] [115]. This class is very useful for the extension of the TB adherence ontology as it allows for multiple states of influencing variables to be added to **`ConditionProbability`**. This made it easier to explicitly declare all possible condition probabilities that are associated with a variable represented in the BN. The condition class has two object properties: **`hasVariable`** and **`hasState`**. The **`hasVariable`** property links the condition to the influencing variable and the **`hasState`** links it to the corresponding state that the condition is defining.

6.3 CONSTRUCTION OF A BAYESIAN NETWORK WITH THE ONTOLOGY

The use case example 3 that was presented in section 5.2.3 will be used in this section for demonstrating the use of the ontology for a BN model construction. Use case example 3 will be used to answer the remaining unanswered competency questions (CQs), see section 4.1.3.1 for the CQs. The example is about a modeller who wishes to develop a treatment adherence BN model to predict adherence risk for South Africa, using the influencing factors identified by Naidoo *et al* [25] and captured as **`Patient_Attitude`**.

To initiate the process of a BN model construction with the ontology, the modeller must select the relevant classes from the ontology and these will be automatically transformed into an

appropriate belief network structure. The ontology will be queried to select the list of influencing factors that are required to compose the list of the root nodes and their states. The query below is used to select the factors required for the network construction, based on the narratives given in the above paragraph.

Decision Network Query:

Personal_Attitude *and* (isAssertedNegInfFactorBy some (ClinicalStudyEvidence and ((isCarriedOutAt value SouthAfrica) and (isDocumentedAs value Naidoo2013))))

For a set of factors selected through querying, the combined process of translating the result into nodes and states, and the identification of the parent node of each factor will produce the primitives required for constructing a BN model. Another query will be used to generate the sets of parent nodes for these factors. The queries below are used to generate the parent node for the **Gender** Class. The result of the query shows that **Gender** class is dependent on **WorkingCondition** class. The query returns **UnfavourableWorkingCondition**, an independent variable for **Male** instance of **Gender** class.

Interdependency Query:

TABInfluencingFactor AND inverse hasIndependentFactor (Interdependency AND hasDependentFactor *value* "Male") OR TABInfluencingFactor AND inverse hasIndependentFactor (Interdependency AND hasDependentFactor *value* "Female")

Table 6.2 (below) shows the combined results for the example case, using the combination of queries presented above. The table consists of the selected nodes/variables, states and parent node that will be used for the construction of the BN network structure. The classes of the selected factors become the node and the selected instances become the states. The class of the independent

factor generated from the **Interdependency Query** becomes the parent node, while its instances become the state of that node.

Node/Variable	State	Parent Node Comment
Gender	Male Female	-
Depression	Depression-True Depression-False	-
Emotion	NegativeEmotion PositiveEmotion	-
TobaccoUse	TobaccoAbuse NonTobaccoUse	-
AlcoholConsumption	AlcoholAbuse NonAlcoholUse	-
WorkingCondition	FavourableWorkingCondition UnfavourableWorkingCondition	*Parent node of Gender node*

Table 6.2**:** Selected influencing factors for the BN model

Figure 6.4 shows how the example network will be represented in the extended ontology. The **BayesianNetwork** instance, created for the example case, is the *South_Africa_TAB_BDN*. This instance has ***hasVariable*** relationship with six **Variable** instances namely *Gender*, *Depression*, *Emotion*, *AlcoholConsumption*, *TobaccoUse* and *WorkingCondition*. Each of the **Variable** instances has a "***hasState***" relationship with its sets of states. For example, the **Gender** node has two discrete states, namely "**Male**" and "**Female**".

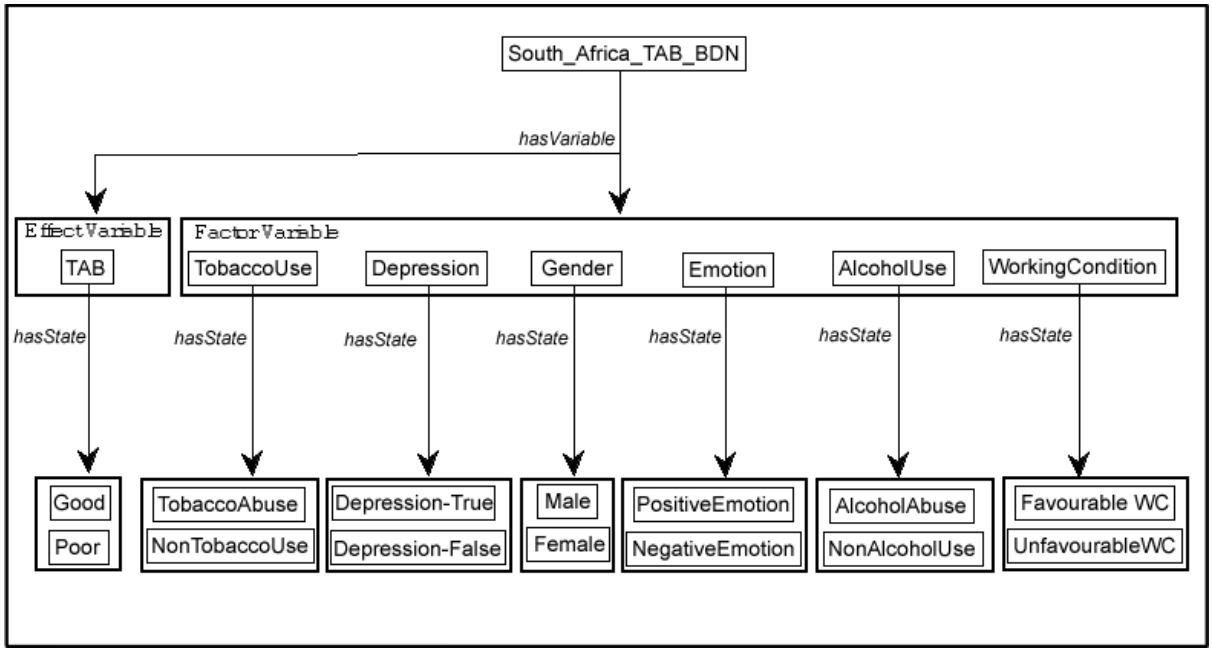

Figure 6.4: BN model representation using the extended ontology

A hypothesis "**TAB**" variable is also created to represent the state associated with the behaviour of a patient that determines his/her decision to take drugs. The **TAB** node represents the mental state of a patient that determines his/her decision to take drugs. To form a BN structure as shown in Figure 6.5, the `Variables` instances become parent nodes of the **TAB** node, except the Working Condition which is the parent node to Gender node.

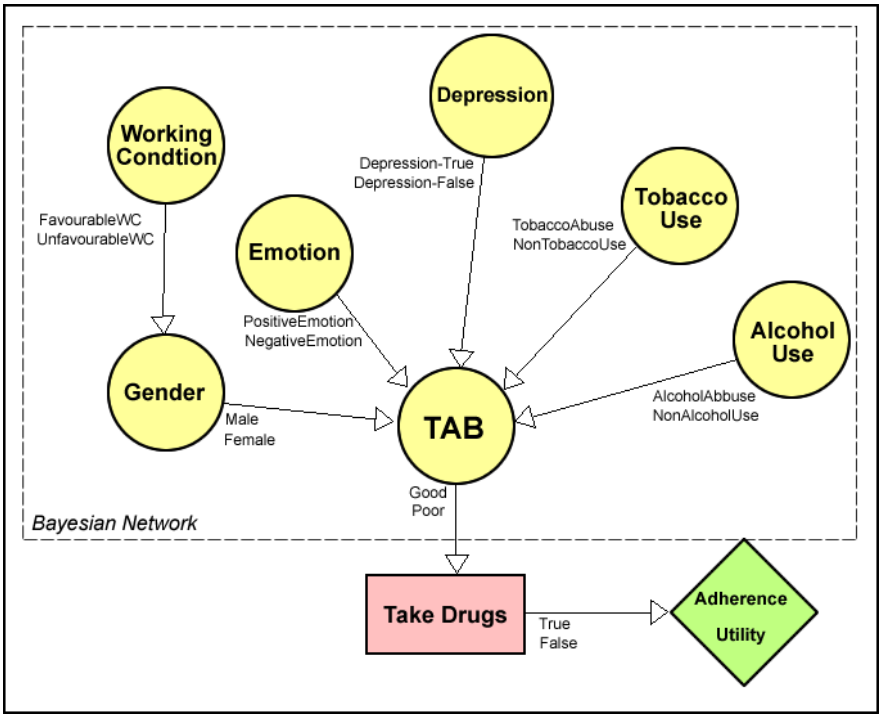

Figure 6.5: Example decision network model

It is important to note the causal relationship between Working Condition node and the Gender node. According to Daniel et al, 2005 [41], unfavourable working conditions, such as long working hours and manual labour, have a negative influence on adherence behaviour of male TB patients. Poor adherence behaviour of male TB patients is due to their unfavourable working conditions.

The **`ProbabilityObject`** class defines the interdependency between the variables as well as the probability of each of the variable states. This will form the structure of the BN for the example case. Firstly the **`PriorProbability`** for the parent nodes is defined with their properties. Table 6.3 below shows the instances of **`PriorProbability`** that are defined with the values, and linked with the corresponding variables and states. The values in the tables are manually inserted in the ontology as an example implementation of South Africa.

Prior Probability Table			
`Instance`	***`hasVariable`***	***`hasState`***	***`hasProValue`***
WoC_FA	WorkingCondition	FavourableWC	0.20
WoC_UF	WorkingCondition	UnfavourableWC	0.80
Dep_DE	Depression	Depression-True	0.10

Dep_ND	Depression	Depression-False	0.90
Emo_PO	Emotion	PositiveEmotion	0.85
Emo_NE	Emotion	NegativeEmotion	0.15
AlC_AA	AlcoholConsumption	AlcoholAbuse	0.60
AlC_NA	AlcoholConsumption	NonAlcoholUse	0.40
ToU_TA	TobaccoUse	TobaccoAbuse	0.55
ToU_TN	TobaccoUse	TobaccoNonAbuse	0.45

Table 6.1: Table showing the instances of **PriorProbability** for the example case

Secondly, the conditions that determine the relationship of the factors nodes to the **TAB** and **Gender** nodes are defined in the **Condition** class, see Table 6.4 below. Instances are defined under the **Condition** class and linked to their variables and states

Condition Table		
Instance	***hasVariable***	***hasState***
GEN_WoC_FA	WorkingCondition	FavourableWC
GEN_WoC_UF	WorkingCondition	UnfavourableWC
TAB_Gen_MA	Gender	Male
TAB_Gen_FE	Gender	Female
TAB_Dep_DE	Depression	Depression-True
TAB_Dep_ND	Depression	Depression-False
TAB_Emo_PO	Emotion	PositiveEmotion
TAB_Emo_NE	Emotion	NegativeEmotion
TAB_AlC_AA	AlcoholConsumption	AlcoholAbuse
TAB_AlC_NA	AlcoholConsumption	NonAlcoholUse
TAB_ToU_TA	TobaccoUse	TobaccoAbuse
TAB_ToU_TN	TobaccoUse	TobaccoNonAbuse

Table 6.2: Table showing the instances of **Condition** for the example case

Thirdly and lastly, the instances of **ConditionProbability** class are defined for all the variables that influence the **TAB** variable. See Table 6.5 below. The OWL representation of the example case is included in the ontology presented in OWL format (see Appendix 1).

Condition Probability Table				
Instance	***hasVariable***	***hasState***	**hasProbValue**	**hasCondition**
GEN_CM_1	WorkingCondition	FavourableWC	0.30	GEN_WoC_FA
GEN_CF_1	WorkingCondition	FavourableWC	0.99	GEN_WoC_FA
GEN_CM_2	WorkingCondition	UnfavourableWC	0.70	GEN_WoC_UF
GEN_CF_2	WorkingCondition	UnfavourableWC	0.01	GEN_WoC_UF
TAB_CP_1	Gender	Male	0.70	TAB_Gen_MA
TAB_CG_1	Gender	Male	0.30	TAB_Gen_MA
TAB_CP_2	Gender	Female	0.15	TAB_Gen_FE
TAB_CG_2	Gender	Female	0.85	TAB_Gen_FE
TAB_CP_3	Depression	Depressed	0.80	TAB_Dep_DE
TAB_CG_3	Depression	Depressed	0.20	TAB_Dep_DE
TAB_CP_4	Depression	NotDepressed	0.01	TAB_Dep_ND
TAB_CG_4	Depression	NotDepressed	0.99	TAB_Dep_ND
TAB_CP_5	Emotion	PositiveEmotion	0.05	TAB_Emo_PO
TAB_CG_5	Emotion	PositiveEmotion	0.95	TAB_Emo_PO

TAB_CP_6	Emotion	NegativeEmotion	0.99	TAB_Emo_NE
TAB_CG_6	Emotion	NegativeEmotion	0.01	TAB_Emo_NE
TAB_CP_7	AlcoholConsumption	AlcoholAbuse	0.99	TAB_AlC_AA
TAB_CG_7	AlcoholConsumption	AlcoholAbuse	0.01	TAB_AlC_AA
TAB_CP_8	AlcoholConsumption	NonAlcoholUse	0.01	TAB_AlC_NA
TAB_CG_8	AlcoholConsumption	NonAlcoholUse	0.99	TAB_AlC_NA
TAB_CP_9	TobaccoUse	TobaccoAbuse	0.90	TAB_ToU_TA
TAB_CG_9	TobaccoUse	TobaccoAbuse	0.10	TAB_ToU_TA
TAB_CP_10	TobaccoUse	TobaccoNonAbuse	0.01	TAB_ToU_TN
TAB_CG_10	TobaccoUse	TobaccoNonAbuse	0.99	TAB_ToU_TN

Table 6.3: Table showing the instances of **`ConditionProbability`** for the example case.

The BN model generated using the ontology can be further customise for the given community. For instance, the prior and condition probabilities are default values from the ontology, the modeller can manually refine these values for the network to be representative of the target community.

Other nodes that could be generated with the ontology by the modeller, aside from the **`TAB`** node which is the hypothesis node, include the “Take Drugs” and “Adherence Utility” nodes. The take drug node is a decision node that is influenced by the mental state of the patient. The adherence utility node predicts the adherence risk of a TB patient in a given community.

The model presented in this section shows how the ontology can be used to generate a BN model for a specific community. A BN model was generated by following the approach and consists of sets of variable and states.

The implementation of the use case example was done using the Java Jena API to automate the construction of the BN model. The queries above, to extract classes and instances from the ontology, were written in SPARQL. The Jena API provided a platform for automating the transformation of the classes into node lists, states and the dependency information required to construct the network structure. The nodes, states and dependency information are then captured back into the TB adherence ontology as a BN model.

6.4 SUMMARY AND DISCUSSION

A probabilistic reasoning extension to the TB adherence factors ontology was presented in this chapter. A transformation algorithm which translates the selected influencing factors into primitives to be used for a BN model construction was discussed in section 6.1. An extension of the TB adherence ontology with SWAP-Uncertainty ontology was discussed in section 6.2. Lastly, the extended TB adherence ontology was used to construct a BN model for a specific community in order to evaluate the approach for the extension.

The strength of the approach for extending the TB adherence ontology presented in this chapter is its simplicity of modelling BN through ontology. The approach is similar to the semi-automatic approach by Fenz and Hudec [94], which consists of simple steps for translating concepts defined in the ontology into a BN model. For instance, it consists of a transformation algorithm that allows modellers to translate influencing factors, generated through the ontology querying, into BN primitives. The algorithm converts classes into nodes, instances into states, and interdependency between factors into links between parent and child nodes.

Manual capture of probabilities affords modellers the opportunity to customise and modify BN models for a specific community. Although Larik and Haider [20] see manual capturing of probabilities as a limitation of generating BN models from an ontology, manual capturing provides modellers with the flexibility of calculating probabilities, using an external formula that represents their community of interest before capturing it with the ontology. Manual capturing of probabilities will give BN models that have been generated through the ontology the uniqueness in representing a specific community.

Additionally, the approach presented an ontology that is fit for constructing a BN model, which is the main purpose of modelling adherence behaviour. SWAP-Uncertainty ontology was used to extend the TB adherence ontology. The TB adherence ontology shares some of the strength of

SWAP ontology in BN models' representation. Through the extension, the TB adherence ontology is enhanced for capturing multiple BN models for specific communities.

The ontology was used to answer CQ3 in section 6.3 whereby BN primitives were generated through the ontology by applying the transformation algorithm to the query outputs. The ontology was successfully used to develop the structure of the BN model by generating the variables and states and creating the structure with the inter-dependency information from the ontology. The probabilities for a BN model were captured manually with the ontology to allow modellers customise the BN model for their communities of interest.

Competency Questions	**Answered? (Yes/No)**	**Example Query**
CQ3a: Can the ontology be used to generate the variable and states for a BN model?	Yes	Decision Network Example
CQ3b: Can the ontology be used to generate the probability tables for a BN model?	Yes	Decision Network Example
CQ3c: Can the ontology be used to generate the BN model structure?	Yes	Decision Network Example

Table 6.4: Summary of use case test for answering CQ3

Chapter 7

DISCUSSION AND CONCLUSION

7.1 CONTEXT OF THE RESEARCH

Adherence behaviour prediction has the potential to improve medical practice and enhance decision-making in disease programmes. Predicting which individuals and communities have the potential for poor adherence behaviour and are thus at high risk of treatment defaulting, is crucial for effective and efficient treatment planning and improving the allocation of resources and interventions in disease control programs within various regions.

However, constructing predictive models, such as a Bayesian Network (BN), for a specific community, is challenging. Adherence behaviour is influenced by a diverse range of personal, cultural and socio-economic factors that vary between geographical regions and communities. Adherence behaviour is complex, dynamic and difficult to understand. Expert knowledge of factors that influence adherence behaviour in general and identifying specific factors that influence adherence in a given community of interest is necessary for generating the parameters and probabilistic distributions required for building a BN. Current knowledge is embedded in a diverse and growing volume of scientific publications which are frequently ambiguous and sometimes contradictory.

Ontologies and BNs are promising technologies that can be integrated for constructing predictive models for treatment adherence. Ontologies have proven to be useful for structuring complex domain concepts and also for capturing facts that are linked with these concepts in a consistent manner. They can be used to develop an adherence knowledge-base that can be queried and navigated by experts in order to find determinants of poor adherence. They can be used to consolidate and harmonise current knowledge about diverse factors that influence treatment adherence from the growing volume of publications, which provide an opportunity to analyse the knowledge and resolve differences. BNs, on the other hand, are useful for modelling uncertainty surrounding causality of poor adherence behaviour.

Factors that influence treatment adherence for a particular community can be modelled into BN primitives for constructing models for predicting adherence risks. Construction of a BN model to predict adherence risk can be facilitated with an ontology that structures and captures knowledge about adherence behaviour. The ontology for adherence can then be used to provide the variables, states and arcs for constructing adherence BN models.

Although there are some existing categorisation systems for factors influencing adherence behaviour, there is no ontology for capturing knowledge about factors that influence adherence, and there is no specific methodology for modelling treatment adherence behaviour in a consistent manner. Furthermore, current ontology engineering methodologies such as MethOntology and UPON do not explicitly support knowledge acquisition from scientific publications or for developing an ontology that can be used to develop predictive BN model. Hence, there is a need to create an approach for developing a treatment adherence ontology that consolidates adherence knowledge and that can facilitate the construction of BN models for predicting adherence risk.

7.2 SUMMARY OF RESULTS

There are two main outputs of the study: an ontology-driven approach for modelling and predicting adherence behaviour, and the tuberculosis adherence factors ontology.

7.2.1 The Ontology-driven Approach for Predicting Adherence Behaviour

The ontology-driven approach for modelling adherence behaviour extends the UPON methodology. The approach is specifically tailored for the development of an ontology for capturing and representing scientific facts about adherence and for generating Bayesian Networks.

The approach consists of six steps: Definition of Design Purpose, Knowledge Acquisition, Model Design, Model Analysis, Model Formalisation and Ontology Evaluation. The first four steps guide the development of a conceptual model and the last two steps guide the formalisation of this model into an ontology. The approach is described in detail in Chapter 3 and its application to TB adherence in sub-Saharan Africa is described in Chapters 4, 5 and 6, and is summarised below:

- **Definition of Purpose:** The scope of modelling adherence behaviour was defined with TB adherence behaviour as a case study. Sub-Saharan Africa was considered as the geographical area for the model. The result of the activity is presented in section 4.1
- **Knowledge Acquisition:** The knowledge acquisition step involved two types of reviews: a review of existing adherence models and a collation of scientific evidence (see section 3.3.2). Concepts for TB adherence behaviour were extracted from the scientific literature through a review of existing adherence models. This led to the identification of categorisation dimensions of factors that influence adherence behaviour. The scientific evidence was collated through the second review type and was used for the evaluation and testing of the ontology. The result of the process was discussed in Section 4.2.
- **Model Design:** Existing categorisation dimensions, identified through the review process, were restructured to produce a comprehensive and harmonised conceptual model. As described in Section 4.3, five dimensions were found useful for representing adherence factors and were properly defined to eliminate overlap and ambiguity of concepts to be represented in the ontology. Additionally, the conceptual model design took into account the translation of the factors into the Bayesian paradigm. The design includes translating the knowledge about factors into BN primitives i.e. nodes, states and arcs (see sections 6.1 and 6.2).
- **Model Analysis:** The developed conceptual model was compared with existing categorisation models and then used to classify factors that influence TB adherence that were derived from clinical studies. The model was found to be as comprehensive as the existing models combined, having gone through several iterations of knowledge acquisition and conceptual model design. The result of the conceptual model analysis is presented in section 4.4.
- **Model Formalisation:** The conceptual model was formalised into an ontology to capture scientific findings about TB adherence behaviour. The model was formalised with Web ontology language (OWL) and was based on existing ontologies such as Evidence ontology [99] FaBiO ontology [108] and Geonames ontology [109] (see section 5.1). The ontology was

extended to include BN primitives using a transformation algorithm and the SWAP-Uncertainty ontology (see section 6.2) to allow for representing and generating adherence BN models.

- **Ontology Evaluation:** The evaluation involved checking the ontology for consistency and testing the ontology with the competency questions. The results of evaluating the ontology's fitness in capturing scientific knowledge about TB adherence are discussed in section 5.4. The result of validating its support for constructing Bayesian Networks is presented in section 6.3.

The application of the six steps of the approach led to the construction of an ontology for factors influencing TB adherence behaviour.

7.2.2 The TB Adherence Factors Ontology

The ontology consistently classifies and structures factors that influence TB adherence. It captures unstructured findings about influencing factors that are embedded in scientific publications. It was shown to effectively capture all factors found in 14 clinical publications pertaining to communities in sub-Saharan Africa.

The ontology was found to be more comprehensive than other informal categorisation systems as it represents more dimensions than existing systems and also explicitly represents the region and the cross-dependency dimensions, which are not explicitly represented in existing systems (see section 4.4). The ontology satisfied all the competency questions (see section 5.4) and was also shown to be effective for generating the structure of a BN model that reflected the risk profile for a particular community (see section 6.3). Lastly, a prototype knowledge-base was developed to demonstrate how the ontology can be queried and navigated by potential users (see Section 5.3.)

7.3 CONTRIBUTIONS OF THE RESEARCH

The key contributions of the research are described below.

7.3.1 Contribution to Adherence Modelling and Prediction

7.3.1.1 An Approach for Building an Ontology for Adherence Behaviour

The major challenge with predicting adherence behaviour lies in the collation and structuring of potential factors that influence adherence behaviour. The identification of specific factors and their influencing effect for a specific community is essential for predicting poor adherence risk. Existing categorisation systems for factors are ambiguous, not consistent with one another and provide no explicit support for querying, navigation and, most importantly, predicting adherence risk (see section 4.2.2).

The approach presented in this study is aimed at building effective Bayesian Networks for predicting adherence risk for specific communities. The approach provides clear and concrete steps that can be followed to create a conceptual model to structure factors identified in scientific publications. While the conceptual model is significant for structuring adherence concepts, formalising the model into an ontology provides a formal computational representation of the conceptual model. The ontology incorporates Bayesian primitives that allow for representing and generating Bayesian Networks that reflect the risk profile for a particular community.

The approach was shown to be effective in building an ontology for TB adherence behaviour in sub-Saharan African and for generating an adherence predictive model for a specific community of interest (see chapters 4 to 6).

7.3.1.2 Structuring Explicit Knowledge for Evidence-based Decision-making

The approach is used to develop an ontology that captures explicit knowledge about treatment adherence as an evidence base for decision support in medical practices. Evidence-based decision-making is a vital process through which effective and efficient healthcare services are delivered [116], [117], [118]. Sources of knowledge for evidence-based decision-making in medical practices include tacit knowledge (clinical expertise and experience of patient preferences) and explicit knowledge (documentation in the form of guidelines and scientific research outputs) [119] [120] [121] [117].

Healthcare officers often draw from both sources to support healthcare decision processes in clinical practices, healthcare policy development and disease intervention planning [120] [116] [122]. While knowledge derived from scientific research reduces uncertainty about courses of actions to be taken, tacit knowledge, on the other hand, is a quick and accessible reference for effective solutions to health problems.

Healthcare officers often rely more on tacit knowledge for most of their decisions, despite the advantages of explicit knowledge. Healthcare officers seldom access explicit knowledge for decision-making and they prefer to read publications in their leisure time, using knowledge from papers as reference points to validate their experiences [117] [121] [120]. The time and energy required to read through volumes of documentation makes it challenging for healthcare officers to draw facts from explicit knowledge during the decision-making process. Although the search mechanism provided by repositories, such as MEDLINE, makes it easier for healthcare officers to access research output [118], scientific facts are embedded within the texts of scientific papers and are sometimes reported qualitatively. With the growing volumes of scientific publications, healthcare officers are constantly faced with time constraints in curating findings that are reported in the publications.

In line with this, the ontology was used to structure and capture these scientific facts and supports a systematic synthesis of explicit adherence knowledge from scientific publications. The ontology-driven approach for modelling adherence offers a method to capture findings about factors that influence adherence behaviour, which are reported in vast volumes of scientific publications, consistently into an ontology, hence facilitating the presentation of explicit knowledge in a structured manner that can be easily translated for evidence-based decision-making.

7.3.2 Contribution to Ontology Engineering

7.3.2.1 Knowledge Acquisition through Review of the Literature

Knowledge acquisition is an important process in ontology engineering. It is essential for the identification of key domain concepts, in the determination of requirements for the ontology to be

developed and to guide the purpose definition for an ontology. There are several sources of knowledge useful for ontology construction, including: domain experts, handbooks, figures, tables, interviews and other ontologies [55] [123]. This study introduces a novel approach to knowledge acquisition by specifying scientific publications as a viable source of knowledge for building ontologies. Scientific publications document expert knowledge and findings that will be formalised in an ontology. Furthermore, scientific publications have presumably been validated through the scientific method, and have gone through at least one rigorous process of peer-review. Therefore, the quality, coherence and conceptual clarity of concepts obtained from the scientific review process should be higher than that obtained through other knowledge sources, such as interviews.

Scientific publications are different from other textual documents, such as figures, tables and handbooks. Unlike these documents that are mostly used for domain ontologies' development, scientific publications serve as the source for extracting concepts (terminologies, vocabularies) and the community specific facts associated with the concepts captured in an ontology.

The review of scientific publications was included in the approach as an alternative knowledge acquisition process rather than the inclusion of a domain expert, as suggested by UPON. However, the use of domain experts for complex domains such as treatment adherence, where there is limited community agreement and different interpretations (i.e. no commonly accepted model), may fall short in identifying the requirements, concepts and relationships between concepts that are needed to build an ontology. An extensive literature review was proposed in the study for knowledge acquisition ontology evaluation (See section 3.2.2). This method proved to be successful and viable and led to the construction of a comprehensive model for representing factors that influence TB adherence behaviour.

Conversely, the best approach to building a representative conceptual model is to use the review of scientific publications approach as complementary to the implicit domain expert knowledge during the knowledge acquisition process. The combination will provide modellers with the opportunity to access from both the explicit and implicit knowledge sources. The combined approach provides a validation

for the knowledge acquisition process, i.e. domain experts can validate the information acquired from the literature review and vice versa.

7.3.2.2 Ontology Development for Predictive Model Construction

The integration of ontologies and BN was considered an integral part of the ontology-driven approach. While an ontology is useful for modelling adherence concepts in a consistent manner, it is limited for representing uncertainty around causality of poor adherence behaviour, which is an important aspect in predicting adherence behaviour. BN, on the other hand, has the ability to capture uncertainty and is useful for representing causal relationships that exist between the influencing factors and treatment adherence behaviour. The possibility of having an ontology that is fit for constructing a BN model demands the integration of two technologies. Hence, the approach integrates Ontology and BN to develop an adherence ontology that comprises knowledge about adherence factors and generates the BN primitives required for constructing a BN model from these factors.

The approach provides support for BN model synthesis by integrating activities that can guide adherence modellers in building adherence ontologies for BN model construction. Firstly, the fitness of the ontology for adherence BN model construction was established as an important purpose to be considered in constraining the setting of design goals, setting the evaluation criteria and use case description. Secondly, the integration of BN technology was recommended in designing and formalising the adherence conceptual model. SWAP-Uncertainty ontology was integrated as a base concept for extending the adherence ontology for the construction of adherence BN models. Lastly, the evaluation of the ontology includes validating its support in the construction of a BN model. The ontology should support the transformation of selected factors into BN primitives and the representation of community specific adherence BN models.

The integration of ontologies and BN was evaluated with the TB adherence factors ontology. The ontology was used to capture knowledge about factors' influence, the relationship between factors and the types of influence a factor has on adherence in various SSA communities. For instance, the ontology captures the facts that alcohol consumption has influence on adherence behaviour and also that alcohol

abuse (factor) causes poor adherence (type of influence) on treatment adherence, specifically, in South Africa. The factors and the types of influence they have on adherence are then used to construct a BN model for predicting adherence risk for SSA communities.

7.3.3 Usage

This section discusses the usage of the ontology-driven approach as well as the usage of the TB adherence factors ontology that was developed with the approach.

7.3.3.1 Usage of the Ontology-driven Approach

The ontology-driven approach can be used by adherence behaviour experts to develop an ontology for adherence behaviour for particular diseases and geographical regions. The approach was used in this study for modelling factors that influence TB adherence behaviour. The steps in the approach can be followed for modelling adherence factors for other diseases as well. For instance, the approach can be used for modelling factors that influence treatment adherence behaviour of HIV or diabetics patients in a country where these diseases are prevalent [124] [125].

The approach can be used by knowledge engineers and adherence experts to develop a structured adherence model that is open, accessible and sharable among several public health domain experts. Also, adherence experts and disease monitoring officers interested in predicting adherence risk for various communities across a broad geographical region can use the approach to build an adherence knowledge-base for construction of a predictive model.

7.3.3.2 Usage of the TB Adherence Factors Ontology

The TB adherence factors ontology is available for various end users in TB control programmes which include adherence experts and TB control officers. The ontology supports the following uses:

Capturing of Findings from Scientific Publication: The TB adherence factors ontology can be used to capture facts about factors that influence adherence behaviour from scientific publications. Users can specifically use the ontology to capture findings about factors that influence TB adherence in SSA from scientific publications. The process of capturing findings from scientific publications is currently

manual. The process involves carrying out a search on scientific publication repositories for clinical papers on adherence behaviour, and selection of the papers that report on factors that influence adherence for various communities. Facts that could be extracted from clinical papers and captured in the TB adherence factors ontology include: the factors, type of influence a factor has on patients' adherence behaviour, the community/region in which the clinical research was carried out, the properties of clinical studies, and interdependencies among the factors. The facts are then captured into the ontology using an ontology editing tool such as Protégé software. The capturing of the facts requires knowledge of ontologies and the ontology editing tool.

The TB adherence factors ontology is extendable to capture new knowledge about factors that influence adherence. Knowledge about adherence can change as new studies are carried out and as findings are published in scientific publications. The findings may present facts for geographical regions that previously lacked such facts, or provide an update for the facts that are already captured. The ontology accommodates capturing of this new and additional knowledge as it is published while preserving the historical knowledge already captured.

Extraction and Sharing of Adherence Knowledge: Adherence experts and TB control officers can access, share and use knowledge about factors that influence TB adherence without spending a lot of time and energy navigating large volumes of scientific publications. The TB adherence factors ontology can be navigated and queried to extract knowledge about community-specific factors that cause poor adherence. This is enabled by the links between the findings, scientific publications and the communities captured in the ontology.

Additionally, the ontology facilitates sharing of community-specific influencing factors among experts in a consistent manner. Adherence experts can extract information from the ontology with ontology editing tools and querying languages, such as SPARQL. Considerable knowledge of ontology development is required in order to use ontology querying languages and editing tools. However, the ontology is also accessible via a prototype web portal that was developed specifically for searching for TB influencing factors (see Section 5.3). The portal enables navigation, complex searches and filtering

to be performed on the ontology. This is to simplify access to the ontology for users with no prior knowledge of ontologies. Through the portal, knowledge about TB adherence behaviour can be accessed and shared by adherence experts and TB control officers without knowledge of the underlying ontology.

Profiling of Community Adherence Behaviour: TB control officers can query and navigate the ontology to select specific factors for characterising a TB adherence community. The selected factors will function as a risk determinant profile for the TB community, which is essential for supporting decisions regarding resource allocation and intervention planning in TB prone areas. For instance, factors such as adverse effect of drugs, poverty level, age and gender, which are common in a specific community, will form the list of poor adherence risk determinants for that community. Based on this list, an intervention plan that is targeted at alleviating the influence of the factors can be developed specifically for this community. TB control officers will be able to profile every TB community and design interventions that address specific determinants for these communities. Planning of TB control programme activities could be enhanced through the identification of specific sub-populations that are more at risk. Targeted intervention supports would depend on the specific risk factors of the community.

Predictive Models Construction: TB control officers interested in identifying the adherence risk determinants, as well as predicting TB adherence risk of various communities, can use the ontology for constructing BN models for his/her community of interest. The ontology is a comprehensive evidence-base for building a community-specific adherence BN model for SSA. The ontology provides users with the primitives that can be used to construct a predictive model. It also supports capturing of the predictive model in the ontology. However, constructing predictive models with the ontology is currently not a fully automated process. Users need to first query the ontology to select influencing factors for a specific community. Using the transformation mechanism, this list of factors will be manually transformed into BN primitives which are then captured back into the ontology as a BN model and the probabilities are manually captured with the ontology. See section 6.3 for the demonstration of how a predictive model can be created using the TB adherence ontology.

7.4 IMPACT OF THE RESEARCH

The impact of the research is centred on adherence risk modelling and prediction. It is as follows:

7.4.1 Implication for Adherence Modelling and Prediction

The study provides a unified method for adherence experts to develop computer based adherence models across various regions and disease areas. The approach is reusable and can be applied to adherence modelling for other diseases besides TB and in other communities outside sub-Saharan Africa. The problem of poor treatment adherence cuts across both infectious and chronic diseases. The approach can be followed to develop adherence models for various diseases and can be applied to any geographical regions.

Adherence experts now have a specific method to develop adherence behaviour ontologies. Experts can represent adherence concepts in a consistent manner and link scientific facts with these concepts. These facts can now be queried, navigated, shared and used.

This study also has an impact on how adherence predictive models can be developed. The study resolves the challenge of sourcing data that can be used for constructing BN models. A knowledge engineer can build an adherence ontology that supports predictive model construction using the approach. Ontologies built through this approach can facilitate construction of BN models with current and continuously updated knowledge of adherence. BN models can be changed and updated as new knowledge is captured in the ontology.

7.4.2 Enhancement of the Understanding of Adherence Behaviour

The structuring of the findings about adherence behaviour from scientific papers, provided via ontologies, will enhance access to the facts that are within volumes of publications. This will have a considerable effect on the understanding, interpretation and comparison of facts about adherence behaviour and will also facilitate the reuse of facts that have been reported for further research processes. Munro *et al* [8] rightly state that the structuring and systematic synthesis of qualitative research contributes to an improved understanding and interpretation of knowledge about adherence to

treatment. The ontology developed with the approach captures and structures facts from qualitative research about TB adherence. Thus, adherence experts will be able to enrich their understanding and interpretation of treatment adherence by querying and navigating the explicit knowledge about adherence behaviour captured in the ontology.

Although the capturing of the findings still involves a manual process and a knowledge of ontologies, accessing the adherence facts is easier than sifting through volumes of scientific papers once they are captured in the ontology. The structuring of the concepts and the established links between the scientific findings, publications, and regions is a systematic synthesis that enables easy access, navigation and filtering of the facts. Rather than searching multiple online repositories of scientific publications, experts can navigate the adherence ontology to access explicit knowledge on a range of adherence findings from these publications.

7.4.3 Evidence-based Support for Disease Control Programmes

Developing adherence ontologies using the approach can provide evidence-based support in disease control programmes. The approach is specific for delivering explicit knowledge from scientific research as an evidence-base for adherence behaviour that can be utilised in healthcare decision-making processes, medical practices and patient management strategies. For instance, access to facts about TB is valuable for implementing community-specific direct observation treatment intervention and to manage the allocation of resources in low resource countries. Decision-making processes and disease intervention programmes can be supported with community specific adherence information that has been derived from adherence ontologies.

The use of explicit knowledge about adherence behaviour in medical practice decision-making is expected to improve with adherence ontologies. Healthcare officers will be able to have direct access to the facts about adherence behaviour for specific communities without having to read through numerous written documents. Furthermore, the provision of an interface to access the ontology will further improve navigation of captured knowledge for medical officers who have no knowledge of ontologies. Healthcare officers can quickly access adherence knowledge that could help in their

decision-making through a simple web interface or a mobile App. Hence, knowledge about adherence behaviour can be accessed during decision-making processes with little effort.

7.4.4 A Sharable Adherence Behaviour Knowledge Repository

A global repository of harmonised and sharable knowledge about adherence behaviour can be established through the use of the approach to build adherence ontologies. Adherence ontologies generated using the approach can be shared among adherence experts and can be reused to further develop other adherence ontologies. Collection of adherence ontologies for various diseases and geographical areas can form a global knowledge repository for treatment adherence behaviour. The global repository for adherence ontologies could be developed and managed by ontology experts and accessed by several domain experts.

The approach proposed the formalisation of adherence concepts using OWL, which is a W3C standard for web semantics. Thus, adherence ontologies that are produced through using the approach are not only sharable among human experts, but can also be automatically exchanged among computer agents. Because OWL is understandable by machines, software can be developed to access and exchange scientific knowledge about adherence behaviour captured in the repository. Thus, a repository of adherence ontologies can be accessed by web applications such as a web tool for predicting adherence risks.

7.5 LIMITATIONS AND FUTURE WORK

7.5.1 Social Quality Assessment of the Adherence Ontology

The approach proposed two steps for evaluating adherence ontologies: the Model Analysis and the Ontology Evaluation. These steps cover three out of four types of assessments proposed by the UPON methodology: the syntactic, semantic and pragmatic quality assessments. The Model Assessment covers most of the pragmatic quality assessment of adherence ontology as well as the fidelity and relevance of the adherence ontology. The Ontology Evaluation step covers the syntactic, semantic and part of the

pragmatic quality assessment of the ontology. The pragmatic quality assessments covered are completeness and relevance of the ontology.

However, the social quality assessment, which is the last quality assessment proposed by UPON, was not included in the approach. Social quality assessment is associated with usage tracking and maintenance of the ontology after development. The inclusion of social quality assessments of an adherence ontology will require additional work to extend the approach to cover the post-development stage of ontology engineering. Interactions with various disease programs and adherence behaviour experts in South Africa were initiated during this study to stimulate an exploration of the benefit of the ontology for the domain.

However, long-term systematic field testing is still required to determine its usefulness and significance for domain experts. There is also a need to publish and maintain the ontology on the World Wide Web in order to provide open access to these experts. Thereafter, the ontology can be subjected to usage assessments to validate the significance of the knowledge captured in the ontology for decision-making and to make refinements and extensions to the ontology to improve its usability.

7.5.2 TB Adherence Model Comprehensiveness

The underlying conceptual model for the TB adherence ontology is more comprehensive than the existing TB adherence categorisation systems. It incorporates more dimensions than any of the current categorization systems and was successfully used to capture most of the factors that influence TB adherence behaviour in SSA that were found in the literature (see section 4.4.1). However, some of the dimensions identified from the literature reviewed were not covered by the conceptual model. Two categorisation dimensions that are not currently included in the ontology are "*degree of influence*" and "*difficulty of measurement"*. Possible future research could entail an investigation into how to incorporate these dimensions into the TB adherence conceptual model in order to further improve the comprehensiveness of the TB adherence ontology.

Extending the model to include these dimensions will improve the comprehensiveness of the ontology, allow for the capturing of more knowledge about TB adherence and improve the usage of the ontology for predictive model construction. For instance, the "*degree of influence*" of a given factor towards adherence behaviour could be captured from scientific publications and transformed into probabilities, which is useful for generating CPTs for BN.

7.5.3 Automatic Capturing of Findings from Scientific Publications

Further work is required to extend the approach to include the automatic capturing of facts from scientific publications into the ontology. The demonstration of the knowledge acquisition process for the case study was carried out through a manual review of the scientific publications to extract findings about the factors. The findings are then manually captured into the ontology at the formalisation step of the approach, however, an advanced text mining method with natural language processing (NLP) could be a better alternative for fact extraction from scientific publications. There have been several applications of NLP healthcare domain, which include analysis and classification of clinical records [126] [127] and medical reports [128] [129] [130], clinical events monitoring [131], [132] [133] [134] and establishment of rich clinical terminologies with SNOMED CT [135] [136]. Further exploration could extend and automate the knowledge acquisition step of the approach with NLP, thus energy and time could be saved with a mechanism that is able to automatically extract facts from online scientific publications for the construction of an adherence ontology.

APPENDIX

APPENDIX 1: THE TB ADHERENCE FACTOR ONTOLOGY

```
<?xml version="1.0"?>

<!DOCTYPE rdf:RDF [
    <!ENTITY owl "http://www.w3.org/2002/07/owl#" >
    <!ENTITY xsd "http://www.w3.org/2001/XMLSchema#" >
    <!ENTITY rdfs "http://www.w3.org/2000/01/rdf-schema#" >
    <!ENTITY ace_lexicon "http://attempto.ifi.uzh.ch/ace_lexicon#" >
    <!ENTITY rdf "http://www.w3.org/1999/02/22-rdf-syntax-ns#" >
    <!ENTITY tabinfluencingfactor "http://ontology.ukzn/tabinfluencingfactor.owl#" >
]>

<rdf:RDF xmlns="http://ontology.ukzn/tabinfluencingfactor.owl#"
     xml:base="http://ontology.ukzn/tabinfluencingfactor.owl"
     xmlns:tabinfluencingfactor="http://ontology.ukzn/tabinfluencingfactor.owl#"
     xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:owl="http://www.w3.org/2002/07/owl#"
     xmlns:ace_lexicon="http://attempto.ifi.uzh.ch/ace_lexicon#"
     xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
     xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
    <owl:Ontology rdf:about="http://ontology.ukzn/tabinfluencingfactor.owl">
        <owl:versionInfo rdf:datatype="&xsd;string">owl:Ontology added by TopBraid</owl:versionInfo>
    </owl:Ontology>

    <!--
    ///////////////////////////////////////////////////////////////////////////////////
    //
    // Annotation properties
    //
    ///////////////////////////////////////////////////////////////////////////////////
     -->

    <!-- http://attempto.ifi.uzh.ch/ace_lexicon#CN_pl -->
    <owl:AnnotationProperty rdf:about="&ace_lexicon;CN_pl"/>

    <!-- http://attempto.ifi.uzh.ch/ace_lexicon#CN_sg -->
    <owl:AnnotationProperty rdf:about="&ace_lexicon;CN_sg"/>

    <!-- http://attempto.ifi.uzh.ch/ace_lexicon#PN_sg -->
    <owl:AnnotationProperty rdf:about="&ace_lexicon;PN_sg"/>

    <!-- http://attempto.ifi.uzh.ch/ace_lexicon#TV_pl -->
    <owl:AnnotationProperty rdf:about="&ace_lexicon;TV_pl"/>

    <!-- http://attempto.ifi.uzh.ch/ace_lexicon#TV_sg -->
    <owl:AnnotationProperty rdf:about="&ace_lexicon;TV_sg"/>

    <!-- http://attempto.ifi.uzh.ch/ace_lexicon#TV_vbg -->
    <owl:AnnotationProperty rdf:about="&ace_lexicon;TV_vbg"/>

    <!--
    ///////////////////////////////////////////////////////////////////////////////////
    //
    // Object Properties
    //
    ///////////////////////////////////////////////////////////////////////////////////
     -->

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsContinuationPhaseFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsContinuationPhaseFactor">
```

```
        <ace_lexicon:TV_sg>assertsContinuousPhaseInfFactors</ace_lexicon:TV_sg>
        <ace_lexicon:TV_vbg>assertsContinuousPhaseInfFactored</ace_lexicon:TV_vbg>
        <ace_lexicon:TV_pl>assertsContinuousPhaseInfFactor</ace_lexicon:TV_pl>
        <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;assertsInfluenceFactor"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsDrugResistancePhaseFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsDrugResistancePhaseFactor">
        <ace_lexicon:TV_vbg>assertsDrugResistancePhaseInfFactored</ace_lexicon:TV_vbg>
        <ace_lexicon:TV_pl>assertsDrugResistancePhaseInfFactor</ace_lexicon:TV_pl>
        <ace_lexicon:TV_sg>assertsDrugResistancePhaseInfFactors</ace_lexicon:TV_sg>
        <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;assertsInfluenceFactor"/>
        <owl:inverseOf rdf:resource="&tabinfluencingfactor;isAssertedDrugResistancePhaseFactorBy"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsInfluenceFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsInfluenceFactor">
        <ace_lexicon:TV_vbg>assertsInfFactored</ace_lexicon:TV_vbg>
        <ace_lexicon:TV_sg>assertsInfFactors</ace_lexicon:TV_sg>
        <ace_lexicon:TV_pl>assertsInfFactor</ace_lexicon:TV_pl>
        <rdfs:domain rdf:resource="&tabinfluencingfactor;Evidence"/>
        <rdfs:range rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsIntensivePhaseFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsIntensivePhaseFactor">
        <ace_lexicon:TV_vbg>assertsIntensivePhaseInfFactored</ace_lexicon:TV_vbg>
        <ace_lexicon:TV_pl>assertsIntensivePhaseInfFactor</ace_lexicon:TV_pl>
        <ace_lexicon:TV_sg>assertsIntensivePhaseInfFactors</ace_lexicon:TV_sg>
        <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;assertsInfluenceFactor"/>
        <owl:inverseOf rdf:resource="&tabinfluencingfactor;isAssertedIntensivePhaseFactorBy"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsNegativeInfluenceFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsNegativeInfluenceFactor">
        <ace_lexicon:TV_vbg>assertsNegInfFactored</ace_lexicon:TV_vbg>
        <ace_lexicon:TV_sg>assertsNegInfFactors</ace_lexicon:TV_sg>
        <ace_lexicon:TV_pl>assertsNegInfFactor</ace_lexicon:TV_pl>
        <rdfs:comment>Asserts Negative Influence Factor implies the Evidence asserts that the Influencing Factor as a
motivator of poor treatment adherence behaviour in tuberculosis patients</rdfs:comment>
        <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;assertsInfluenceFactor"/>
        <owl:inverseOf rdf:resource="&tabinfluencingfactor;isAssertedNegativeInfluenceFactorBy"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsNeutralInfluenceFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsNeutralInfluenceFactor">
        <ace_lexicon:TV_vbg>assertsNeuInfFactored</ace_lexicon:TV_vbg>
        <rdfs:comment>Asserts Neutral Influencing Factor implies the Evidence asserts that the Influencing Factor has a
nonsignificant or unknown influence on treatment adherence behaviour in tuberculosis patients</rdfs:comment>
        <ace_lexicon:TV_pl>assertsNeuInfFactor</ace_lexicon:TV_pl>
        <ace_lexicon:TV_sg>assertsNeuInfFactors</ace_lexicon:TV_sg>
        <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;assertsInfluenceFactor"/>
        <owl:inverseOf rdf:resource="&tabinfluencingfactor;isAssertedPositiveInfluenceFactorBy"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsPositiveInfluenceFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsPositiveInfluenceFactor">
        <ace_lexicon:TV_vbg>assertsPosInfFactored</ace_lexicon:TV_vbg>
        <ace_lexicon:TV_pl>assertsPosInfFactor</ace_lexicon:TV_pl>
        <ace_lexicon:TV_sg>assertsPosInfFactors</ace_lexicon:TV_sg>
        <rdfs:comment>Asserts Positive Influencing Factor implies the Evidence asserts that the Influencing Factor as a
motivator of good treatment adherence behaviour in tuberculosis patients</rdfs:comment>
        <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;assertsInfluenceFactor"/>
        <owl:inverseOf rdf:resource="&tabinfluencingfactor;isAssertedPositiveInfluenceFactorBy"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasCondition -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasCondition">
        <rdfs:range rdf:resource="&tabinfluencingfactor;Condition"/>
        <rdfs:domain rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasCreator -->
```

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<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasCreator">
    <ace_lexicon:TV_sg>hasCreators</ace_lexicon:TV_sg>
    <ace_lexicon:TV_vbg>hasCreatored</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_pl>hasCreator</ace_lexicon:TV_pl>
    <rdfs:range rdf:resource="&tabinfluencingfactor;Author"/>
    <rdfs:domain rdf:resource="&tabinfluencingfactor;Work"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasISOAdminCode -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasISOAdminCode">
    <ace_lexicon:TV_sg>hasISOAdminCodes</ace_lexicon:TV_sg>
    <ace_lexicon:TV_pl>hasISOAdminCode</ace_lexicon:TV_pl>
    <ace_lexicon:TV_vbg>hasISOAdminCoded</ace_lexicon:TV_vbg>
    <rdfs:domain rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <rdfs:range rdf:resource="&tabinfluencingfactor;ISOAdminCode"/>
</owl:ObjectProperty>


<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasParent -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasParent">
    <ace_lexicon:TV_sg>hasParents</ace_lexicon:TV_sg>
    <ace_lexicon:TV_pl>hasParent</ace_lexicon:TV_pl>
    <ace_lexicon:TV_vbg>hasParented</ace_lexicon:TV_vbg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
    <owl:inverseOf rdf:resource="&tabinfluencingfactor;isParentOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasPublisher -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasPublisher">
    <ace_lexicon:TV_pl>hasPublisher</ace_lexicon:TV_pl>
    <ace_lexicon:TV_sg>hasPublishers</ace_lexicon:TV_sg>
    <ace_lexicon:TV_vbg>hasPublishered</ace_lexicon:TV_vbg>
    <rdfs:range rdf:resource="&tabinfluencingfactor;Publisher"/>
    <rdfs:domain rdf:resource="&tabinfluencingfactor;Work"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasRealisation -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasRealisation">
    <ace_lexicon:TV_vbg>hasRealisationed</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_sg>hasRealisations</ace_lexicon:TV_sg>
    <ace_lexicon:TV_pl>hasRealisation</ace_lexicon:TV_pl>
    <rdfs:range rdf:resource="&tabinfluencingfactor;Expression"/>
    <rdfs:domain rdf:resource="&tabinfluencingfactor;Work"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasSpatialRelationshipWith -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasSpatialRelationshipWith">
    <ace_lexicon:TV_vbg>hasSpatialRelationshipWithed</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_pl>hasSpatialRelationshipWith</ace_lexicon:TV_pl>
    <ace_lexicon:TV_sg>hasSpatialRelationshipWiths</ace_lexicon:TV_sg>
    <rdfs:range rdf:resource="&tabinfluencingfactor;Place"/>
    <rdfs:domain rdf:resource="&tabinfluencingfactor;Place"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasState -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasState">
    <rdfs:range rdf:resource="&tabinfluencingfactor;State"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasVariable -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasVariable">
    <rdfs:range rdf:resource="&tabinfluencingfactor;Variable"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isAssertedContinuationPhaseFactorBy -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isAssertedContinuationPhaseFactorBy">
    <ace_lexicon:TV_pl>isAssertedContinuousPhaseInfFactorBy</ace_lexicon:TV_pl>
    <ace_lexicon:TV_vbg>isAssertedContinuousPhaseInfFactorBied</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_sg>isAssertedContinuousPhaseInfFactorBies</ace_lexicon:TV_sg>
    <owl:inverseOf rdf:resource="&tabinfluencingfactor;assertsContinuationPhaseFactor"/>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isAssertedInfluenceFactorBy"/>
</owl:ObjectProperty>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isAssertedDrugResistancePhaseFactorBy -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isAssertedDrugResistancePhaseFactorBy">
   <ace_lexicon:TV_sg>isAssertedDrugResistancePhaseInfFactorBies</ace_lexicon:TV_sg>
   <ace_lexicon:TV_vbg>isAssertedDrugResistancePhaseInfFactorBied</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_pl>isAssertedDrugResistancePhaseInfFactorBy</ace_lexicon:TV_pl>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isAssertedInfluenceFactorBy"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isAssertedInfluenceFactorBy -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isAssertedInfluenceFactorBy">
   <ace_lexicon:TV_sg>isAssertedInfFactorBies</ace_lexicon:TV_sg>
   <ace_lexicon:TV_pl>isAssertedInfFactorBy</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>isAssertedInfFactorBied</ace_lexicon:TV_vbg>
   <rdfs:range rdf:resource="&tabinfluencingfactor;Evidence"/>
   <rdfs:domain rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
   <owl:inverseOf rdf:resource="&tabinfluencingfactor;assertsInfluenceFactor"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isAssertedIntensivePhaseFactorBy -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isAssertedIntensivePhaseFactorBy">
   <ace_lexicon:TV_sg>isAssertedIntensivePhaseInfFactorBies</ace_lexicon:TV_sg>
   <ace_lexicon:TV_pl>isAssertedIntensivePhaseInfFactorBy</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>isAssertedIntensivePhaseInfFactorBied</ace_lexicon:TV_vbg>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isAssertedInfluenceFactorBy"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isAssertedNegativeInfluenceFactorBy -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isAssertedNegativeInfluenceFactorBy">
   <ace_lexicon:TV_pl>isAssertedNegInfFactorBy</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>isAssertedNegInfFactorBied</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_sg>isAssertedNegInfFactorBies</ace_lexicon:TV_sg>
   <rdfs:comment>ASSERTS NEGative INFluencing FACTOR implies that the Influencing Factor is asserted by the
Evidence as a motivator of poor treatment adherence behaviour in tuberculosis patients</rdfs:comment>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isAssertedInfluenceFactorBy"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isAssertedNeutralInfluenceFactorBy -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isAssertedNeutralInfluenceFactorBy">
   <rdfs:comment>ASSERTS NEUtral INFluencing FACTOR implies that the Influencing Factor is asserted by the
Evidence has a nonsignificantor unknown influence on treatment adherence behaviour in tuberculosis
patients</rdfs:comment>
   <owl:inverseOf rdf:resource="&tabinfluencingfactor;assertsNeutralInfluenceFactor"/>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isAssertedInfluenceFactorBy"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isAssertedPositiveInfluenceFactorBy -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isAssertedPositiveInfluenceFactorBy">
   <ace_lexicon:TV_sg>isAssertedPosInfFactorBies</ace_lexicon:TV_sg>
   <ace_lexicon:TV_pl>isAssertedPosInfFactorBy</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>isAssertedPosInfFactorBied</ace_lexicon:TV_vbg>
   <rdfs:comment>ASSERTS POSitive INFluencing FACTOR implies that the Influencing Factor is asserted by the
Evidence as a motivator of good treatment adherence behaviour in tuberculosis patients</rdfs:comment>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isAssertedInfluenceFactorBy"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isCarriedOutAt -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isCarriedOutAt">
   <ace_lexicon:TV_vbg>isCarriedOutAted</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_sg>isCarriedOutAts</ace_lexicon:TV_sg>
   <ace_lexicon:TV_pl>isCarriedOutAt</ace_lexicon:TV_pl>
   <rdfs:domain rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <rdfs:range rdf:resource="&tabinfluencingfactor;Place"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isConnectedWith -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isConnectedWith">
   <ace_lexicon:TV_sg>isConnectedWiths</ace_lexicon:TV_sg>
   <ace_lexicon:TV_vbg>isConnectedWithed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_pl>isConnectedWith</ace_lexicon:TV_pl>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isDocumentedAs -->
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<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isDocumentedAs">
   <ace_lexicon:TV_vbg>isDocumentedAsed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_pl>isDocumentedAs</ace_lexicon:TV_pl>
   <ace_lexicon:TV_sg>isDocumentedAses</ace_lexicon:TV_sg>
   <rdfs:domain rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <rdfs:range rdf:resource="&tabinfluencingfactor;Work"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isEastOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isEastOf">
   <ace_lexicon:TV_pl>isEastOf</ace_lexicon:TV_pl>
   <ace_lexicon:TV_sg>isEastOfs</ace_lexicon:TV_sg>
   <ace_lexicon:TV_vbg>isEastOfed</ace_lexicon:TV_vbg>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
   <owl:inverseOf rdf:resource="&tabinfluencingfactor;isWestOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isExternallyConnectedWith -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isExternallyConnectedWith">
   <ace_lexicon:TV_vbg>isExternallyConnectedWithed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_pl>isExternallyConnectedWith</ace_lexicon:TV_pl>
   <ace_lexicon:TV_sg>isExternallyConnectedWiths</ace_lexicon:TV_sg>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isConnectedWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isInsideOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isInsideOf">
   <ace_lexicon:TV_vbg>isInsideOfed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_pl>isInsideOf</ace_lexicon:TV_pl>
   <ace_lexicon:TV_sg>isInsideOfs</ace_lexicon:TV_sg>
   <rdfs:range rdf:resource="&tabinfluencingfactor;Place"/>
   <rdfs:domain rdf:resource="&tabinfluencingfactor;Place"/>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isNonTangentialProperPartOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isNonTangentialProperPartOf">
   <ace_lexicon:TV_sg>isNonTangentialProperPartOfs</ace_lexicon:TV_sg>
   <ace_lexicon:TV_pl>isNonTangentialProperPartOf</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>isNonTangentialProperPartOfed</ace_lexicon:TV_vbg>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isProperPartOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isNorthEastOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isNorthEastOf">
   <ace_lexicon:TV_pl>isNorthEastOf</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>isNorthEastOfed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_sg>isNorthEastOfs</ace_lexicon:TV_sg>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
   <owl:inverseOf rdf:resource="&tabinfluencingfactor;isSouthWestOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isNorthOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isNorthOf">
   <ace_lexicon:TV_pl>isNorthOf</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>isNorthOfed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_sg>isNorthOfs</ace_lexicon:TV_sg>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isNorthWestOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isNorthWestOf">
   <ace_lexicon:TV_vbg>isNorthWestOfed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_pl>isNorthWestOf</ace_lexicon:TV_pl>
   <ace_lexicon:TV_sg>isNorthWestOfs</ace_lexicon:TV_sg>
   <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
   <owl:inverseOf rdf:resource="&tabinfluencingfactor;isSouthEastOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isParentOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isParentOf">
   <ace_lexicon:TV_vbg>isParentOfed</ace_lexicon:TV_vbg>
   <ace_lexicon:TV_sg>isParentOfs</ace_lexicon:TV_sg>
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    <ace_lexicon:TV_pl>isParentOf</ace_lexicon:TV_pl>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isPartOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isPartOf">
    <ace_lexicon:TV_pl>isPartOf</ace_lexicon:TV_pl>
    <ace_lexicon:TV_sg>isPartOfs</ace_lexicon:TV_sg>
    <ace_lexicon:TV_vbg>isPartOfed</ace_lexicon:TV_vbg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isProperPartOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isProperPartOf">
    <ace_lexicon:TV_vbg>isProperPartOfed</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_pl>isProperPartOf</ace_lexicon:TV_pl>
    <ace_lexicon:TV_sg>isProperPartOfs</ace_lexicon:TV_sg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isPartOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isSouthEastOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isSouthEastOf">
    <ace_lexicon:TV_sg>isSouthEastOfs</ace_lexicon:TV_sg>
    <ace_lexicon:TV_pl>isSouthEastOf</ace_lexicon:TV_pl>
    <ace_lexicon:TV_vbg>isSouthEastOfed</ace_lexicon:TV_vbg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isSouthOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isSouthOf">
    <ace_lexicon:TV_pl>isSouthOf</ace_lexicon:TV_pl>
    <ace_lexicon:TV_vbg>isSouthOfed</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_sg>isSouthOfs</ace_lexicon:TV_sg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
    <owl:inverseOf rdf:resource="&tabinfluencingfactor;isNorthOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isSouthWestOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isSouthWestOf">
    <ace_lexicon:TV_vbg>isSouthWestOfed</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_pl>isSouthWestOf</ace_lexicon:TV_pl>
    <ace_lexicon:TV_sg>isSouthWestOfs</ace_lexicon:TV_sg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isTangentialProperPartOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isTangentialProperPartOf">
    <ace_lexicon:TV_vbg>isTangentialProperPartOfed</ace_lexicon:TV_vbg>
    <ace_lexicon:TV_pl>isTangentialProperPartOf</ace_lexicon:TV_pl>
    <ace_lexicon:TV_sg>isTangentialProperPartOfs</ace_lexicon:TV_sg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;isProperPartOf"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#isWestOf -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;isWestOf">
    <ace_lexicon:TV_sg>isWestOfs</ace_lexicon:TV_sg>
    <ace_lexicon:TV_pl>isWestOf</ace_lexicon:TV_pl>
    <ace_lexicon:TV_vbg>isWestOfed</ace_lexicon:TV_vbg>
    <rdfs:subPropertyOf rdf:resource="&tabinfluencingfactor;hasSpatialRelationshipWith"/>
</owl:ObjectProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#treatmentPhase -->
<owl:ObjectProperty rdf:about="&tabinfluencingfactor;treatmentPhase">
    <ace_lexicon:TV_sg>assertsTreatmentPhaseInfFactors</ace_lexicon:TV_sg>
    <ace_lexicon:TV_pl>assertsTreatmentPhaseInfFactor</ace_lexicon:TV_pl>
    <ace_lexicon:TV_vbg>assertsTreatmentPhaseInfFactored</ace_lexicon:TV_vbg>
    <owl:inverseOf rdf:resource="&tabinfluencingfactor;treatmentPhase"/>
    <rdfs:subPropertyOf rdf:resource="&owl;topObjectProperty"/>
    <owl:propertyChainAxiom rdf:parseType="Collection">
        <rdf:Description rdf:about="&tabinfluencingfactor;isAssertedDrugResistancePhaseFactorBy"/>
    </owl:propertyChainAxiom>
    <owl:propertyChainAxiom rdf:parseType="Collection">
        <rdf:Description rdf:about="&tabinfluencingfactor;assertsDrugResistancePhaseFactor"/>
```

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        </owl:propertyChainAxiom>
        <owl:propertyChainAxiom rdf:parseType="Collection">
            <rdf:Description rdf:about="&tabinfluencingfactor;isAssertedIntensivePhaseFactorBy"/>
        </owl:propertyChainAxiom>
        <owl:propertyChainAxiom rdf:parseType="Collection">
            <rdf:Description rdf:about="&tabinfluencingfactor;isAssertedContinuationPhaseFactorBy"/>
        </owl:propertyChainAxiom>
        <owl:propertyChainAxiom rdf:parseType="Collection">
            <rdf:Description rdf:about="&tabinfluencingfactor;assertsIntensivePhaseFactor"/>
        </owl:propertyChainAxiom>
        <owl:propertyChainAxiom rdf:parseType="Collection">
            <rdf:Description rdf:about="&tabinfluencingfactor;assertsContinuationPhaseFactor"/>
        </owl:propertyChainAxiom>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#typeOfEffect -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;typeOfEffect">
        <ace_lexicon:TV_pl>assertsInfFactorType</ace_lexicon:TV_pl>
        <ace_lexicon:TV_vbg>assertsInfFactorTyped</ace_lexicon:TV_vbg>
        <ace_lexicon:TV_sg>assertsInfFactorTypes</ace_lexicon:TV_sg>
        <rdfs:comment>ASSERTS INFluencing FACTOR TYPE implies that the Evidence asserts the influencing factor to
be of a particular type based on its influence on  treatment adherence behaviour in tuberculosis patients</rdfs:comment>
        <rdfs:subPropertyOf rdf:resource="&owl;topObjectProperty"/>
        <owl:propertyChainAxiom rdf:parseType="Collection">
            <rdf:Description rdf:about="&tabinfluencingfactor;isAssertedNegativeInfluenceFactorBy"/>
        </owl:propertyChainAxiom>
        <owl:propertyChainAxiom rdf:parseType="Collection">
            <rdf:Description rdf:about="&tabinfluencingfactor;isAssertedNeutralInfluenceFactorBy"/>
        </owl:propertyChainAxiom>
        <owl:propertyChainAxiom rdf:parseType="Collection">
            <rdf:Description rdf:about="&tabinfluencingfactor;isAssertedPositiveInfluenceFactorBy"/>
        </owl:propertyChainAxiom>
    </owl:ObjectProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#assertsInterdependency -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;assertsInterdependency"/>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasDependentFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasDependentFactor"/>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasIndependentFactor -->
    <owl:ObjectProperty rdf:about="&tabinfluencingfactor;hasIndependentFactor"/>

    <!--
     ///////////////////////////////////////////////////////////////////////////////////
     //
     // Data properties
     //
     ///////////////////////////////////////////////////////////////////////////////////
      -->

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasArea -->
    <owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasArea">
        <rdfs:domain rdf:resource="&tabinfluencingfactor;Place"/>
        <rdfs:range rdf:resource="&xsd;double"/>
    </owl:DatatypeProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasGDP -->
    <owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasGDP">
        <rdfs:domain rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
        <rdfs:range rdf:resource="&xsd;integer"/>
    </owl:DatatypeProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasHIVPrevalenceRate -->
    <owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasHIVPrevalenceRate">
        <rdfs:domain rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
        <rdfs:range rdf:resource="&xsd;double"/>
    </owl:DatatypeProperty>

    <!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasPopDensity -->
    <owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasPopDensity">
        <rdfs:domain rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    </owl:DatatypeProperty>
```

```
<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasPopulation -->
<owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasPopulation">
   <rdfs:domain rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <rdfs:range rdf:resource="&xsd;integer"/>
</owl:DatatypeProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasProbValue -->
<owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasProbValue">
   <rdfs:domain rdf:resource="&tabinfluencingfactor;ProbabilityObject"/>
   <rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasSampleSize -->
<owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasSampleSize">
   <rdfs:domain rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <rdfs:range rdf:resource="&xsd;integer"/>
</owl:DatatypeProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasTBPrevalenceRate -->
<owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasTBPrevalenceRate">
   <rdfs:domain rdf:resource="&tabinfluencingfactor;Place"/>
   <rdfs:range rdf:resource="&xsd;double"/>
</owl:DatatypeProperty>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#hasYear -->
<owl:DatatypeProperty rdf:about="&tabinfluencingfactor;hasYear">
   <ace_lexicon:TV_sg>hasYears</ace_lexicon:TV_sg>
   <ace_lexicon:TV_pl>hasYear</ace_lexicon:TV_pl>
   <ace_lexicon:TV_vbg>hasYeared</ace_lexicon:TV_vbg>
</owl:DatatypeProperty>

<!--
///////////////////////////////////////////////////////////////////////////////////
//
// Classes
//
///////////////////////////////////////////////////////////////////////////////////
 -->


<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AcademicProceeding -->
<owl:Class rdf:about="&tabinfluencingfactor;AcademicProceeding">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Expression"/>
   <ace_lexicon:CN_pl>AcademicProceedings</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>AcademicProceeding</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AdministrativeArea -->
<owl:Class rdf:about="&tabinfluencingfactor;AdministrativeArea">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Place"/>
   <ace_lexicon:CN_sg>AdministrativeArea</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>AdministrativeAreas</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AdverseEffect -->
<owl:Class rdf:about="&tabinfluencingfactor;AdverseEffect">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;MedicationRelatedFactor"/>
   <ace_lexicon:CN_sg>AdverseEffect</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>AdverseEffects</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AgeGroup -->
<owl:Class rdf:about="&tabinfluencingfactor;AgeGroup">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;DemographicRelatedFactor"/>
   <ace_lexicon:CN_pl>AgeGroups</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>AgeGroup</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Agent -->
<owl:Class rdf:about="&tabinfluencingfactor;Agent">
   <ace_lexicon:CN_sg>Agent</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Agents</ace_lexicon:CN_pl>
```

```
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlcoholConsumption -->
<owl:Class rdf:about="&tabinfluencingfactor;AlcoholConsumption">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;SubstanceAbuseFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlternativeTreatment -->
<owl:Class rdf:about="&tabinfluencingfactor;AlternativeTreatment">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TreamentHistoryFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Article -->
<owl:Class rdf:about="&tabinfluencingfactor;Article">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Expression"/>
   <ace_lexicon:CN_pl>Articles</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>Article</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Author -->
<owl:Class rdf:about="&tabinfluencingfactor;Author">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Agent"/>
   <ace_lexicon:CN_sg>Author</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Authors</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BasicAmenityFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;BasicAmenityFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;EconomicFactor"/>
   <ace_lexicon:CN_pl>BasicAmenities</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>BasicAmenity</ace_lexicon:CN_sg>
</owl:Class>



<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BayesianNetwork -->
<owl:Class rdf:about="&tabinfluencingfactor;BayesianNetwork"/>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BeliefRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;BeliefRelatedFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;SocialFactor"/>
   <ace_lexicon:CN_sg>Belief</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Beliefs</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BodyOfWater -->
<owl:Class rdf:about="&tabinfluencingfactor;BodyOfWater">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;GeographicFeatures"/>
   <ace_lexicon:CN_pl>BodyOfWaters</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>BodyOfWater</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CaregiverCommunication -->
<owl:Class rdf:about="&tabinfluencingfactor;CaregiverCommunication">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthCaregiverRelatedFactor"/>
   <ace_lexicon:CN_pl>CareGiverCommunications</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>CareGiverCommunication</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CaregiverFriendliness -->
<owl:Class rdf:about="&tabinfluencingfactor;CaregiverFriendliness">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthCaregiverRelatedFactor"/>
   <ace_lexicon:CN_sg>CareGiverFriendliness</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>CareGiverFriendlinesses</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#City -->
<owl:Class rdf:about="&tabinfluencingfactor;City">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;SettlementArea"/>
   <ace_lexicon:CN_sg>City</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Cities</ace_lexicon:CN_pl>
</owl:Class>
```

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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ClinicalHour -->
<owl:Class rdf:about="&tabinfluencingfactor;ClinicalHour">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthFacilityRelatedFactor"/>
    <ace_lexicon:CN_pl>ClinicalHours</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>ClinicalHour</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ClinicalStudyEvidence -->
<owl:Class rdf:about="&tabinfluencingfactor;ClinicalStudyEvidence">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ExperimentalEvidence"/>
    <ace_lexicon:CN_sg>Study</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Studies</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CoMobidityFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;CoMobidityFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TherapyRelatedFactor"/>
    <ace_lexicon:CN_pl>CoMobidities</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>CoMobidity</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Condition -->
<owl:Class rdf:about="&tabinfluencingfactor;Condition"/>



<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ConditionProbability -->
<owl:Class rdf:about="&tabinfluencingfactor;ConditionProbability">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ProbabilityObject"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ConferencePaper -->
<owl:Class rdf:about="&tabinfluencingfactor;ConferencePaper">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Expression"/>
    <ace_lexicon:CN_sg>ConferencePaper</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>ConferencePapers</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ConferenceProceeding -->
<owl:Class rdf:about="&tabinfluencingfactor;ConferenceProceeding">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;AcademicProceeding"/>
    <ace_lexicon:CN_pl>ConferenceProceedings</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>ConferenceProceeding</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DefaultingHistory -->
<owl:Class rdf:about="&tabinfluencingfactor;DefaultingHistory">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TreamentHistoryFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DemographicRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;DemographicRelatedFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;PatientCentredFactor"/>
    <ace_lexicon:CN_pl>Demographics</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Demographic</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Depression -->
<owl:Class rdf:about="&tabinfluencingfactor;Depression">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;PsychologicalFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Diet -->
<owl:Class rdf:about="&tabinfluencingfactor;Diet">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthyLivingFactor"/>
    <ace_lexicon:CN_pl>Diets</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Diet</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DistanceToHealthFacility -->
<owl:Class rdf:about="&tabinfluencingfactor;DistanceToHealthFacility">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;LocationRelatedFactor"/>
    <ace_lexicon:CN_pl>DistanceToHealthFacilities</ace_lexicon:CN_pl>
```

```
    <ace_lexicon:CN_sg>DistanceToHealthFacility</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DrugAvailability -->
<owl:Class rdf:about="&tabinfluencingfactor;DrugAvailability">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthFacilityRelatedFactor"/>
    <ace_lexicon:CN_sg>DrugAvailability</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>DrugAvailabilities</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DwellingRegion -->
<owl:Class rdf:about="&tabinfluencingfactor;DwellingRegion">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;LocationRelatedFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EconomicFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;EconomicFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
    <ace_lexicon:CN_pl>Economics</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Economic</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Emotion -->
<owl:Class rdf:about="&tabinfluencingfactor;Emotion">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;PsychologicalFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EmploymentFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;EmploymentFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;EconomicFactor"/>
    <ace_lexicon:CN_pl>Employments</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Employment</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EmploymentStatus -->
<owl:Class rdf:about="&tabinfluencingfactor;EmploymentStatus">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;EmploymentFactor"/>
    <ace_lexicon:CN_pl>EmploymentStatuses</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>EmploymentStatus</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Evidence -->
<owl:Class rdf:about="&tabinfluencingfactor;Evidence">
    <ace_lexicon:CN_sg>Evidence</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Evidences</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Exercise -->
<owl:Class rdf:about="&tabinfluencingfactor;Exercise">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthyLivingFactor"/>
    <ace_lexicon:CN_sg>Exercise</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Exercises</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ExperienceStigma -->
<owl:Class rdf:about="&tabinfluencingfactor;ExperienceStigma">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Stigmatisation"/>
    <ace_lexicon:CN_pl>ExperienceStigmas</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>ExperienceStigma</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ExperimentalEvidence -->
<owl:Class rdf:about="&tabinfluencingfactor;ExperimentalEvidence">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Evidence"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Expression -->
<owl:Class rdf:about="&tabinfluencingfactor;Expression">
    <ace_lexicon:CN_sg>Expression</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Expressions</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FamilySupport -->
```

```
<owl:Class rdf:about="&tabinfluencingfactor;FamilySupport">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;SocialNetworkFactor"/>
   <ace_lexicon:CN_pl>FamilySupports</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>FamilySupport</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FeelingClinicallyBetter -->
<owl:Class rdf:about="&tabinfluencingfactor;FeelingClinicallyBetter">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;BeliefRelatedFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FoodAvailability -->
<owl:Class rdf:about="&tabinfluencingfactor;FoodAvailability">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;BasicAmenityFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Gender -->
<owl:Class rdf:about="&tabinfluencingfactor;Gender">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;DemographicRelatedFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GeographicAccessFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;GeographicAccessFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
   <ace_lexicon:CN_pl>GeographicAccesses</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>GeographicAccess</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GeographicFeatures -->
<owl:Class rdf:about="&tabinfluencingfactor;GeographicFeatures">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Place"/>
   <ace_lexicon:CN_sg>GeographicFeatures</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>GeographicFeatureses</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HIV-ART -->
<owl:Class rdf:about="&tabinfluencingfactor;HIV-ART">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;CoMobidityFactor"/>
   <ace_lexicon:CN_sg>HIV-ART</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>HIV-ARTs</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HealthCaregiverRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;HealthCaregiverRelatedFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthSystemFactor"/>
   <ace_lexicon:CN_sg>HealthCareGiver</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>HealthCareGivers</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HealthFacilityRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;HealthFacilityRelatedFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;HealthSystemFactor"/>
   <ace_lexicon:CN_sg>HealthFacility</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>HealthFacilities</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HealthSystemFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;HealthSystemFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
   <ace_lexicon:CN_pl>HealthSystems</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>HealthSystem</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HealthyLivingFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;HealthyLivingFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;LifestyleRelatedFactor"/>
   <ace_lexicon:CN_sg>HealthyLiving</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>HealthyLivings</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Homelessness -->
<owl:Class rdf:about="&tabinfluencingfactor;Homelessness">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;BasicAmenityFactor"/>
```

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    <ace_lexicon:CN_sg>Homelessness</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Homelessnesses</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ISO3166-Continent -->
<owl:Class rdf:about="&tabinfluencingfactor;ISO3166-Continent">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ISOAdminCode"/>
    <ace_lexicon:CN_pl>ISO3166-Continents</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>ISO3166-Continent</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ISO3166-Country -->
<owl:Class rdf:about="&tabinfluencingfactor;ISO3166-Country">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ISOAdminCode"/>
    <ace_lexicon:CN_sg>ISO3166-Country</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>ISO3166-Countries</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ISO3166-PrimarySubdivision -->
<owl:Class rdf:about="&tabinfluencingfactor;ISO3166-PrimarySubdivision">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ISOAdminCode"/>
    <ace_lexicon:CN_pl>ISO3166-PrimarySubdivisions</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>ISO3166-PrimarySubdivision</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ISO3166-SecondarySubdivision -->
<owl:Class rdf:about="&tabinfluencingfactor;ISO3166-SecondarySubdivision">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ISOAdminCode"/>
    <ace_lexicon:CN_pl>ISO3166-SecondarySubdivisions</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>ISO3166-SecondarySubdivision</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ISOAdminCode -->
<owl:Class rdf:about="&tabinfluencingfactor;ISOAdminCode">
    <ace_lexicon:CN_sg>ISOAdminCode</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>ISOAdminCodes</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IllnessHistory -->
<owl:Class rdf:about="&tabinfluencingfactor;IllnessHistory">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TreamentHistoryFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IncentiveExpectation -->
<owl:Class rdf:about="&tabinfluencingfactor;IncentiveExpectation">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;BeliefRelatedFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IncomeClass -->
<owl:Class rdf:about="&tabinfluencingfactor;IncomeClass">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;StandardOfLivingFactor"/>
    <ace_lexicon:CN_sg>IncomeClass</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>IncomeClasses</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#JobType -->
<owl:Class rdf:about="&tabinfluencingfactor;JobType">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;EmploymentFactor"/>
    <ace_lexicon:CN_sg>JobType</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>JobTypes</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KnowledgeRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;KnowledgeRelatedFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;PatientCentredFactor"/>
    <ace_lexicon:CN_pl>Knowledges</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Knowledge</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LifestyleRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;LifestyleRelatedFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
    <ace_lexicon:CN_sg>Lifestyle</ace_lexicon:CN_sg>
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    <ace_lexicon:CN_pl>Lifestyles</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Literacy -->
<owl:Class rdf:about="&tabinfluencingfactor;Literacy">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;KnowledgeRelatedFactor"/>
    <ace_lexicon:CN_pl>Literacies</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Literacy</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LocationRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;LocationRelatedFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;GeographicAccessFactor"/>
    <ace_lexicon:CN_pl>Locations</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Location</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MaritalStatus -->
<owl:Class rdf:about="&tabinfluencingfactor;MaritalStatus">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;DemographicRelatedFactor"/>
    <ace_lexicon:CN_sg>MaritalStatus</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>MaritalStatuses</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MedicationRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;MedicationRelatedFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TherapyRelatedFactor"/>
    <ace_lexicon:CN_pl>TherapyRelateds</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>TherapyRelated</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Ocean -->
<owl:Class rdf:about="&tabinfluencingfactor;Ocean">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;BodyOfWater"/>
    <ace_lexicon:CN_sg>Ocean</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Oceans</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PatientCentredFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;PatientCentredFactor">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
    <ace_lexicon:CN_sg>PatientCentred</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>PatientCentreds</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PercievedStigma -->
<owl:Class rdf:about="&tabinfluencingfactor;PercievedStigma">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Stigmatisation"/>
    <ace_lexicon:CN_sg>PercievedStigma</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>PercievedStigmas</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Personal_Attitude -->
<owl:Class rdf:about="&tabinfluencingfactor;Personal_Attitude">
    <owl:equivalentClass>
        <owl:Class>
            <owl:unionOf rdf:parseType="Collection">
                <rdf:Description rdf:about="&tabinfluencingfactor;AlcoholConsumption"/>
                <rdf:Description rdf:about="&tabinfluencingfactor;Depression"/>
                <rdf:Description rdf:about="&tabinfluencingfactor;Emotion"/>
                <rdf:Description rdf:about="&tabinfluencingfactor;Gender"/>
                <rdf:Description rdf:about="&tabinfluencingfactor;TobaccoUse"/>
            </owl:unionOf>
        </owl:Class>
    </owl:equivalentClass>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PhysicalInteractionEvidence -->
<owl:Class rdf:about="&tabinfluencingfactor;PhysicalInteractionEvidence">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ExperimentalEvidence"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Place -->
```

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<owl:Class rdf:about="&tabinfluencingfactor;Place">
   <ace_lexicon:CN_pl>Places</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>Place</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PovertyLevel -->
<owl:Class rdf:about="&tabinfluencingfactor;PovertyLevel">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;StandardOfLivingFactor"/>
   <ace_lexicon:CN_pl>PovertyLevels</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>PovertyLevel</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PriorProbability -->
<owl:Class rdf:about="&tabinfluencingfactor;PriorProbability">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;ProbabilityObject"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ProbabilityObject -->
<owl:Class rdf:about="&tabinfluencingfactor;ProbabilityObject"/>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PsychiatricCondition -->
<owl:Class rdf:about="&tabinfluencingfactor;PsychiatricCondition">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;PsychologicalFactor"/>
   <ace_lexicon:CN_pl>PsychiatricConditions</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>PsychiatricCondition</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PsychologicalFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;PsychologicalFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;PatientCentredFactor"/>
   <ace_lexicon:CN_sg>Psychological</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Psychologicals</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Publisher -->
<owl:Class rdf:about="&tabinfluencingfactor;Publisher">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Agent"/>
   <ace_lexicon:CN_sg>Publisher</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Publishers</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SettlementArea -->
<owl:Class rdf:about="&tabinfluencingfactor;SettlementArea">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;Place"/>
   <ace_lexicon:CN_sg>SettlementArea</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>SettlementAreas</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SocialFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;SocialFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
   <ace_lexicon:CN_pl>Socials</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>Social</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SocialNetworkFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;SocialNetworkFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;SocialFactor"/>
   <ace_lexicon:CN_sg>SocialNetwork</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>SocialNetworks</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#StandardOfLivingFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;StandardOfLivingFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;EconomicFactor"/>
   <ace_lexicon:CN_pl>StandardOfLivings</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>StandardOfLiving</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#State -->
<owl:Class rdf:about="&tabinfluencingfactor;State"/>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Stigmatisation -->
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<owl:Class rdf:about="&tabinfluencingfactor;Stigmatisation">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;SocialFactor"/>
   <ace_lexicon:CN_pl>Stigmas</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>Stigma</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SubstanceAbuseFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;SubstanceAbuseFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;LifestyleRelatedFactor"/>
   <ace_lexicon:CN_pl>SubstanceAbuses</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>SubstanceAbuse</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SymptomsReport -->
<owl:Class rdf:about="&tabinfluencingfactor;SymptomsReport">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;MedicationRelatedFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TABInfluencingFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;TABInfluencingFactor">
   <ace_lexicon:CN_sg>TABInfluencingFactor</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>TABInfluencingFactors</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TBKnowledge -->
<owl:Class rdf:about="&tabinfluencingfactor;TBKnowledge">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;KnowledgeRelatedFactor"/>
   <ace_lexicon:CN_sg>TBKnowledge</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>TBKnowledges</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TherapyRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;TherapyRelatedFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TABInfluencingFactor"/>
   <ace_lexicon:CN_sg>Clinical</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Clinicals</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TobaccoUse -->
<owl:Class rdf:about="&tabinfluencingfactor;TobaccoUse">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;SubstanceAbuseFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TransportCost -->
<owl:Class rdf:about="&tabinfluencingfactor;TransportCost">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TransportationRelatedFactor"/>
   <ace_lexicon:CN_pl>TransportCosts</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>TransportCost</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TransportationRelatedFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;TransportationRelatedFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;GeographicAccessFactor"/>
   <ace_lexicon:CN_sg>Transportation</ace_lexicon:CN_sg>
   <ace_lexicon:CN_pl>Transportations</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TravelTime -->
<owl:Class rdf:about="&tabinfluencingfactor;TravelTime">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TransportationRelatedFactor"/>
   <ace_lexicon:CN_pl>TravelTimets</ace_lexicon:CN_pl>
   <ace_lexicon:CN_sg>TravelTimet</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TreamentHistoryFactor -->
<owl:Class rdf:about="&tabinfluencingfactor;TreamentHistoryFactor">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;TherapyRelatedFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TreatmentEfficacy -->
<owl:Class rdf:about="&tabinfluencingfactor;TreatmentEfficacy">
   <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;BeliefRelatedFactor"/>
   <ace_lexicon:CN_pl>TreatmentEfficacies</ace_lexicon:CN_pl>
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    <ace_lexicon:CN_sg>TreatmentEfficacy</ace_lexicon:CN_sg>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Variable -->
<owl:Class rdf:about="&tabinfluencingfactor;Variable"/>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Work -->
<owl:Class rdf:about="&tabinfluencingfactor;Work">
    <ace_lexicon:CN_sg>Work</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Works</ace_lexicon:CN_pl>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WorkingCondition -->
<owl:Class rdf:about="&tabinfluencingfactor;WorkingCondition">
    <rdfs:subClassOf rdf:resource="&tabinfluencingfactor;EmploymentFactor"/>
</owl:Class>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Interdependency -->
<owl:Class rdf:about="&tabinfluencingfactor;Interdependency"/>

<!--
///////////////////////////////////////////////////////////////////////////////////
//
// Individuals
//
///////////////////////////////////////////////////////////////////////////////////
 -->

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AF -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AF">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Continent"/>
    <ace_lexicon:PN_sg>AF</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AN">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Continent"/>
    <ace_lexicon:PN_sg>AN</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AS">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Continent"/>
    <ace_lexicon:PN_sg>AS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AU -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AU">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Continent"/>
    <ace_lexicon:PN_sg>AU</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AbujaFCT.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AbujaFCT.ng">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>AbujaFCT.ng</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-FC"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Acre.br -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Acre.br">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Acre.br</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BR-AC"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Brazil"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Adamaoua.cm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Adamaoua.cm">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Adamaoua.cm</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;CM-AD"/>
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    <hasParent rdf:resource="&tabinfluencingfactor;Cameroun"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AddisAbaba.et -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AddisAbaba.et">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>AddisAbaba.et</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ET-AA"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Ethiopia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Adygey.ru -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Adygey.ru">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Adygey.ru</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;RU-AD"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Russia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Afar.et -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Afar.et">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Afar.et</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ET-AF"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Ethiopia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Africa -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Africa">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Africa</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;AF"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Ain.fr -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Ain.fr">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Ain.fr</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;FR-AI"/>
    <hasParent rdf:resource="&tabinfluencingfactor;France"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Aisne.fr -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Aisne.fr">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Aisne.fr</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;FR-AS"/>
    <hasParent rdf:resource="&tabinfluencingfactor;France"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Al-Iskandariyah.eg -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Al-Iskandariyah.eg">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Al-Iskandariyah.eg</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;EG-AL"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Egypt"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Al-Jizah.eg -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Al-Jizah.eg">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Al-Jizah.eg</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;EG-JZ"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Egypt"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlC_AA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlC_AA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.6</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
</owl:NamedIndividual>
```

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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlC_NA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlC_NA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.4</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlcoholAbuse -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlcoholAbuse">
    <rdf:type rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <ace_lexicon:PN_sg>AA-True</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BurkinaFasoStudy"/>
    <isAssertedContinuationPhaseFactorBy rdf:resource="&tabinfluencingfactor;MumbaiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RectifeStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RussiaRegionStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy2"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlcoholConsumption -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlcoholConsumption">
    <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Alexandria.eg -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Alexandria.eg">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Alexandria.eg</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Egypt"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlexandriaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlexandriaStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2013</hasYear>
    <ace_lexicon:PN_sg>AlexandriaStudy</ace_lexicon:PN_sg>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Al-Iskandariyah.eg"/>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;El-Din2013"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Algeria -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Algeria">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Algeria</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlternativeTreatmentUsage -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlternativeTreatmentUsage">
    <rdf:type rdf:resource="&tabinfluencingfactor;AlternativeTreatment"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AmnatCharoen.th -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AmnatCharoen.th">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>AmnatCharoen.th</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;TH-AC"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Thailand"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#An-Giang.vn -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;An-Giang.vn">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>An-Giang.vn</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;VN-AG"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Vietnam"/>
</owl:NamedIndividual>
```

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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Andara.na -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Andara.na">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Andara.na</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Namibia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AndaraStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AndaraStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2010</hasYear>
   <ace_lexicon:PN_sg>AndaraStudy</ace_lexicon:PN_sg>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Andara.na"/>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Chani2010"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Antananarivo.md -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Antananarivo.md">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Antananarivo.md</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MD-AV"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Madagasca"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Antartica -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Antartica">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Antartica</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;AN"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Antoine2009 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Antoine2009">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Antoine2009</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ArssiZone.et -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ArssiZone.et">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>ArssiZone.et</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ET-OR-AR"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Oromia.et"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ArssiZoneStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ArssiZoneStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2002</hasYear>
   <ace_lexicon:PN_sg>ArssiZoneStudy</ace_lexicon:PN_sg>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;ArssiZone.et"/>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Tekle2002"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Arusha.tz -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Arusha.tz">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Arusha.tz</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;TZ-AS"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Tanzania"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Asia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Asia">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Asia</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;AS"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Assam.in -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Assam.in">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
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    <ace_lexicon:PN_sg>Assam.in</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;IN-AS"/>
    <hasParent rdf:resource="&tabinfluencingfactor;India"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Aswan.eg -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Aswan.eg">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Aswan.eg</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;EG-AN"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Egypt"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Australia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Australia">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Australia</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AverageIncome -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AverageIncome">
    <rdf:type rdf:resource="&tabinfluencingfactor;IncomeClass"/>
    <ace_lexicon:PN_sg>AverageIncome</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Aza-Kashmir.pk -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Aza-Kashmir.pk">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Aza-Kashmir.pk</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;PK-JK"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Pakistan"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BEN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BEN">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>BEN</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BF-CT -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BF-CT">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>BF-CT</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BF-ES -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BF-ES">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>BF-ES</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BF-SA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BF-SA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>BF-SA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BF-SO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BF-SO">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>BF-SO</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BFA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BFA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>BFA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BR-AC -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BR-AC">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>BR-AC</ace_lexicon:PN_sg>
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</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BR-PA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BR-PA">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>BR-PA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BR-PE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BR-PE">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>BR-PE</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BR-SP -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BR-SP">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>BR-SP</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BRA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BRA">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>BRA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BWA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BWA">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>BWA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Ba-Can.vn -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Ba-Can.vn">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Ba-Can.vn</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;VN-CM"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Vietnam"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Bagchi2010 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Bagchi2010">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Bagchi2010</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Bam2006 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Bam2006">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Bam2006</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BangkokMetropolis.th -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BangkokMetropolis.th">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>BangkokMetropolis.th</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;TH-BR"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Thailand"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BangkokStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BangkokStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2008</hasYear>
   <ace_lexicon:PN_sg>BangkokStudy</ace_lexicon:PN_sg>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;BangkokMetropolis.th"/>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Okanurak2008"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Banten.id -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Banten.id">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Banten.id</ace_lexicon:PN_sg>
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    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ID-BT"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Indonesia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Baring.ke -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Baring.ke">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Baring.ke</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;KE-BA"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Kenya"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BelieveInTreatmentEfficacy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BelieveInTreatmentEfficacy">
    <rdf:type rdf:resource="&tabinfluencingfactor;TreatmentEfficacy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BeninRepublic -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BeninRepublic">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>BeninRepublic</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BEN"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Botswana -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Botswana">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Botswana</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BWA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Brazil -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Brazil">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Brazil</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BRA"/>
    <hasParent rdf:resource="&tabinfluencingfactor;SouthAmerica"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Bulawayo.zw -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Bulawayo.zw">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Bulawayo.zw</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZW-BU"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Zimbabwe"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BurkinaFaso -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BurkinaFaso">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>BurkinaFaso</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BFA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#BurkinaFasoStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;BurkinaFasoStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2013</hasYear>
    <ace_lexicon:PN_sg>BurkinaFasoStudy</ace_lexicon:PN_sg>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;BurkinaFaso"/>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Meda2013"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CM-AD -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;CM-AD">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>CM-AD</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CM-CE -->
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<owl:NamedIndividual rdf:about="&tabinfluencingfactor;CM-CE">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>CM-CE</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CM-ES -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;CM-ES">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>CM-ES</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CM-SU -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;CM-SU">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>CM-SU</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CMR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;CMR">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>CMR</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#COD -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;COD">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>COD</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Ca-Mau.vn -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Ca-Mau.vn">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Ca-Mau.vn</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;VN-CM"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Vietnam"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Cameroun -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Cameroun">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Cameroun</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;CMR"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Central.cm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Central.cm">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Central.cm</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;CM-CE"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Cameroun"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Central.np -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Central.np">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Central.np</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NP-MM"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nepal"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Central.zm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Central.zm">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Central.zm</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZM-CE"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Zambia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Centre.bf -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Centre.bf">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Centre.bf</ace_lexicon:PN_sg>
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    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BF-CT"/>
    <hasParent rdf:resource="&tabinfluencingfactor;BurkinaFaso"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Chad -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Chad">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Chad</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Chani2010 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Chani2010">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Chani2010</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Chaouia-Ouardigha.ma -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Chaouia-Ouardigha.ma">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Chaouia-Ouardigha.ma</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MA-CO"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Morocco"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Cher.fr -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Cher.fr">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Cher.fr</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;FR-CH"/>
    <hasParent rdf:resource="&tabinfluencingfactor;France"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Comolet1998 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Comolet1998">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Comolet1998</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#CongoDR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;CongoDR">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>CongoDR</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;COD"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Copperbelt.zm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Copperbelt.zm">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Copperbelt.zm</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZM-CO"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Zambia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DZA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;DZA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>DZA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Daniel2006 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Daniel2006">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Daniel2006</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Delhi.in -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Delhi.in">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Delhi.in</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;IN-DL"/>
    <hasParent rdf:resource="&tabinfluencingfactor;India"/>
```

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</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DeltaState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;DeltaState.ng">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>DeltaState.ng</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-DE"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Dep_DE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Dep_DE">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.1</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Dep_ND -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Dep_ND">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.9</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Depression -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Depression">
    <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Depression-False -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Depression-False">
    <rdf:type rdf:resource="&tabinfluencingfactor;Depression"/>
    <ace_lexicon:PN_sg>Depression-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Depression-True -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Depression-True">
    <rdf:type rdf:resource="&tabinfluencingfactor;Depression"/>
    <ace_lexicon:PN_sg>Depression-True</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RussiaRegionStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DrugAdverseEffectExperienced -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;DrugAdverseEffectExperienced">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdverseEffect"/>
    <ace_lexicon:PN_sg>DAE-True</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;ArssiZoneStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NdolaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RectifeStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DrugAdverseEffectNotExperienced -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;DrugAdverseEffectNotExperienced">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdverseEffect"/>
    <ace_lexicon:PN_sg>DAE-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DrugOftenAvailable -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;DrugOftenAvailable">
    <rdf:type rdf:resource="&tabinfluencingfactor;DrugAvailability"/>
    <ace_lexicon:PN_sg>DrugOftenAvailable</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#DrugSledomAvailable -->
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<owl:NamedIndividual rdf:about="&tabinfluencingfactor;DrugSledomAvailable">
   <rdf:type rdf:resource="&tabinfluencingfactor;DrugAvailability"/>
   <ace_lexicon:PN_sg>DrugSledomAvailable</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NdolaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EG-AL -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EG-AL">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>EG-AL</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EG-AN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EG-AN">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>EG-AN</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EG-JZ -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EG-JZ">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>EG-JZ</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EG-QN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EG-QN">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>EG-QN</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EGY -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EGY">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>EGY</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ET-AA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ET-AA">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ET-AA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ET-AF -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ET-AF">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ET-AF</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ET-OR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ET-OR">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ET-OR</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ET-OR-AR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ET-OR-AR">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-SecondarySubdivision"/>
   <ace_lexicon:PN_sg>ET-OR-AR</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ET-SN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ET-SN">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ET-SN</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ET-TI -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ET-TI">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ET-TI</ace_lexicon:PN_sg>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ETH -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ETH">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>ETH</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EU -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EU">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Continent"/>
   <ace_lexicon:PN_sg>EU</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Eastern.np -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Eastern.np">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Eastern.np</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NP-PW"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nepal"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Eastern.zm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Eastern.zm">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Eastern.zm</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZM-ES"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Zambia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EasternCape.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EasternCape.za">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>EasternCape.za</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-EC"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EdoState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EdoState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>EdoState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-ED"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Egypt -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Egypt">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Egypt</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;EGY"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EkitiState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EkitiState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>EkitiState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-EK"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#El-Din2013 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;El-Din2013">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>El-Din2013</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Elderly -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Elderly">
   <rdf:type rdf:resource="&tabinfluencingfactor;AgeGroup"/>
   <ace_lexicon:PN_sg>Elderly</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
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    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TanzaniaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Embu.ke -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Embu.ke">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Embu.ke</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;KE-EB"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Kenya"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Emo_NE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Emo_NE">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.15</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Emo_PO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Emo_PO">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.85</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Emotion -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Emotion">
    <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Employed -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Employed">
    <rdf:type rdf:resource="&tabinfluencingfactor;EmploymentStatus"/>
    <ace_lexicon:PN_sg>Employed</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EnjoysFamilySupport -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EnjoysFamilySupport">
    <rdf:type rdf:resource="&tabinfluencingfactor;FamilySupport"/>
    <ace_lexicon:PN_sg>FS-True</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Erongo.na -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Erongo.na">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Erongo.na</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NA-ER"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Namibia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Est.bf -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Est.bf">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Est.bf</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BF-ES"/>
    <hasParent rdf:resource="&tabinfluencingfactor;BurkinaFaso"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Est.cm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Est.cm">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Est.cm</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;CM-ES"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Cameroun"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Estifanos2007 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Estifanos2007">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
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    <ace_lexicon:PN_sg>Estifanos2007</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Ethiopia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Ethiopia">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Ethiopia</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ETH"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#EthiopiaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;EthiopiaStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2013</hasYear>
    <ace_lexicon:PN_sg>EhtiopiaStudy</ace_lexicon:PN_sg>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Ethiopia"/>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Tadesse2013"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Eure.fr -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Eure.fr">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Eure.fr</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;FR-EU"/>
    <hasParent rdf:resource="&tabinfluencingfactor;France"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Europe -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Europe">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Europe</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;EU"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FR-AI -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FR-AI">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>FR-AI</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FR-AS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FR-AS">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>FR-AS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FR-CH -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FR-CH">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>FR-CH</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FR-EU -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FR-EU">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>FR-EU</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FRA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FRA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>FRA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FarToFacility -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FarToFacility">
    <rdf:type rdf:resource="&tabinfluencingfactor;DistanceToHealthFacility"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AlexandriaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;EthiopiaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MumbaiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
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    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TanzaniaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FarWestern.np -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FarWestern.np">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>FarWestern.np</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NP-SP"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Nepal"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FavourableClinicalHour -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FavourableClinicalHour">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalHour"/>
    <ace_lexicon:PN_sg>FavourableClinicalHour</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FavourableWorkingCondition -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FavourableWorkingCondition">
    <rdf:type rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FeelingClinicallyBetter -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FeelingClinicallyBetter">
    <rdf:type rdf:resource="&tabinfluencingfactor;FeelingClinicallyBetter"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;JavaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MalaysiaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NdolaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy2"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;YaoundeStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Female -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Female">
    <rdf:type rdf:resource="&tabinfluencingfactor;Gender"/>
    <ace_lexicon:PN_sg>Female</ace_lexicon:PN_sg>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;FranceStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MoroccoStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RectifeStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SagamuStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TanzaniaStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#France -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;France">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>France</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Europe"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;FRA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FranceStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FranceStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2009</hasYear>
    <ace_lexicon:PN_sg>FranceStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Antoine2009"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;France"/>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Free-State.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Free-State.za">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Free-State.za</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-FS"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FreeFromSymptoms -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FreeFromSymptoms">
   <rdf:type rdf:resource="&tabinfluencingfactor;SymptomsReport"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MalaysiaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;YaoundeStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#FriendlyStaff -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FriendlyStaff">
   <rdf:type rdf:resource="&tabinfluencingfactor;CaregiverFriendliness"/>
   <ace_lexicon:PN_sg>FriendlyStaff</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CF_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CF_1">
   <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
   <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
   <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
   <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_FA"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CF_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CF_2">
   <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
   <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
   <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_UF"/>
   <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CM_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CM_1">
   <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
   <hasProbValue rdf:datatype="&xsd;double">0.3</hasProbValue>
   <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
   <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_FA"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CM_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CM_2">
   <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
   <hasProbValue rdf:datatype="&xsd;double">0.7</hasProbValue>
   <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_UF"/>
   <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_WoC_FA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_WoC_FA">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_WoC_UF -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_WoC_UF">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Gauteng.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Gauteng.za">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Gauteng.za</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-GT"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Gender -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Gender">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;Female"/>
   <hasState rdf:resource="&tabinfluencingfactor;Male"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GoodCommunication -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GoodCommunication">
   <rdf:type rdf:resource="&tabinfluencingfactor;CaregiverCommunication"/>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GoodDiet -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GoodDiet">
   <rdf:type rdf:resource="&tabinfluencingfactor;Diet"/>
   <ace_lexicon:PN_sg>GoodDiet</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Good_TAB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Good_TAB">
   <rdf:type rdf:resource="&tabinfluencingfactor;State"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HIVC-False -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;HIVC-False">
   <rdf:type rdf:resource="&tabinfluencingfactor;HIV-ART"/>
   <ace_lexicon:PN_sg>HIVC-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HIVC-True -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;HIVC-True">
   <rdf:type rdf:resource="&tabinfluencingfactor;HIV-ART"/>
   <ace_lexicon:PN_sg>HIVC-True</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RectifeStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SagamuStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Harare.zw -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Harare.zw">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Harare.zw</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZW-HA"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Zimbabwe"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HighIncome -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;HighIncome">
   <rdf:type rdf:resource="&tabinfluencingfactor;IncomeClass"/>
   <ace_lexicon:PN_sg>HighIncome</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HighPovertyLevel -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;HighPovertyLevel">
   <rdf:type rdf:resource="&tabinfluencingfactor;PovertyLevel"/>
   <ace_lexicon:PN_sg>HighPovertyLevel</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;EthiopiaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;JavaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RussiaRegionStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HighTBKnowledge -->
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<owl:NamedIndividual rdf:about="&tabinfluencingfactor;HighTBKnowledge">
    <rdf:type rdf:resource="&tabinfluencingfactor;TBKnowledge"/>
    <ace_lexicon:PN_sg>HighTBKnowledge</ace_lexicon:PN_sg>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;ArssiZoneStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BurkinaFasoStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HighTransportCost -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;HighTransportCost">
    <rdf:type rdf:resource="&tabinfluencingfactor;TransportCost"/>
    <ace_lexicon:PN_sg>HighTransportCost</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MalaysiaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MumbaiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#HighTravelTime -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;HighTravelTime">
    <rdf:type rdf:resource="&tabinfluencingfactor;TravelTime"/>
    <ace_lexicon:PN_sg>HighTravelTime</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MalaysiaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MumbaiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Homeless-False -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Homeless-False">
    <rdf:type rdf:resource="&tabinfluencingfactor;Homelessness"/>
    <ace_lexicon:PN_sg>Homeless-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Homeless-True -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Homeless-True">
    <rdf:type rdf:resource="&tabinfluencingfactor;Homelessness"/>
    <ace_lexicon:PN_sg>Homeless-True</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RussiaRegionStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ID-BT -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ID-BT">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>ID-BT</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ID-JI -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ID-JI">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>ID-JI</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ID-JK -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ID-JK">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>ID-JK</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ID-JR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ID-JR">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>ID-JR</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ID-JT -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ID-JT">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
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    <ace_lexicon:PN_sg>ID-JT</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ID-YO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ID-YO">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>ID-YO</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IDN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;IDN">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>IDN</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IN-AS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;IN-AS">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>IN-AS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IN-DL -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;IN-DL">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>IN-DL</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IN-MH -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;IN-MH">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>IN-MH</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IN-PB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;IN-PB">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>IN-PB</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IND -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;IND">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>IND</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#IbadanNorthLAG.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;IbadanNorthLAG.ng">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>IbadanNorthLAG.ng</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;OyoState.ng"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Ibuquerque2007 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Ibuquerque2007">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Ibuquerque2007</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Illiterate -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Illiterate">
    <rdf:type rdf:resource="&tabinfluencingfactor;Literacy"/>
    <ace_lexicon:PN_sg>Illiterate</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#InceptiveExpected -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;InceptiveExpected">
    <rdf:type rdf:resource="&tabinfluencingfactor;IncentiveExpectation"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy"/>
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</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#India -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;India">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>India</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Asia"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;IND"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Indonesia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Indonesia">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Indonesia</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Asia"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;IDN"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Iringa.tz -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Iringa.tz">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Iringa.tz</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;TZ-IG"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Tanzania"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Islamabad.pk -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Islamabad.pk">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Islamabad.pk</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;PK-IS"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Pakistan"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Jakubowiak2008 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Jakubowiak2008">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Jakubowiak2008</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Jarkata-Rama.id -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Jarkata-Rama.id">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Jarkata-Rama.id</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ID-JR"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Indonesia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#JavaRegion.id -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;JavaRegion.id">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>JavaRegion.id</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Indonesia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#JavaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;JavaStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2009</hasYear>
   <ace_lexicon:PN_sg>JavaStudy</ace_lexicon:PN_sg>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Jawa-Barat.id"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Jawa-Tenga.id"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Jawa-Timur.id"/>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Widhanarko2009"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Jawa-Barat.id -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Jawa-Barat.id">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Jawa-Barat.id</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ID-JR"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Indonesia"/>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Jawa-Tenga.id -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Jawa-Tenga.id">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Jawa-Tenga.id</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ID-JT"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Indonesia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Jawa-Timur.id -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Jawa-Timur.id">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Jawa-Timur.id</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ID-JI"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Indonesia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Johansson1999 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Johansson1999">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Johansson1999</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Johor.my -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Johor.my">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Johor.my</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MY-JH"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Malaysia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KE-BA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KE-BA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>KE-BA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KE-EB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KE-EB">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>KE-EB</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KE-KT -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KE-KT">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>KE-KT</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KE-NB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KE-NB">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>KE-NB</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KEN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KEN">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>KEN</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Kaona2004 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Kaona2004">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Kaona2004</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Kathmandu.np -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Kathmandu.np">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Kathmandu.np</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Nepal"/>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KathmanduStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KathmanduStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2006</hasYear>
    <ace_lexicon:PN_sg>KathmanduStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Bam2006"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Kathmandu.np"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KavangoEast.na -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KavangoEast.na">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>KavangoEast.na</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NA-KE"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Namibia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KavangoRegion -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KavangoRegion">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>KavangoRegion</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Namibia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KavangoWest.na -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KavangoWest.na">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>KavangoWest.na</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NA-KW"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Namibia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Kedar.my -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Kedar.my">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Kedar.my</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MY-KH"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Malaysia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Kenya -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Kenya">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Kenya</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;KEN"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Kitui.ke -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Kitui.ke">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Kitui.ke</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;KE-KT"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Kenya"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KogiState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KogiState.ng">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>KogiState.ng</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-KG"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KwaZuluNatal.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KwaZuluNatal.za">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>KwaZuluNatal.za</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-NL"/>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#KwaraState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;KwaraState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>KwaraState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-KW"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LSO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LSO">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>LSO</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LackOfFamilySupport -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LackOfFamilySupport">
   <rdf:type rdf:resource="&tabinfluencingfactor;FamilySupport"/>
   <ace_lexicon:PN_sg>FS-False</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;ArssiZoneStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;JavaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LackOfFood -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LackOfFood">
   <rdf:type rdf:resource="&tabinfluencingfactor;FoodAvailability"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LackOfTreatmentEfficacyBelief -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LackOfTreatmentEfficacyBelief">
   <rdf:type rdf:resource="&tabinfluencingfactor;TreatmentEfficacy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LagosState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LagosState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>LagosState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-LA"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Lesotho -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Lesotho">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Lesotho</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;LSO"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Liefooghe2001 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Liefooghe2001">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Liefooghe2001</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Limpopo.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Limpopo.za">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Limpopo.za</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-LP"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Literate -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Literate">
   <rdf:type rdf:resource="&tabinfluencingfactor;Literacy"/>
   <ace_lexicon:PN_sg>Literate</ace_lexicon:PN_sg>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LowIncome -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LowIncome">
   <rdf:type rdf:resource="&tabinfluencingfactor;IncomeClass"/>
   <ace_lexicon:PN_sg>LowIncome</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;EthiopiaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;JavaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VladimirStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LowPovertyLevel -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LowPovertyLevel">
   <rdf:type rdf:resource="&tabinfluencingfactor;PovertyLevel"/>
   <ace_lexicon:PN_sg>LowPovertyLevel</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LowTBKnowledge -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LowTBKnowledge">
   <rdf:type rdf:resource="&tabinfluencingfactor;TBKnowledge"/>
   <ace_lexicon:PN_sg>LowTBKnowledge</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;ArssiZoneStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BurkinaFasoStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MalaysiaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NdolaStudy"/>
   <isAssertedContinuationPhaseFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LowTransportCost -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LowTransportCost">
   <rdf:type rdf:resource="&tabinfluencingfactor;TransportCost"/>
   <ace_lexicon:PN_sg>LowTransportCost</ace_lexicon:PN_sg>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#LowTravelTime -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;LowTravelTime">
   <rdf:type rdf:resource="&tabinfluencingfactor;TravelTime"/>
   <ace_lexicon:PN_sg>LowTravelTime</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MA-CO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MA-CO">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>MA-CO</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MA-OR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MA-OR">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>MA-OR</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MA-TD -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MA-TD">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>MA-TD</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MAR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MAR">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>MAR</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MD-AV -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MD-AV">
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    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>MD-AV</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MD-TL -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MD-TL">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>MD-TL</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MD-TM -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MD-TM">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>MD-TM</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MDG -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MDG">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>MDG</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MOZ -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MOZ">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>MOZ</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MY-JH -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MY-JH">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>MY-JH</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MY-KH -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MY-KH">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>MY-KH</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MY-PH -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MY-PH">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>MY-PH</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MY-SA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MY-SA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>MY-SA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MYS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MYS">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>MYS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Madagasca -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Madagasca">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Madagasca</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MDG"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Maharashtra.in -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Maharashtra.in">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Maharashtra.in</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;IN-MH"/>
    <hasParent rdf:resource="&tabinfluencingfactor;India"/>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Malaysia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Malaysia">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Malaysia</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Asia"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MYS"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MalaysiaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MalaysiaStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2002</hasYear>
    <ace_lexicon:PN_sg>MalaysiaStudy</ace_lexicon:PN_sg>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Malaysia"/>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;OBoyle2002"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Male -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Male">
    <rdf:type rdf:resource="&tabinfluencingfactor;Gender"/>
    <ace_lexicon:PN_sg>Male</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;FranceStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MoroccoStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RectifeStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SagamuStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;Study001"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TanzaniaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Married -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Married">
    <rdf:type rdf:resource="&tabinfluencingfactor;MaritalStatus"/>
    <ace_lexicon:PN_sg>Married</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#McLnerney2007 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;McLnerney2007">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>McLnerney2007</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Meda2013 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Meda2013">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Meda2013</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MediumPovertyLevel -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MediumPovertyLevel">
    <rdf:type rdf:resource="&tabinfluencingfactor;PovertyLevel"/>
    <ace_lexicon:PN_sg>MediumPovertyLevel</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;JavaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RussiaRegionStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MidWestern.np -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MidWestern.np">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>MidWestern.np</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NP-MP"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Nepal"/>
</owl:NamedIndividual>
```

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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MiddleAge -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MiddleAge">
   <rdf:type rdf:resource="&tabinfluencingfactor;AgeGroup"/>
   <ace_lexicon:PN_sg>MiddleAge</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TanzaniaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Mishra2006 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Mishra2006">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Mishra2006</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Mkopi2012 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Mkopi2012">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Mkopi2012</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Morocco -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Morocco">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Morocco</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MAR"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MoroccoStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MoroccoStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2013</hasYear>
   <ace_lexicon:PN_sg>MoroccoStudy</ace_lexicon:PN_sg>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Morocco"/>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Tachfouti2013"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Mozambique -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Mozambique">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Mozambique</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MOZ"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Mpumalanga.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Mpumalanga.za">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Mpumalanga.za</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-MP"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Mumbai.in -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Mumbai.in">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Mumbai.in</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;India"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#MumbaiStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;MumbaiStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2010</hasYear>
   <ace_lexicon:PN_sg>MumbaiStudy</ace_lexicon:PN_sg>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Bagchi2010"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Mumbai.in"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Muture2011 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Muture2011">
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    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Muture2011</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Continent"/>
    <ace_lexicon:PN_sg>NA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NA-CA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NA-CA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NA-CA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NA-ER -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NA-ER">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NA-ER</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NA-KE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NA-KE">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NA-KE</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NA-KW -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NA-KW">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NA-KW</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NAM -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NAM">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>NAM</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NER -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NER">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>NER</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-DE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-DE">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-DE</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-ED -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-ED">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-ED</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-EK -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-EK">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-EK</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-FC -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-FC">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-FC</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-KG -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-KG">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
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    <ace_lexicon:PN_sg>NG-KG</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-KW -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-KW">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-KW</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-LA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-LA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-LA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WorkingCondition-Gender -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WorkingCondition-Gender">
    <rdf:type rdf:resource="&tabinfluencingfactor;Interdependency"/>
    <hasDependentFactor rdf:resource="&tabinfluencingfactor;Male"/>
    <hasIndependentFactor rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-OD -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-OD">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-OD</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-OG -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-OG">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-OG</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-OS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-OS">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-OS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NG-OY -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NG-OY">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NG-OY</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NGA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NGA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>NGA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NP-MM -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NP-MM">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NP-MM</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NP-MP -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NP-MP">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NP-MP</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NP-PM -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NP-PM">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NP-PM</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NP-PW -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NP-PW">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
```

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    <ace_lexicon:PN_sg>NP-PW</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NP-SP -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NP-SP">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>NP-SP</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NPL -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NPL">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>NPL</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Naidoo2013 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Naidoo2013">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Naidoo2013</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Nairobi.ke -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Nairobi.ke">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Nairobi.ke</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;KE-NB"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Kenya"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NairobiStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NairobiStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2011</hasYear>
    <ace_lexicon:PN_sg>NairobiStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Muture2011"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Nairobi.ke"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Namibia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Namibia">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Namibia</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NAM"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Ndola.zm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Ndola.zm">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Ndola.zm</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Zambia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NdolaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NdolaStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2004</hasYear>
    <ace_lexicon:PN_sg>NdolaStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Kaona2004"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Ndola.zm"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NearToFacility -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NearToFacility">
    <rdf:type rdf:resource="&tabinfluencingfactor;DistanceToHealthFacility"/>
    <ace_lexicon:PN_sg>NearToFacility</ace_lexicon:PN_sg>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TanzaniaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NegativeEmotion -->
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<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NegativeEmotion">
    <rdf:type rdf:resource="&tabinfluencingfactor;Emotion"/>
    <ace_lexicon:PN_sg>NegativeEmotion</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RussiaRegionStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Nepal -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Nepal">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Nepal</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Asia"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NPL"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NepalWDStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NepalWDStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2006</hasYear>
    <ace_lexicon:PN_sg>NepalWDStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Mishra2006"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Western.np"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Niger -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Niger">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Niger</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NER"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Nigeria -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Nigeria">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Nigeria</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NGA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NonAlcoholUser -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NonAlcoholUser">
    <rdf:type rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <ace_lexicon:PN_sg>AA-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NonTobaccoUser -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NonTobaccoUser">
    <rdf:type rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <ace_lexicon:PN_sg>TS-True</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NorthAmerica -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NorthAmerica">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>NorthAmerica</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NorthWest.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NorthWest.za">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>NorthWest.za</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-NW"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NorthernCape.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NorthernCape.za">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>NorthernCape.za</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-NC"/>
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</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#OBoyle2002 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;OBoyle2002">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>OBoyle2002</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#OgunState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;OgunState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>OgunState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-OG"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Okanurak2008 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Okanurak2008">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Okanurak2008</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#OndoState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;OndoState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>OndoState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-OD"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Oriental.ma -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Oriental.ma">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Oriental.ma</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MA-OR"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Morocco"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Oromia.et -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Oromia.et">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Oromia.et</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ET-OR"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Ethiopia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#OsunState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;OsunState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>OsunState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-OS"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#OyoState.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;OyoState.ng">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>OyoState.ng</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NG-OY"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Nigeria"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PAK -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PAK">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>PAK</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PK-IS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PK-IS">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>PK-IS</ace_lexicon:PN_sg>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PK-JK -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PK-JK">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>PK-JK</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PK-PB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PK-PB">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>PK-PB</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Pahang.my -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Pahang.my">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Pahang.my</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MY-PH"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Malaysia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Pakistan -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Pakistan">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Pakistan</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Asia"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;PAK"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PakistanStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PakistanStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2001</hasYear>
   <ace_lexicon:PN_sg>PakistanStudy</ace_lexicon:PN_sg>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Liefooghe2001"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Pakistan"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Para.br -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Para.br">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Para.br</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BR-PA"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Brazil"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PastTreatmentDefaulter -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PastTreatmentDefaulter">
   <rdf:type rdf:resource="&tabinfluencingfactor;DefaultingHistory"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Pefura2011 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Pefura2011">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Pefura2011</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Pernambuco.br -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Pernambuco.br">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Pernambuco.br</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BR-PE"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Brazil"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PlannedResidentialArea -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PlannedResidentialArea">
   <rdf:type rdf:resource="&tabinfluencingfactor;DwellingRegion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PoorCommunication -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PoorCommunication">
   <rdf:type rdf:resource="&tabinfluencingfactor;CaregiverCommunication"/>
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    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AlexandriaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NepalWDStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TamataveStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PoorDiet -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PoorDiet">
    <rdf:type rdf:resource="&tabinfluencingfactor;Diet"/>
    <ace_lexicon:PN_sg>PoorDiet</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Poor_TAB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Poor_TAB">
    <rdf:type rdf:resource="&tabinfluencingfactor;State"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PostiveEmotion -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PostiveEmotion">
    <rdf:type rdf:resource="&tabinfluencingfactor;Emotion"/>
    <ace_lexicon:PN_sg>PostiveEmotion</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PsycoC-False -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PsycoC-False">
    <rdf:type rdf:resource="&tabinfluencingfactor;PsychiatricCondition"/>
    <ace_lexicon:PN_sg>PsycoC-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#PsycoC-True -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PsycoC-True">
    <rdf:type rdf:resource="&tabinfluencingfactor;PsychiatricCondition"/>
    <ace_lexicon:PN_sg>PsycoC-True</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Punjab.in -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Punjab.in">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Punjab.in</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;IN-PB"/>
    <hasParent rdf:resource="&tabinfluencingfactor;India"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Punjab.pk -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Punjab.pk">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Punjab.pk</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;PK-PB"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Pakistan"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Qina.eg -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Qina.eg">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Qina.eg</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;EG-QN"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Egypt"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#RU-AD -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;RU-AD">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>RU-AD</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#RU-SA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;RU-SA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>RU-SA</ace_lexicon:PN_sg>
</owl:NamedIndividual>
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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#RU-VL -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;RU-VL">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>RU-VL</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#RU-YV -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;RU-YV">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
    <ace_lexicon:PN_sg>RU-YV</ace_lexicon:PN_sg>
</owl:NamedIndividual>


<!-- http://ontology.ukzn/tabinfluencingfactor.owl#RUS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;RUS">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>RUS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Rectife.br -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Rectife.br">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Rectife.br</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Brazil"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#RectifeStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;RectifeStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2007</hasYear>
    <ace_lexicon:PN_sg>RectifeStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Ibuquerque2007"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Rectife.br"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Russia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Russia">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Russia</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Europe"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;RUS"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#RussiaRegionStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;RussiaRegionStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2008</hasYear>
    <ace_lexicon:PN_sg>RussiaRegionStudy</ace_lexicon:PN_sg>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Adygey.ru"/>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Jakubowiak2008"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Samara.ru"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Valdimir.ru"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Yevrey.ru"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SA">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Continent"/>
    <ace_lexicon:PN_sg>SA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SWZ -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SWZ">
    <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
    <ace_lexicon:PN_sg>SWZ</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Sabah.my -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Sabah.my">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Sabah.my</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MY-SA"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Malaysia"/>
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</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Sagamu.ng -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Sagamu.ng">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Sagamu.ng</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;OgunState.ng"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SagamuStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SagamuStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2006</hasYear>
    <ace_lexicon:PN_sg>SagamuStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Daniel2006"/>
   <assertsInterdependency rdf:resource="&tabinfluencingfactor;WorkingCondition-Gender"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Sahel.bf -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Sahel.bf">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Sahel.bf</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BF-SA"/>
    <hasParent rdf:resource="&tabinfluencingfactor;BurkinaFaso"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Samara.ru -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Samara.ru">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Samara.ru</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;RU-SA"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Russia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SaoPaulo.br -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SaoPaulo.br">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>SaoPaulo.br</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BR-SP"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Brazil"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Single -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Single">
    <rdf:type rdf:resource="&tabinfluencingfactor;MaritalStatus"/>
    <ace_lexicon:PN_sg>Single</ace_lexicon:PN_sg>
    <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthAfrica -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthAfrica">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <hasTBPrevalenceRate rdf:datatype="&xsd;double">1.0</hasTBPrevalenceRate>
    <hasArea rdf:datatype="&xsd;double">1221000.0</hasArea>
    <hasHIVPrevalenceRate rdf:datatype="&xsd;double">18.5</hasHIVPrevalenceRate>
    <hasGDP rdf:datatype="&xsd;integer">3506000000</hasGDP>
    <hasPopDensity rdf:datatype="&xsd;integer">45</hasPopDensity>
    <hasPopulation rdf:datatype="&xsd;integer">52981991</hasPopulation>
    <ace_lexicon:PN_sg>SouthAfrica</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZAF"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthAfricaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthAfricaStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2007</hasYear>
    <ace_lexicon:PN_sg>SouthAfricaStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;McLnerney2007"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthAfricaStudy1 -->
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<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthAfricaStudy1">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2013</hasYear>
   <hasSampleSize rdf:datatype="&xsd;integer">3107</hasSampleSize>
   <ace_lexicon:PN_sg>SouthAfricaStudy1</ace_lexicon:PN_sg>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Naidoo2013"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthAfricaStudy2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthAfricaStudy2">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthAfrica_TAB_BDN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthAfrica_TAB_BDN">
   <rdf:type rdf:resource="&tabinfluencingfactor;BayesianNetwork"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;TAB"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthAmerica -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthAmerica">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>SouthAmerica</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;SA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthernEthiopia.et -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthernEthiopia.et">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>SouthernEthiopia.et</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Ethiopia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthernEthiopiaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthernEthiopiaStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2007</hasYear>
   <ace_lexicon:PN_sg>SouthernEthiopiaStudy</ace_lexicon:PN_sg>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Estifanos2007"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;SouthernNationsNationalitiesandPeople.et"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthernNationsNationalitiesandPeople.et -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthernNationsNationalitiesandPeople.et">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>SouthernNationsNationalitiesandPeople.et</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ET-SN"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Ethiopia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#StableJob -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;StableJob">
   <rdf:type rdf:resource="&tabinfluencingfactor;JobType"/>
   <ace_lexicon:PN_sg>StableJob</ace_lexicon:PN_sg>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Stigma-False -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Stigma-False">
   <rdf:type rdf:resource="&tabinfluencingfactor;ExperienceStigma"/>
   <rdf:type rdf:resource="&tabinfluencingfactor;PercievedStigma"/>
   <ace_lexicon:PN_sg>Stigma-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Stigma-True -->
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<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Stigma-True">
   <rdf:type rdf:resource="&tabinfluencingfactor;ExperienceStigma"/>
   <rdf:type rdf:resource="&tabinfluencingfactor;PercievedStigma"/>
   <ace_lexicon:PN_sg>Stigma-True</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;PakistanStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy2"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VladimirStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;YaoundeStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Study001 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Study001">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <ace_lexicon:PN_sg>Study001</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Sud-Ouest.bf -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Sud-Ouest.bf">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Sud-Ouest.bf</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;BF-SO"/>
   <hasParent rdf:resource="&tabinfluencingfactor;BurkinaFaso"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Sud.cm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Sud.cm">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Sud.cm</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;CM-SU"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Cameroun"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Swaziland -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Swaziland">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Swaziland</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;SWZ"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#SymptomsPersistence -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SymptomsPersistence">
   <rdf:type rdf:resource="&tabinfluencingfactor;SymptomsReport"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy"/>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;Good_TAB"/>
   <hasState rdf:resource="&tabinfluencingfactor;Poor_TAB"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_AlC_AA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_AlC_AA">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
   <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_AlC_NA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_AlC_NA">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_1">
```

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    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.3</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasState rdf:resource="&tabinfluencingfactor;Male"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_MA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_10 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_10">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TN"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_2">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.85</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;Female"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_FE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_3 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_3">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.2</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_DE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_4 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_4">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_ND"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_5 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_5">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.95</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_PO"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_6 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_6">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_NE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_7 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_7">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_AA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_8 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_8">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
```

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    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_NA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_9 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_9">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.1</hasProbValue>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TA"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_1">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.7</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasState rdf:resource="&tabinfluencingfactor;Male"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_MA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_10 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_10">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TN"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_2">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.15</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;Female"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_FE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_3 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_3">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.8</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_DE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_4 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_4">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_ND"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_5 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_5">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.05</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_PO"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_6 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_6">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
```

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    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_NE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_7 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_7">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_AA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_8 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_8">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_NA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_9 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_9">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.9</hasProbValue>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TA"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Dep_DE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Dep_DE">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Dep_ND -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Dep_ND">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Emo_NE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Emo_NE">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Emo_PO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Emo_PO">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Gen_FE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Gen_FE">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasState rdf:resource="&tabinfluencingfactor;Female"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Gen_MA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Gen_MA">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasState rdf:resource="&tabinfluencingfactor;Male"/>
</owl:NamedIndividual>
```

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<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_ToU_TA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_ToU_TA">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
   <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_ToU_TN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_ToU_TN">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TCH -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TCH">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>TCH</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TH-AC -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TH-AC">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>TH-AC</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TH-BR -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TH-BR">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>TH-BR</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#THA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;THA">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>THA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TZ-AS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TZ-AS">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>TZ-AS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TZ-IG -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TZ-IG">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>TZ-IG</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TZA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TZA">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>TZA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Tachfouti2013 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Tachfouti2013">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Tachfouti2013</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Tadesse2013 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Tadesse2013">
   <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
   <ace_lexicon:PN_sg>Tadesse2013</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Tadla-Azilal.ma -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Tadla-Azilal.ma">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Tadla-Azilal.ma</ace_lexicon:PN_sg>
```

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    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MA-TD"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Morocco"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Tamatave.md -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Tamatave.md">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Tamatave.md</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Madagasca"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TamataveStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TamataveStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">1998</hasYear>
    <ace_lexicon:PN_sg>TamataveStudy</ace_lexicon:PN_sg>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Antananarivo.md"/>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Comolet1998"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Tanzania -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Tanzania">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Tanzania</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;TZA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TanzaniaStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TanzaniaStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2012</hasYear>
    <ace_lexicon:PN_sg>TanzaniaStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Mkopi2012"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Tanzania"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Tekle2002 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Tekle2002">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Tekle2002</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Thailand -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Thailand">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Thailand</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Asia"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;THA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Tigray.et -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Tigray.et">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Tigray.et</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ET-TI"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Ethiopia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ToU_TA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ToU_TA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.55</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ToU_TN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ToU_TN">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.45</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
```

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</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Toamasina.md -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Toamasina.md">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Toamasina.md</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MD-TM"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Madagasca"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TobaccoUse -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TobaccoUse">
    <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TobaccoUser -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TobaccoUser">
    <rdf:type rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <ace_lexicon:PN_sg>TS-False</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AndaraStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MoroccoStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;MumbaiStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy1"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthAfricaStudy2"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Toliara.md -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Toliara.md">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Toliara.md</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;MD-TL"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Madagasca"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#UnFavourableWorkingCondition -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;UnFavourableWorkingCondition">
    <rdf:type rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SagamuStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;VietnamStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Unemployed -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Unemployed">
    <rdf:type rdf:resource="&tabinfluencingfactor;EmploymentStatus"/>
    <ace_lexicon:PN_sg>Unemployed</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;RussiaRegionStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#UnfavourableClinicalHour -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;UnfavourableClinicalHour">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalHour"/>
    <ace_lexicon:PN_sg>UnfavourableClinicalHour</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AlexandriaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;NairobiStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#UnfriendlyStaff -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;UnfriendlyStaff">
    <rdf:type rdf:resource="&tabinfluencingfactor;CaregiverFriendliness"/>
    <ace_lexicon:PN_sg>UnfriendlyStaff</ace_lexicon:PN_sg>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#UnplannedSettlementArea -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;UnplannedSettlementArea">
    <rdf:type rdf:resource="&tabinfluencingfactor;DwellingRegion"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AlexandriaStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;FranceStudy"/>
    <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;SouthernEthiopiaStudy"/>
```

```
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#UnstableJob -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;UnstableJob">
   <rdf:type rdf:resource="&tabinfluencingfactor;JobType"/>
   <ace_lexicon:PN_sg>UnstableJob</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;BangkokStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#VN-AG -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;VN-AG">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>VN-AG</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#VN-BK -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;VN-BK">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>VN-BK</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#VN-CM -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;VN-CM">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>VN-CM</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#VNM -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;VNM">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>VNM</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Valdimir.ru -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Valdimir.ru">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Valdimir.ru</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;RU-VL"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Russia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Vietnam -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Vietnam">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Vietnam</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Asia"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;VNM"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#VietnamStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;VietnamStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">1999</hasYear>
   <ace_lexicon:PN_sg>VietnamStudy</ace_lexicon:PN_sg>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Johansson1999"/>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Vietnam"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#VladimirStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;VladimirStudy">
   <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
   <hasYear rdf:datatype="&xsd;integer">2008</hasYear>
   <ace_lexicon:PN_sg>VladimirStudy</ace_lexicon:PN_sg>
   <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Valdimir.ru"/>
   <isDocumentedAs rdf:resource="&tabinfluencingfactor;Woith2008"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WestAfrca -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WestAfrca">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>WestAfrca</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
</owl:NamedIndividual>
```

```
<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Western.np -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Western.np">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Western.np</ace_lexicon:PN_sg>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NP-PM"/>
    <hasParent rdf:resource="&tabinfluencingfactor;Nepal"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WesternCape.za -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WesternCape.za">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>WesternCape.za</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;SouthAfrica"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZA-WC"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Widhanarko2009 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Widhanarko2009">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Widhanarko2009</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Widowed -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Widowed">
    <rdf:type rdf:resource="&tabinfluencingfactor;MaritalStatus"/>
    <ace_lexicon:PN_sg>Widowed</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WoC_FA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WoC_FA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.2</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WoC_UF -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WoC_UF">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.8</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Woith2008 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Woith2008">
    <rdf:type rdf:resource="&tabinfluencingfactor;Work"/>
    <ace_lexicon:PN_sg>Woith2008</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WorkingCondition -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WorkingCondition">
    <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Yahounde.cm -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Yahounde.cm">
    <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
    <ace_lexicon:PN_sg>Yahounde.cm</ace_lexicon:PN_sg>
    <hasParent rdf:resource="&tabinfluencingfactor;Cameroun"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#YaoundeStudy -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;YaoundeStudy">
    <rdf:type rdf:resource="&tabinfluencingfactor;ClinicalStudyEvidence"/>
    <hasYear rdf:datatype="&xsd;integer">2011</hasYear>
    <ace_lexicon:PN_sg>YaoundeStudy</ace_lexicon:PN_sg>
    <isDocumentedAs rdf:resource="&tabinfluencingfactor;Pefura2011"/>
    <isCarriedOutAt rdf:resource="&tabinfluencingfactor;Yahounde.cm"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Yevrey.ru -->
```

```
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Yevrey.ru">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Yevrey.ru</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;RU-YV"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Russia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Yogyakarta.id -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Yogyakarta.id">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Yogyakarta.id</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ID-YO"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Indonesia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Young -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Young">
   <rdf:type rdf:resource="&tabinfluencingfactor;AgeGroup"/>
   <ace_lexicon:PN_sg>Young</ace_lexicon:PN_sg>
   <isAssertedNegativeInfluenceFactorBy rdf:resource="&tabinfluencingfactor;AlexandriaStudy"/>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;KathmanduStudy"/>
   <isAssertedPositiveInfluenceFactorBy rdf:resource="&tabinfluencingfactor;TanzaniaStudy"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-EC -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-EC">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-EC</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-FS -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-FS">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-FS</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-GT -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-GT">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-GT</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-LP -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-LP">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-LP</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-MP -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-MP">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-MP</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-NC -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-NC">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-NC</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-NL -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-NL">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-NL</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-NW -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-NW">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-NW</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZA-WC -->
```

```
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZA-WC">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZA-WC</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZAF -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZAF">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>ZAF</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZM-CE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZM-CE">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZM-CE</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZM-CO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZM-CO">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZM-CO</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZM-ES -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZM-ES">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZM-ES</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZMB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZMB">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>ZMB</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZW-BU -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZW-BU">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZW-BU</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZW-HA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZW-HA">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-PrimarySubdivision"/>
   <ace_lexicon:PN_sg>ZW-HA</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#ZWE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ZWE">
   <rdf:type rdf:resource="&tabinfluencingfactor;ISO3166-Country"/>
   <ace_lexicon:PN_sg>ZWE</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Zambezi.na -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Zambezi.na">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Zambezi.na</ace_lexicon:PN_sg>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;NA-CA"/>
   <hasParent rdf:resource="&tabinfluencingfactor;Namibia"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Zambia -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Zambia">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Zambia</ace_lexicon:PN_sg>
   <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
   <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZMB"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Zimbabwe -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Zimbabwe">
   <rdf:type rdf:resource="&tabinfluencingfactor;AdministrativeArea"/>
   <ace_lexicon:PN_sg>Zimbabwe</ace_lexicon:PN_sg>
```

```
    <hasParent rdf:resource="&tabinfluencingfactor;Africa"/>
    <hasISOAdminCode rdf:resource="&tabinfluencingfactor;ZWE"/>
  </owl:NamedIndividual>

  <!--
  ///////////////////////////////////////////////////////////////////////////////////
  //
  // Annotations
  //
  ///////////////////////////////////////////////////////////////////////////////////
   -->

  <rdf:Description rdf:about="&tabinfluencingfactor;Emotion">
    <ace_lexicon:CN_sg>Emotion</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Emotions</ace_lexicon:CN_pl>
  </rdf:Description>
  <rdf:Description rdf:about="&tabinfluencingfactor;TobaccoUse">
    <ace_lexicon:CN_pl>Tobaccos</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Tobacco</ace_lexicon:CN_sg>
  </rdf:Description>
  <rdf:Description rdf:about="&tabinfluencingfactor;Gender">
    <ace_lexicon:CN_pl>Genders</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Gender</ace_lexicon:CN_sg>
  </rdf:Description>
  <rdf:Description rdf:about="&tabinfluencingfactor;FeelingClinicallyBetter">
    <ace_lexicon:CN_pl>FellingClinicallyBetters</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>FellingClinicallyBetter</ace_lexicon:CN_sg>
  </rdf:Description>
  <rdf:Description rdf:about="&tabinfluencingfactor;Depression">
    <ace_lexicon:CN_sg>Depression</ace_lexicon:CN_sg>
    <ace_lexicon:CN_pl>Depressions</ace_lexicon:CN_pl>
  </rdf:Description>
  <rdf:Description rdf:about="&tabinfluencingfactor;AlcoholConsumption">
    <ace_lexicon:CN_pl>Alcohols</ace_lexicon:CN_pl>
    <ace_lexicon:CN_sg>Alcohol</ace_lexicon:CN_sg>
  </rdf:Description>
</rdf:RDF>

<!-- Generated by the OWL API (version 3.5.1) http://owlapi.sourceforge.net -->
```

APPENDIX 2: THE OWL REPRESENTATION OF THE EXAMPLE BAYESIAN NETWORK MODEL

South Africa BayesianNetwork Model

```
        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#SouthAfrica_TAB_BDN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;SouthAfrica_TAB_BDN">
   <rdf:type rdf:resource="&tabinfluencingfactor;BayesianNetwork"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;TAB"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>
```

Variables

```
<!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlcoholConsumption -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlcoholConsumption">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
   <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Depression -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Depression">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
   <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Emotion -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Emotion">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
   <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Gender -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Gender">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;Female"/>
   <hasState rdf:resource="&tabinfluencingfactor;Male"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#WorkingCondition -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WorkingCondition">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#TobaccoUse -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TobaccoUse">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
   <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB">
   <rdf:type rdf:resource="&tabinfluencingfactor;Variable"/>
   <hasState rdf:resource="&tabinfluencingfactor;Good_TAB"/>
   <hasState rdf:resource="&tabinfluencingfactor;Poor_TAB"/>
</owl:NamedIndividual>
```

States

```
        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlcoholAbuse -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlcoholAbuse">
   <rdf:type rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
   <ace_lexicon:PN_sg>AA-True</ace_lexicon:PN_sg>
  ...
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#NonAlcoholUser -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NonAlcoholUser">
   <rdf:type rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
   <ace_lexicon:PN_sg>AA-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Depression-False -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Depression-False">
   <rdf:type rdf:resource="&tabinfluencingfactor;Depression"/>
   <ace_lexicon:PN_sg>Depression-False</ace_lexicon:PN_sg>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Depression-True -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Depression-True">
   <rdf:type rdf:resource="&tabinfluencingfactor;Depression"/>
   <ace_lexicon:PN_sg>Depression-True</ace_lexicon:PN_sg>
   ...
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#FavourableWorkingCondition -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;FavourableWorkingCondition">
   <rdf:type rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#UnFavourableWorkingCondition -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;UnFavourableWorkingCondition">
   <rdf:type rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
   ...
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Female -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Female">
   <rdf:type rdf:resource="&tabinfluencingfactor;Gender"/>
   <ace_lexicon:PN_sg>Female</ace_lexicon:PN_sg>
   ...
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Male -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Male">
   <rdf:type rdf:resource="&tabinfluencingfactor;Gender"/>
   <ace_lexicon:PN_sg>Male</ace_lexicon:PN_sg>
  ...
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Good_TAB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Good_TAB">
   <rdf:type rdf:resource="&tabinfluencingfactor;State"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Poor_TAB -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Poor_TAB">
   <rdf:type rdf:resource="&tabinfluencingfactor;State"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#NegativeEmotion -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NegativeEmotion">
   <rdf:type rdf:resource="&tabinfluencingfactor;Emotion"/>
   <ace_lexicon:PN_sg>NegativeEmotion</ace_lexicon:PN_sg>
   ...
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#PostiveEmotion -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;PostiveEmotion">
   <rdf:type rdf:resource="&tabinfluencingfactor;Emotion"/>
   <ace_lexicon:PN_sg>PostiveEmotion</ace_lexicon:PN_sg>
</owl:NamedIndividual>
```

```
        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#TobaccoUser -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TobaccoUser">
   <rdf:type rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
   <ace_lexicon:PN_sg>TS-False</ace_lexicon:PN_sg>
   ...
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#NonTobaccoUser -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;NonTobaccoUser">
   <rdf:type rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
   <ace_lexicon:PN_sg>TS-True</ace_lexicon:PN_sg>
</owl:NamedIndividual>
```

Condition

```
<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_WoC_FA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_WoC_FA">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_WoC_UF -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_WoC_UF">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Dep_DE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Dep_DE">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
   <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Dep_ND -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Dep_ND">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
   <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Emo_NE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Emo_NE">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
   <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Emo_PO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Emo_PO">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
   <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Gen_FE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Gen_FE">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasState rdf:resource="&tabinfluencingfactor;Female"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_Gen_MA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_Gen_MA">
   <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
   <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
   <hasState rdf:resource="&tabinfluencingfactor;Male"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_ToU_TA -->
```

```
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_ToU_TA">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_ToU_TN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_ToU_TN">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_AlC_AA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_AlC_AA">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_AlC_NA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_AlC_NA">
    <rdf:type rdf:resource="&tabinfluencingfactor;Condition"/>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
</owl:NamedIndividual>
```

PriorProbability

```
        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlC_AA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlC_AA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.6</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#AlC_NA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;AlC_NA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.4</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Dep_DE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Dep_DE">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.1</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Dep_ND -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Dep_ND">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.9</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#Emo_NE -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Emo_NE">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.15</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#Emo_PO -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;Emo_PO">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.85</hasProbValue>
```

```
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#ToU_TA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ToU_TA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.55</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#ToU_TN -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;ToU_TN">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.45</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
</owl:NamedIndividual>

        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#WoC_FA -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WoC_FA">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.2</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#WoC_UF -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;WoC_UF">
    <rdf:type rdf:resource="&tabinfluencingfactor;PriorProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.8</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>
```

ConditionProbability

```
        <!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CF_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CF_1">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_FA"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CF_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CF_2">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_UF"/>
    <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CM_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CM_1">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.3</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;FavourableWorkingCondition"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_FA"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#GEN_CM_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;GEN_CM_2">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.7</hasProbValue>
    <hasCondition rdf:resource="&tabinfluencingfactor;GEN_WoC_UF"/>
    <hasState rdf:resource="&tabinfluencingfactor;UnFavourableWorkingCondition"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;WorkingCondition"/>
</owl:NamedIndividual>
```

```
<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_1">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.3</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasState rdf:resource="&tabinfluencingfactor;Male"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_MA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_10 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_10">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TN"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_2">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.85</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;Female"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_FE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_3 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_3">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.2</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_DE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_4 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_4">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_ND"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_5 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_5">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.95</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_PO"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_6 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_6">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_NE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_7 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_7">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_AA"/>
</owl:NamedIndividual>
```

```
<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_8 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_8">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_NA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CG_9 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CG_9">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.1</hasProbValue>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TA"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_1 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_1">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.7</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasState rdf:resource="&tabinfluencingfactor;Male"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_MA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_10 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_10">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;NonTobaccoUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TN"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_2 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_2">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.15</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;Female"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;Gender"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Gen_FE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_3 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_3">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.8</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-True"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_DE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_4 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_4">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Depression"/>
    <hasState rdf:resource="&tabinfluencingfactor;Depression-False"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Dep_ND"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_5 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_5">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.05</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;PostiveEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_PO"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_6 -->
```

```
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_6">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;Emotion"/>
    <hasState rdf:resource="&tabinfluencingfactor;NegativeEmotion"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_Emo_NE"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_7 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_7">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.99</hasProbValue>
    <hasState rdf:resource="&tabinfluencingfactor;AlcoholAbuse"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_AA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_8 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_8">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.01</hasProbValue>
    <hasVariable rdf:resource="&tabinfluencingfactor;AlcoholConsumption"/>
    <hasState rdf:resource="&tabinfluencingfactor;NonAlcoholUser"/>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_AlC_NA"/>
</owl:NamedIndividual>

<!-- http://ontology.ukzn/tabinfluencingfactor.owl#TAB_CP_9 -->
<owl:NamedIndividual rdf:about="&tabinfluencingfactor;TAB_CP_9">
    <rdf:type rdf:resource="&tabinfluencingfactor;ConditionProbability"/>
    <hasProbValue rdf:datatype="&xsd;double">0.9</hasProbValue>
    <hasCondition rdf:resource="&tabinfluencingfactor;TAB_ToU_TA"/>
    <hasVariable rdf:resource="&tabinfluencingfactor;TobaccoUse"/>
    <hasState rdf:resource="&tabinfluencingfactor;TobaccoUser"/>
</owl:NamedIndividual>
```

APPENDIX 3: EXTRACT OF THE SPARQL QUERY IMPLEMENTED ON THE PROTOTYPE WEB PORTAL

```
PREFIX tabinfluencingfactor: <http://ontology.ukzn/tabinfluencingfactor.owl#> ;
REFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>;
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>;
SELECT DISTINCT ?InfluencingFactor ?factorclass (COUNT(?Study) as ?StudyNo)
WHERE {
        {?TABInfluencingFactor tabinfluencingfactor:insertObjectProperty(InflenceType) ?ClinicalStudyEvidence .
?TABInfluencingFactor rdf:type ?factorclass . ?factorclass rdfs:subClassOf ?superclass . ?Study
tabinfluencingfactor:isCarriedOutAt ?Place . ?Place tabinfluencingfactor:isInsideOf ?x .?x tabinfluencingfactor:hasParent
?y . ?y tabinfluencingfactor:hasParent ?z .  ?z tabinfluencingfactor:hasParent insertPlace}
        UNION
        {?TABInfluencingFactor tabinfluencingfactor:insertObjectProperty(InflenceType) ?ClinicalStudyEvidence .
?TABInfluencingFactor rdf:type ?factorclass . ?factorclass rdfs:subClassOf ?superclass . ?Study
tabinfluencingfactor:isCarriedOutAt ?Place . ?Place tabinfluencingfactor:hasParent ?y . ?y tabinfluencingfactor:hasParent
?z .  ?z tabinfluencingfactor:hasParent insertPlace}
        UNION
        {?TABInfluencingFactor tabinfluencingfactor:insertObjectProperty(InflenceType) ?ClinicalStudyEvidence .
?TABInfluencingFactor rdf:type ?factorclass . ?factorclass rdfs:subClassOf ?superclass . ?Study
tabinfluencingfactor:isCarriedOutAt ?Place . ?Place tabinfluencingfactor:isInsideOf ?y . ?y tabinfluencingfactor:hasParent
?z .  ?z tabinfluencingfactor:hasParent insertPlace}
        UNION
        {?TABInfluencingFactor tabinfluencingfactor:insertObjectProperty(InflenceType) ?ClinicalStudyEvidence .
?TABInfluencingFactor rdf:type ?factorclass . ?factorclass rdfs:subClassOf ?superclass . ?Study
tabinfluencingfactor:isCarriedOutAt ?Place . ?Place tabinfluencingfactor:hasParent ?z . ?z
tabinfluencingfactor:hasParent insertPlace}
        UNION
        {?TABInfluencingFactor tabinfluencingfactor:insertObjectProperty(InflenceType) ?ClinicalStudyEvidence .
?TABInfluencingFactor rdf:type ?factorclass . ?factorclass rdfs:subClassOf ?superclass . ?Study
tabinfluencingfactor:isCarriedOutAt ?Place . ?Place tabinfluencingfactor:isInsideOf ?z .  ?z tabinfluencingfactor:hasParent
insertPlace}
        UNION
        {?TABInfluencingFactor tabinfluencingfactor:insertObjectProperty(InflenceType) ?ClinicalStudyEvidence .
?TABInfluencingFactor rdf:type ?factorclass . ?factorclass rdfs:subClassOf ?superclass . ?Study
tabinfluencingfactor:isCarriedOutAt ?Place . ?Place tabinfluencingfactor:hasParent insertPlace}
        UNION
        {?TABInfluencingFactor tabinfluencingfactor:insertObjectProperty(InflenceType) ?ClinicalStudyEvidence.
?TABInfluencingFactor rdf:type ?factorclass . ?factorclass rdfs:subClassOf ?superclass . ?Study
tabinfluencingfactor:isCarriedOutAt" insertPlace}
        }
GROUPBY ?InfluencingFactor ?factorclass ?StudyNo
```

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