

I. Use Case Description	
Use Case Name	Comparison of two Child Asthma Studies
Use Case Identifier	OE_CHEAR_ASTHMA_2016_v1.9
Source	CHEAR
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Creation / Revision Date	April 22th, 2016
Associated Documents	https://sites.google.com/site/oe2016chear/home <i>Requirements documentation, traceability matrix if applicable</i>

II. Use Case Summary	
Goal	Compare and contrast two or more studies related to asthma in children.
Requirements	<p><i>State any requirement(s) specific to this use case, including any capabilities from a business architecture or process model that the use case supports, any metrics or other reporting requirements, etc., including any reference identifier for the requirement(s), as applicable</i></p> <p>The purpose of this Use Case is to develop an ontology to compare and contrast two studies with one goal of determining how study results might meaningfully be combined. One examined relationships between different body size measurements and asthma in ethnic minority children^[1], while the other examined the association between prenatal and postnatal maternal stress and wheeze in 417 children enrolled in a prospective birth cohort in Mexico City^[2].</p> <p>During these two studies, a collection of variables were created and measured for the Growing Up Healthy (GUH) study (part of the Breast Cancer and the Environment Research Program (BCERP)), subset of these variables could be used to address the following hypothesis.</p> <p>(1) Smoking in the home increases the risk of asthma in the study participant;</p> <p>(2) Increased body size is associated with increased risk of asthma in the study participant.</p> <p>Smoking in the home would be an important covariate for the second hypothesis and body size would be an important covariate for the first hypothesis.</p>
Scope	The use case is about child asthma related topics only with a concentration on associations with obesity, smoking in the home, and prenatal / postnatal stress on mothers and only based

	on data from two studies conducted in New York and Mexico City.
Priority	<i>Identify the priority of the use case (with respect to other use cases for the project)</i>
Stakeholders	<i>Identify all known stakeholders for the use case</i>
Description	<p>Asthma is a chronic, inflammatory lung disease characterized by symptoms of cough, wheezing, shortness of breath, and chest tightness. Asthma in children, estimated to cost \$3.2 billion per year, accounts for 14 million missed school days annually and is the third-ranking cause of hospitalization among those younger than 15 years of age. The prevalence of childhood asthma has increased dramatically over the past few decades in the United States. Many factors have been proposed to explain increasing asthma rates, including genetic, environmental, and socioeconomic factors.[1]</p> <p>There has been a growing interest in the hypothesis that obesity contributes to the increased prevalence of asthma. The prevalence of childhood obesity is also increasing at alarming rates for children of all ages. Obesity is a known risk factor for diabetes, heart disease, hypertension, and certain cancers. Evidence is now also building for an association between asthma and obesity. This analysis also suggested that over 100,000 American children from age 5 to 14 suffer from asthma each year as a result of being overweight.</p> <p>In addition to obesity, there is also increasing evidence to suggest early-life exposure to psychosocial stress can also have adverse childhood respiratory effects. A study was conducted to examine the association between prenatal and postnatal maternal stress and wheeze in 417 children enrolled in a prospective birth cohort in Mexico City. The results showed that prenatal and postnatal stress on mothers was associated with wheeze in preschool-aged children, and the effect of postnatal stress was stronger in girls. [2]</p>
Actors / Interfaces	<p>Primary: Health professionals and epidemiologist Secondary: System Secondary: Ontology</p>
Pre-conditions	<p><i>Identify any assumptions about the state of the system that must be met for the trigger (below) to initiate the use case. Any assumptions about the state of other related systems can also be stated here. List all preconditions.</i></p> <ul style="list-style-type: none"> ● Measures of Respiratory Health

	<ul style="list-style-type: none"> Measures of weight, height, waist circumference, calculation of BMI, BMI z-score, percent fat, Covariates: age, sex, race, education, SES, parental income.
Post-conditions	<p><i>Provide any conditions that will be true of the state of the system after the use case has been completed.</i></p> <p>(1) Address the association between smoking in the home (or other factors) and risk of asthma/respiratory symptoms in the study participant.</p> <p>(2) Ways to reduce risks for asthma and other respiratory issues in children.</p>
Triggers	<p><i>Describe in detail the event or events that initiate the execution of this use case. Triggers can be external, temporal, or internal. They can be single events or a complex event that indicates that some set of conditions has been met.</i></p> <ul style="list-style-type: none"> Symptoms of Asthma and other respiratory issues in children. High incidence of obesity in children. Smoking in the home Psychosocial stress - in particular prenatal / postnatal stress on the mother.
Performance Requirements	<i>List any known performance-specific requirements – timing and sizing (volume, frequency, etc.), maintainability, reusability, other “-ilities”, etc.</i>
Assumptions	
Open Issues	

III. Usage Scenarios

Provide at least two usage scenarios that flesh out the requirements outlined in the summary, including identification of requirements specific to any envisioned ontology or semantically-driven service or application. Scenarios should be described as narrative, with supporting diagrams as appropriate. In an Agile process, every user story relevant to the use case should be included and elaborated/rolled up into one or more usage scenarios, with a clear mapping from the user story to the scenario it is integrated in or mapped to.

1) An epidemiologist named Ellen wants to know if there any equivalent questions about night cough both asked in the obesity-asthma association study and the stress-wheeze association study? She enter this query into the system. The system queries the ontology and returns, the question “ObesityAsthmaAssociationStudy”, hasSubject “NightCough”, and, the question “During the past 12 months did your child have dry cough during the night, besides any cough associated with colds or respiratory infections?”, owned by study instance “StressWheezeAssociationStudy”, hasSubject “DryCough” and “NightCough”. Then we can say that these two questions are similar.

2) Edward is an epidemiologist focusing on respiratory diseases including asthma. He is interested in the effects of Prenatal and Postnatal effects of exposure to tobacco smoke.

He wants to know if there are similar variables in the stress-wheeze association study for smoking exposure factor and the obesity-asthma association study. He enters a query into the system. The system queries the ontology and returns that both studies have instances of “PrenataLETSExposure” and “PostnataLETSExposure”.

3) Eileen the epidemiologist wants to know, in addition to the characteristics used to diagnose Asthma in the “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children” Study, what other characteristic could be added to get better/different results? She enters the query into the system and discovers: Prenatal and Postnatal Stress Scores could be considered in the study to find out if they have any relationship with the Asthma being diagnosed for children living in New York. Prenatal and Postnatal stress scores are computed using NLE(Negative Life Events) which were identified from the Data Collection Instruments.

4) Elvis is an epidemiology expert who wants to know the sex-specific differences in approach among the two studies “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children” and “Prenatal and postnatal stress and wheeze in Mexican children”. He enters the query and receives the following response from the system: Asking for the education level and income of the family member is common to both studies. Both studies have similar questions. He then left the building.

IV. Basic Flow of Events

Narrative: Often referred to as the primary scenario or course of events, the basic flow defines the process/data/work flow that would be followed if the use case were to follow its main plot from start to end. Error states or alternate states that might occur as a matter of course in fulfilling the use case should be included under Alternate Flow of Events, below. The basic flow should provide any reviewer a quick overview of how an implementation is intended to work. A summary paragraph should be included that provides such an overview (which can include lists, conversational analysis that captures stakeholder interview information, etc.), followed by more detail expressed via the table structure.

In cases where the user scenarios are sufficiently different from one another, it may be helpful to describe the flow for each scenario independently, and then merge them together in a composite flow.

Basic / Normal Flow of Events			
Step	Actor (Person)	Actor (System)	Description
1	User		identifies one of the trigger conditions
2	User		Accesses the interface
3	User		Types in a question . For example”What is the difference in approach among the two studies S1 and S2 in determining the socioeconomic status of the participants of the study ?”
4		System	Search the encoded questions of the 2 asked studies in the Ontology, if found, it retrieves all the subjects(classes and instances) of the found questions. For the above question, it would access the “Socio Economic” questions from both studies.
5		System	It compares the entities in the found questions from the 2 studies, both studies have questions with labels like

			“Education Level” and “Income”. Thus the result would be something like “they are similar”. Questions that have completely different subjects, labels or comments are used to answer the question for the difference in approach.
6		System	These more questions(ids) are found, “the kind of house the participant’s family owns”, “the number of cars they have”, “what kind of gadgets they use in their house”, in study 2 and the answer is generated based on the query result.
7	User		Exits the system after reading the answer

V. Alternate Flow of Events

Narrative: The alternate flow defines the process/data/work flow that would be followed if the use case enters an error or alternate state from the basic flow defined, above. A summary paragraph should be included that provides an overview of each alternate flow, followed by more detail expressed via the table structure.

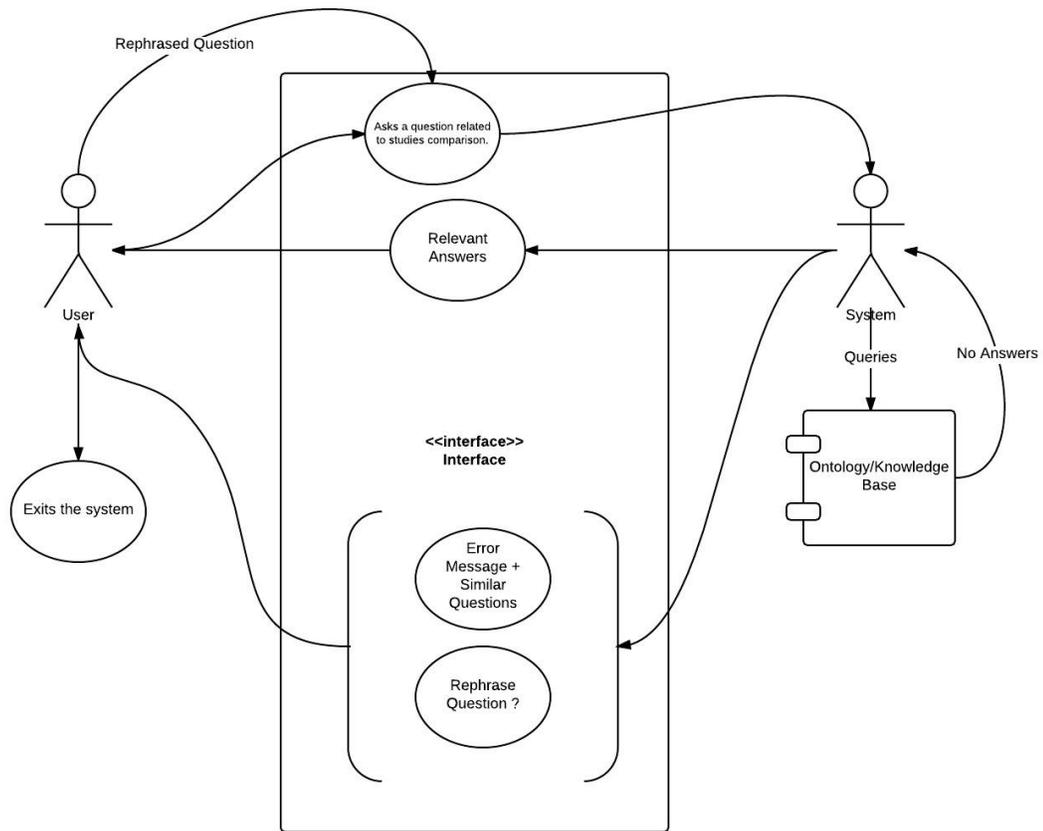
Alternate Flow of Events			
Step	Actor (Person)	Actor (System)	Description
1	User		Identifies one of the trigger conditions
2	User		Accesses the interface
3	User		Types in a question. For example “What Body measures are relevant to the diagnosis of asthma?”
4		System	Parsed the question and identify the query as positive relation between disorder-asthma and all body measurements concepts based on paper.
5		System	Search the Ontology for all concepts that has a positive relation to disorder-asthma. For the above question, the initial data retrieved would be the concept positively influence asthma diagnosis, which are “Percent Body Fat”, “BMI Percentile”, “Waist to Height Ratio” and “Waist Circumference”.
6		System	Put a restriction on “body measure” concepts only, we have only “Waist Circumference” as a direct answer. Then it can be inferred that the other 3 concepts are calculations that have been derived from body measure concepts, thus the subjects of these (which are body measure concepts) are used as additional answers for the question.
8		System	Answer : Height, Weight, Waist Circumference, Bioimpedance and Head Circumference are the most relevant (based on paper as background knowledge, or the sentiment analysis confidence score) body measures that have a positive influence on the diagnosis of asthma.
9	User		Exits the system after reading the answer

Exception Flow of Events			
Step	Actor (Person)	Actor (System)	Description
1	User		Identifies one of the trigger conditions
2	User		Accesses the interface
3	User		Types in a question related to the target study or studies.
3		System	Does not have an answer to the question
5		System	Points the user to other questions asked with similar concepts(whether share similar concepts, classes, subjects, etc.), while displaying an Error message to the user.
6		System	Gives the user an option of rephrasing the question or exiting the application.
7	User		Exits the system.

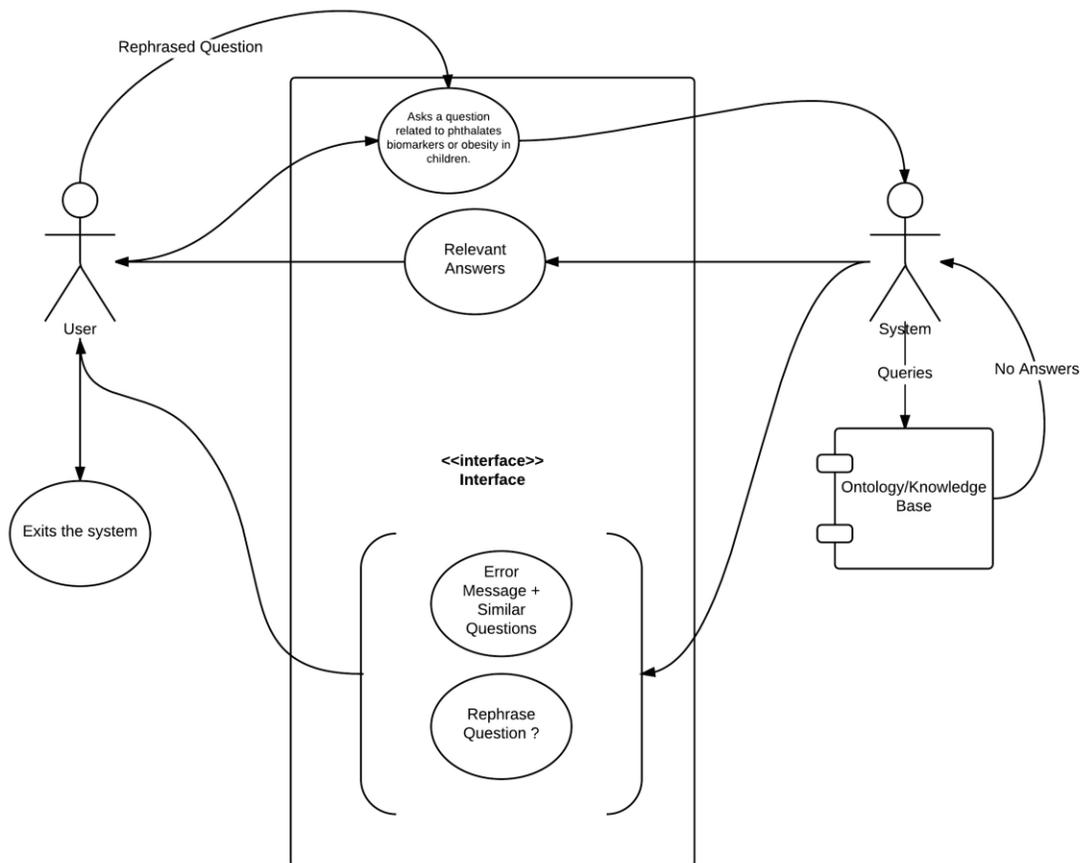
VI. Use Case and Activity Diagram(s)

Provide the primary use case diagram, including actors, and a high-level activity diagram to show the flow of primary events that include/surround the use case. Subordinate diagrams that map the flow for each usage scenario should be included as appropriate

Use Case Diagram for the Normal Flow :



Use Case Diagram for the Alternate Flow:



VII. Competency Questions

Provide at least 2 competency questions that you will ask of the vocabulary/ontology/knowledge base to implement this use case, including example answers to the questions.

The user will want to utilize the ontology by asking specific questions on the relationships between several different but potentially correlated child health studies. The ontology will contain a collection of terms with definitions, instruments or measurement to get the values of covariates for studying the association between cause factors and its outcomes of health problems.

John:

Revised Competency Questions (across the two questionnaires) :

- 1) In the questionnaires about asthma symptoms in “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children” and “Measures of obesity associated with asthma diagnosis in ethnic minority children”, what other terms are used to represent a respiratory problem such as “Wheezing”?

Answer : Cough, Chest Tightening and Shortness of Breath are also used to indicate a respiratory problem in addition to Wheezing.

How the Ontology is used : We use `rdfs:subClassOf` `chear:RespiratoryProblem` to show all terms representing respiratory problems across both questionnaires.

2) In the questionnaires about smoking in “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children” and “Measures of obesity associated with asthma diagnosis in ethnic minority children”, what other terms are used to represent “Second-hand smoke”?

Answer : Passive Smoke

How the Ontology is used : We use the `rdfs:subClassOf` `chear:Exposure` to find other terms which are used to represent second-hand smoke across both questionnaires.

Anirudh:

Question 1 : For a 4 year old child, what could be some of the typical causes of physician diagnosed asthma?

Answer : Some of the causes of asthma for a 4 year old children would include, passive smoking, Prenatal stress, wheezing.

How the Ontology is used : The age is either provided by the user or determined using the time ontology properties based on the inference. If the age is not directly provided, then the date of birth is used as the beginning date (using the `hasBeginning` property) and the end date is set as the date of the study. Using the `durationDescription` class we can calculate the duration of any interval. Once we have the age of the child participating in the study, we look at the age range for the different studies being compared. Once we choose the appropriate studies, we look at the subjects of the questions from the study and use the subjects that are listed as probable causes for asthma.

Question 2 : What is the difference in approach among the two studies “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children” and “Prenatal and postnatal stress and wheeze in Mexican children Sex-specific differences” in determining the socioeconomic status of the participants of the study ?

Answer : While asking for the Education Level and Income of the family member is common to both studies, the “Prenatal and postnatal stress and wheeze in Mexican children Sex-specific differences” study goes in more detail, asking questions about the kind of house the participant’s family owns, the number of cars they have, what kind of gadgets they use in their house etc.

How the Ontology is used : The Ontology encodes the whole question as it is, these

encoded questions should be mapped to subjects using the hasSubject property. Subjects of questions from different studies can be compared to each other to find the details of the questions asked. For the above question, we first access the “Socio Economic” questions from both studies. We then compare the subjects of the questions, which have been encoded as concepts and mapped using "hasSubject", in these questions, both studies have questions with subjects like Education Level and Income. So we know they are similar. Questions that have completely different subjects can be used to answer the question for the difference in approach.

Jason:

(1) Are there any similar questions about night cough both asked in the obesity-asthma association study and the stress-wheeze association study? If yes, what are they?

Answer: Yes. The question “Does (CHILD’S NAME) ever cough at night when she does not have a cold?” in the obesity-asthma association study is considered the same as the question “During the past 12 months did your child have dry cough during the night, besides any cough associated with colds or respiratory infections?”. Answers to these two questions can be mapped to the same variable.

In our newest version of ontology, the question “Does (CHILD’S NAME) ever cough at night when she does not have a cold?”, owned by study instance “ObesityAsthmaAssociationStudy”, hasSubject “NightCough”, and, the question “During the past 12 months did your child have dry cough during the night, besides any cough associated with colds or respiratory infections?”, owned by study instance “StressWheezeAssociationStudy”, hasSubject “DryCough” and “NightCough”. Then we can say that these two questions are similar.

(2) What’s the similar variable in the stress-wheeze association study for the smoking exposure factor in the obesity-asthma association study?

Answer: Passive smoking and postnatal ETS exposure.

How the Ontology is used : The questions in the two studies are encoded and linked to the studies using object property “hasResource”. And “hasSubject” property is used to describe related subjects of a specific question. To find the so-called “similar” variable, we search for those subject classes that are subclasses of a same class.

Anirudh :

Question 1 : Along with the characteristics used to diagnose Asthma in the “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children” Study, what other characteristic could be added to get better/different results?

Answer : Questions about House, Postnatal Environmental Tobacco Smoke Exposure, Dry Cough and Education Level could be considered in the study to find out if they have any relationship with the Asthma being diagnosed in Kids from New York.

How the Ontology is used : The Subject for each study is checked (based on the hasSubject property that maps questions to the respective subject), so we can find the subjects each study has taken into account for example Age, SocioEconomic Status , Race and Gender, and so find that the other study has used an additional characteristic being Prenatal and Postnatal Stress Scores.

Question 2 : What is the difference in approach among the two studies “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children” and “Prenatal and postnatal stress and wheeze in Mexican children Sex-specific differences” in determining the socioeconomic status of the participants of the study ?

Answer : While asking for the Education Level and Income of the family member is common to both studies, the “Prenatal and postnatal stress and wheeze in Mexican children Sex-specific differences” study goes in more detail, asking questions about the kind of house the participant’s family owns, the number of cars they have, what kind of gadgets they use in their house etc.

How the Ontology is used : The Ontology encodes the whole question as it is, these encoded questions should have classes/concepts that can be used to map the questions from different studies and use them to compare the studies. For the above question, we first access the “Socio Economic” questions from both studies. We then compare the subjects of the questions, which have been encoded as concepts and mapped using "about", in these questions, both studies have questions with subjects like Education Level and Income. So we know they are similar. Questions that have completely different subjects can be used to answer the question for the difference in approach.

Question 3 : What Body measures are relevant to the diagnosis of asthma?

Answer : Height, Weight, Waist Circumference, Bioimpedance and Head Circumference are the most relevant body measures that have a positive influence on the diagnosis of asthma.

How the Ontology is used : The Ontology contains a detailed description of how the body measure are related to each other and what can be derived from each body measure. Also, every concept that has a positive relation to a specific disorder like asthma will be mapped together. So for the above example, the initial data retrieved would be the concept positively influence asthma diagnosis. These include Percent Body Fat, BMI Percentile, Waist to Height Ratio and Waist Circumference. Since Waist Circumference is already a body measure it can be directly used for the answer. While the other 3 concepts are just

calculations that have been derived from other body measures, we consider the body measures they have been derived from as the answer for the question asked.

Question 4: Based on what factors is psychosocial stress in the participants calculated?

Answer : Psychosocial Stress is calculated based on Survey questions about financial, legal, career, relationship, home safety, neighborhood safety, medical issues (self and others), home, prejudice, and authority.

How the Ontology is used : In the ontology, we encode questions as a whole and classify them based on their subject. And certain terms/concepts can be derived from information obtained from these questions. So in the above example, Stress Scores are derived, from question about the domains/mentioned above. These relationships would be encoded by a human being using the hasPositiveRelation property.

Describe at least one way you expect to use the semantics and/or provenance to propose an answer to the questions. Include an initial description of why the semantics and/or provenance representation and reasoning provides an advantage over other obvious approaches to the problem. (optional – depending on the use case and need for supporting business case).

Semantics will help to ensure consistency in the use of terminology and accepted ranges for measurements. This can be captured through the ontology. In this case, we are encoding two different studies related to childhood asthma[1][2] both of which contain terms related to childhood asthma and obesity which may contain conflicting definitions. Without the use of the ontology, there would be no framework for standardizing the semantics of these terms. Without capturing provenance, it would be difficult to trace the origin of the authoritative source to ensure the validity of the definition.

For example, in the study “Measures of Obesity Associated with Asthma Diagnosis in Ethnic Minority Children”, Body-Mass Index (BMI) was calculated by dividing the weight measurement (expressed in kilograms) by the square of the height (expressed in meters). However the study also indicates that there are known issues with the uniform application of BMI standards across different races.[3] Children in some racial groups tend to have relatively less body fat than others. In the other study “Prenatal and postnatal stress and wheeze in Mexican children Sex-specific differences”, BMI was measured across a group of children of the same ethnic group and therefore not as prone to these known inaccuracies. The ontology can be used to compare results of questions about asthma such as “Are there any differences in the incidence of coughing and nighttime wheezing in children with a BMI > 25 and therefore obese or at risk for obesity, when compared across different ethnic groups?”. The ontology has set a standardized definition for BMI, but also needs to take into account differences between various racial groups of children to determine that Mexican children may, for example, be at a higher risk of asthma symptoms than children of other racial groups. The ontology would be used to set relationships between the various racial groups and their corresponding definition of BMI.

VIII. Resources

In order to support the capabilities described in this Use Case, a set of resources must be available and/or configured. These resources include the set of actors listed above, with additional detail, and any other ancillary systems, sensors, or services that are relevant to the problem/use case.

Knowledge Bases, Repositories, or other Data Sources

Data	Type	Characteristics	Description	Owner	Source	Access Policies & Usage
<i>(dataset or repository name)</i>	<i>(remote, local/in situ, etc.)</i>	<i>e.g. – no cloud cover</i>	<i>Short description of the dataset, possibly including rationale of the usage characteristics</i>		<i>Source (possibly a system, or remote site) for discovery and access</i>	
PubMed Central		from MEDLINE, life science journals, and online books	Biomedical related scientific paper			
Wikipedia		multilingual, web-based, free-content	Real world knowledge base			
Freebase		community-curated database	Hierarchical knowledge base			
UMLS		linking health information, medical terms, drug names, and billing codes across different computer systems	Unified Medical Language System			

External Ontologies, Vocabularies, or other Model Services

Resource	Language	Description	Owner	Source	Describes/Uses	Access Policies & Usage
<i>(ontology, vocabulary, or model name)</i>	<i>(ontology language and syntactic form, e.g., RDFS - N3)</i>	<i>If the service is one that runs a given ontology or model-based application at a given</i>		<i>Source (link to the registry or directly to the ontology, vocabulary, or model where that model is maintained, if</i>	<i>List of one or more data sources described by and/or used by the model</i>	

		<i>frequency, state that in addition to the basic description</i>		<i>available)</i>		
SONWMECT	RDF, OWL	comprehensive clinical terminology	International Health Terminology Standards Organization (IHTSDO)	https://www.nlm.nih.gov/research/umls/Snomed/snomed_main.html		
GUH obesity and asthma paper	Natural					
ISAAC-asthma questions.docx	Natural					
PROGRESS Study Child database-list of variables.docx	Natural					
PROGRESS Study manuscript	Natural					
SES STATUS - PROGRESS_13 questions	Natural					
Smoking questions-English and Spanish_	Natural					

June_3_2013	Natural					
Variables to calculate SES						
MSSM Baseline	Natural					
MSSM FU1	Natural					
	Natural					

Other Resources, Service, or Triggers (e.g., event notification services, application services, etc.)

Resource	Type	Description	Owner	Source	Access Policies & Usage
(sensor or external service name)		Include a description of the resource as well as availability, if applicable	Primary owner of the service	Application or service URL ; if subscription based, include subscription and any subscription owner	

IX. References and Bibliography

List all reference documents – policy documents, regulations, standards, de-facto standards, glossaries, dictionaries and thesauri, taxonomies, and any other reference materials considered relevant to the use case

[1]Vangeepuram N, Teitelbaum SL, Galvez MP, Brenner B, Doucette J, Wolff MS. Measures of obesity associated with asthma diagnosis in ethnic minority children. Journal of Obesity. 2011;2011:517417. doi: 10.1155/2011/517417. Epub 2011 May 10.

[2] Rosa MJ, Just AC, Tamayo Y Ortiz M, Schnaas L, Svensson K, Wright RO, Téllez Rojo MM, Wright RJ. Prenatal and postnatal stress and wheeze in Mexican children: Sex-specific differences. *Ann Allergy Asthma Immunol*. 2016 Jan 25. pii: S1081-1206(15)00846-7. doi: 10.1016/j.anai.2015.12.025.

[3] M. Neovius, Y. Linne, B. Barkeling, and S. Rossner, "Discrepancies between classification systems of childhood obesity," *Obesity Reviews*, vol. 5, no. 2, pp. 105–114, 2004.

X. Notes

There is always some piece of information that is required that has no other place to go. This is the place for that information.