I. Use Case Description	
Use Case Name	*Personalized Depression Treatment Ontology*
Use Case Identifier	
Source	
Point of Contact	*Cole Feuer, Nancy Zhang, Gunnar Eastman*
Creation / Revision Date	*09/14/24*
Associated Documents	

II. Use Case Summary	
Goal	*To create an ontology that can improve the personalization of depression treatment by mapping relationships between patient demographics, treatment types, and outcomes.*
Requirements	*The system must integrate data from clinical trials, genetic studies, and patient-reported outcomes.* *It must have practical use in supporting clinicians in creating the best treatment plan for patients.*
Scope	*Focus on integrating genetic, demographic, and treatment outcome data to help clinicians find better treatment strategies for depression patients faster and with less trial-and-error.*
Priority	*High, as improving the speed and accuracy of mental health treatments has important social and medical implications.*
Stakeholders	*Primary stakeholders: Clinicians, mental health researchers, and patients.* *Secondary stakeholders: Hospitals, mental health organizations, and pharmaceutical companies.*
Description	*This use case focuses on the creation of a personalized depression treatment ontology aimed at improving the efficiency and accuracy of mental health treatment. The ontology will integrate diverse data sources, including patient demographics, genetic data, clinical trials, and patient-reported outcomes. The system will assist clinicians in formulating personalized treatment plans, reducing the trial-and-error approach often associated with mental health care.* *Principal Actors:* *Clinicians: Use the system to recommend personalized depression treatments based on patient data.* *Patients: Provide data on treatment outcomes, allowing the ontology to evolve with real-world experiences.* *Researchers: Input clinical trial and genetic data into the system to enhance its accuracy.* *Genetic Counselors: Utilize genetic data to offer tailored treatment recommendations for patients.* *Restated Goals:* *Provide clinicians with personalized treatment recommendations for depression based on patient-specific data.* *Minimize the trial-and-error approach in mental health treatment, leading to faster and more accurate care.* *Integrate ongoing patient-reported outcomes and clinical trial data to continuously improve treatment recommendations.*

Actors / Interfaces	*Primary Actors:* ● *Clinicians: Use the ontology for recommending treatments.* ● *Patients: Provide patient-reported outcome data.* ● *Researchers: Input and analyze clinical and genetic data.* *Systems:* ● *Clinical trials databases* ● *Genetic databases* ● *Ontology management system* ● *Electronic medical records systems.*
Pre-conditions	*A clinician or researcher is logged into the system.* *The system has access to clinical, genetic, and patient-reported outcome datasets.*
Post-conditions	*A treatment plan with a predicted success rate is recommended for the patient.* *Data from the current treatment experience is fed back into the ontology to improve future predictions.*
Triggers	*The clinician inputs a patient's demographic and genetic information into the system.* *The need for treatment recommendations triggers the use of the ontology.*
Performance Requirements	*Response time: needs to provide treatment recommendations reasonably quickly* *Scalability: needs to scale with data imputed and new research* *Concurrency: needs to be accessible to multiple clinicians and researchers at a time.* *Updatability: needs to adapt to new research and update suggestions accordingly*
Assumptions	
Open Issues	

III. Usage Scenarios

Scenario 1: Clinician Seeking Treatment for a New Patient
A clinician is meeting with a new patient who has been diagnosed with depression. The patient has not previously received treatment for depression, and the clinician wants to recommend the most effective treatment option while minimizing the trial-and-error approach that is commonly used in mental health care. The clinician uses the ontology-based system to provide personalized treatment recommendations based on the patient's demographics and genetic data.

Scenario 2: Genetic Counselor Providing Personalized Treatment Recommendations
A genetic counselor, specializing in the treatment of mental health conditions, is meeting with a patient who has struggled with depression and has not responded well to traditional antidepressants. The counselor uses the ontology-based system to recommend personalized treatment options based on the patient's genetic profile and demographic information

IV. Basic Flow of Events

Basic / Normal Flow of Events			
Step	**Actor (Person)**	**Actor (System)**	**Description**
1	**Clinician**	**Treatment ontology recommendation system**	**The clinician logs into the treatment recommendation system.**
2	**Clinician**	**Treatment ontology**	**The clinician enters patient information (age,**

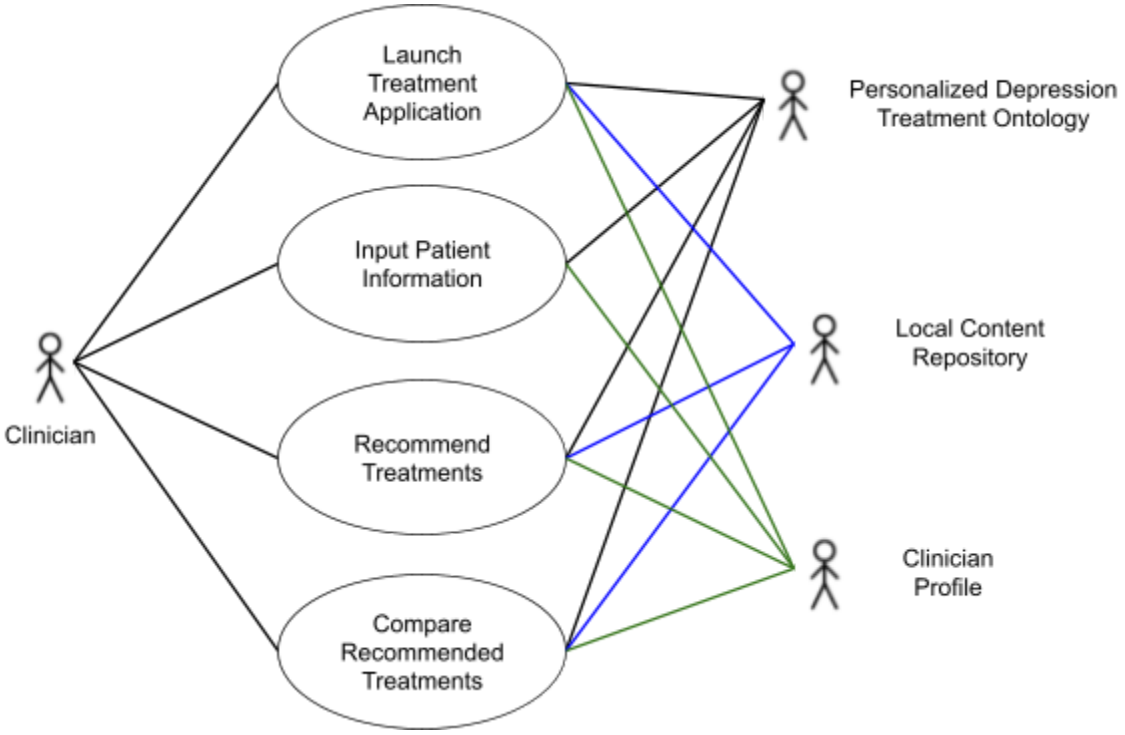
		recommendation system	gender, genetic data).
3	N/A	Treatment ontology recommendation system	The system searches through the ontology to find relevant treatments based on similar cases.
4	N/A	Treatment ontology recommendation system	The system suggests potential treatments with predicted effectiveness.
5	Clinician	Treatment ontology recommendation system	The clinician selects a treatment and provides it to the patient.
6	Clinician	Treatment ontology recommendation system	The clinician logs treatment outcomes into the system for future analysis.

V. Alternate Flow of Events

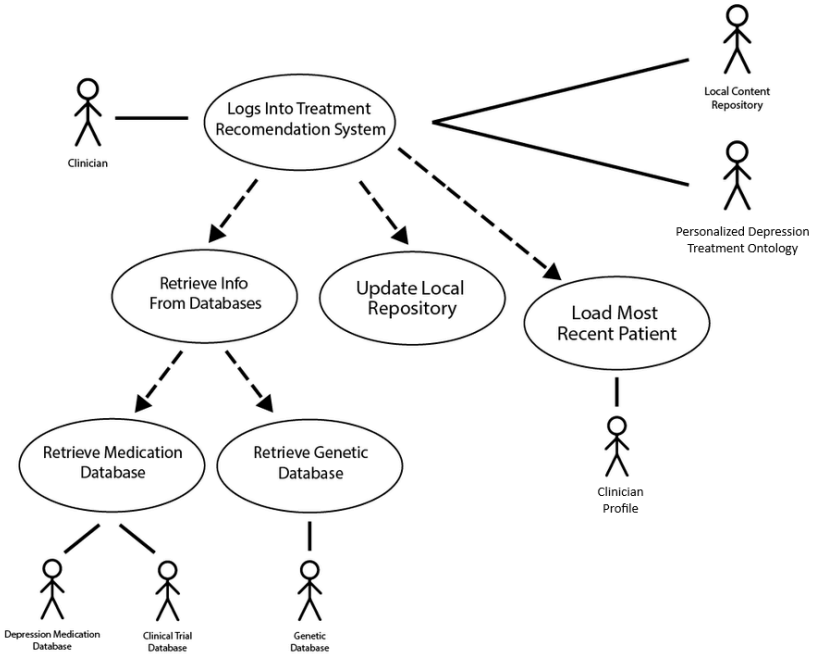
Alternate Flow of Events			
Step	**Actor (Person)**	**Actor (System)**	**Description**
1	Clinician	Treatment ontology recommendation system	The clinician enters patient data, but the ontology finds insufficient data for an accurate prediction (e.g., for rare genetic conditions).
2	Clinician	Treatment ontology recommendation system	The system requests additional clinical trial or research data related to the case.
3	Clinician	Treatment ontology recommendation system	The clinician is provided with a generic recommendation based on broad population data rather than personalized data.

VI. Use Case and Activity Diagram(s)

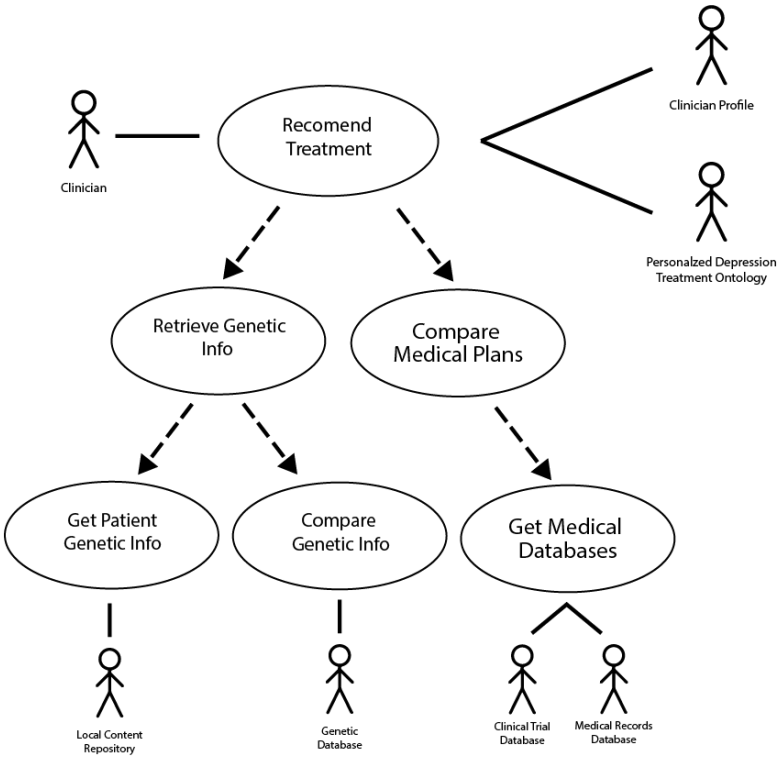
Overview Diagram



Launch Treatment Recommendation System Diagram



Recommend Treatment Diagram



VII. Competency Questions

What is the most effective treatment for patients with specific genetic markers associated with depression?

Example Answer: The system identifies that patients with a particular genetic marker (e.g., serotonin transporter gene polymorphisms) have shown a higher response rate to selective serotonin reuptake inhibitors (SSRIs). Based on this, the ontology suggests SSRIs as the recommended treatment with a success prediction of 75%, supported by clinical trial data and patient outcomes from similar cases.
Which treatment options have the highest success rates for patients aged 30-45 with treatment-resistant depression?

Example Answer: The system analyzes treatment histories and outcomes for patients aged 30-45 who have not responded to traditional antidepressants. It suggests alternative options, such as cognitive behavioral therapy (CBT) combined with ketamine treatment, showing a 60% improvement rate. The recommendation is based on aggregated patient-reported outcomes and clinical trials in this age group.

Semantics: The ontology utilizes relationships between entities such as "patient demographics," "genetic markers," "treatment types," and "treatment outcomes." These relationships allow the system to infer connections between a patient's genetic data and the most relevant treatment options, even when some information may be missing or incomplete. By organizing knowledge in a structured and interconnected way, the ontology enables more accurate predictions than simple rule-based systems.

For example, if a genetic marker related to a poor response to SSRIs is found, the system can infer that other treatments such as norepinephrine-dopamine reuptake inhibitors (NDRIs) might be more effective, even if that specific combination has not been tested as extensively.

Provenance: Provenance reasoning tracks the origin and reliability of data used in treatment recommendations. This means the system can differentiate between recommendations based on large clinical trials, patient-reported outcomes, and preliminary genetic studies. This capability allows the system to prioritize more reliable data, improving trustworthiness and accuracy in treatment selection.

For instance, if a treatment recommendation is based on a large, peer-reviewed clinical trial, the system can flag this as high-confidence information. In contrast, if the recommendation is based on emerging genetic research, it can mark this as tentative, guiding the clinician's decision-making process.

VIII. Resources

Knowledge Bases, Repositories, or other Data Sources

Data	Type	Characteristics	Description	Owner	Source	Access Policies & Usage
(dataset or repository name)	*(remote, local/in situ, etc.)*	*e.g. – no cloud cover*	*Short description of the dataset, possibly including rationale of the usage characteristics*		*Source (possibly a system, or remote site) for discovery and access*	
GENDEP (Genome-Based Therapeutic Drugs for Depression) Dataset	*Genetic and Clinical Data*	*Combines genetic data with clinical outcomes from antidepressant treatment trials*	*The GENDEP project focuses on the genetic determinants of antidepressant response, making it highly relevant for an ontology that aims to personalize treatments based on genetic profiles.*		*Publicly available (European Genome-phenome Archive)*	
STAR D (Sequenced Treatment Alternatives to Relieve Depression) Dataset	*Clinical Trial Data*	*Large-scale, longitudinal, real-world study of depression treatment*	*one of the largest and most comprehensive studies of depression treatment. It tracks patients across several levels of antidepressant treatment, detailing effectiveness, side effects, and patient-reported measures over time.*		*Publicly available (European Genome-phenome Archive)*	
UK Biobank	*Genetic, Demographic, and Health Data*	*Large cohort with comprehensive genetic, demographic, and health-related data.*	*The UK Biobank includes both genetic and health data from over 500,000 participants. It provides great data on depression diagnoses, symptoms, and genetic factors, which can be integrated into the ontology to provide personalized treatment insights.*		*UK Biobank (need to apply)*	
PsychENCODE Consortium Data	*Genetic and Epigenetic*	*Multi-omic data combining genetic, epigenetic, and*	*The PsychENCODE project provides detailed genetic and epigenetic*		*PsychENCODE Consortium,(NIH data portals)*	

	Data	*transcriptomic information*	*data, offering insights into how gene expression impacts depression and mental health. This is valuable for understanding the biological mechanisms that might influence treatment responses.*			

External Ontologies, Vocabularies, or other Model Services

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

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

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.