# Early Detection of CHAPLE Disease in Pediatric Protein-Losing Enteropathy: A Feasibility Study

Kyeryoung Lee, PhD[1]*, Liang-Chin Huang, PhD[1]*, Hunki Paek, PhD[1], Augustine Annan, PhD[1], Xiaoyan Wang, Ph D[1]
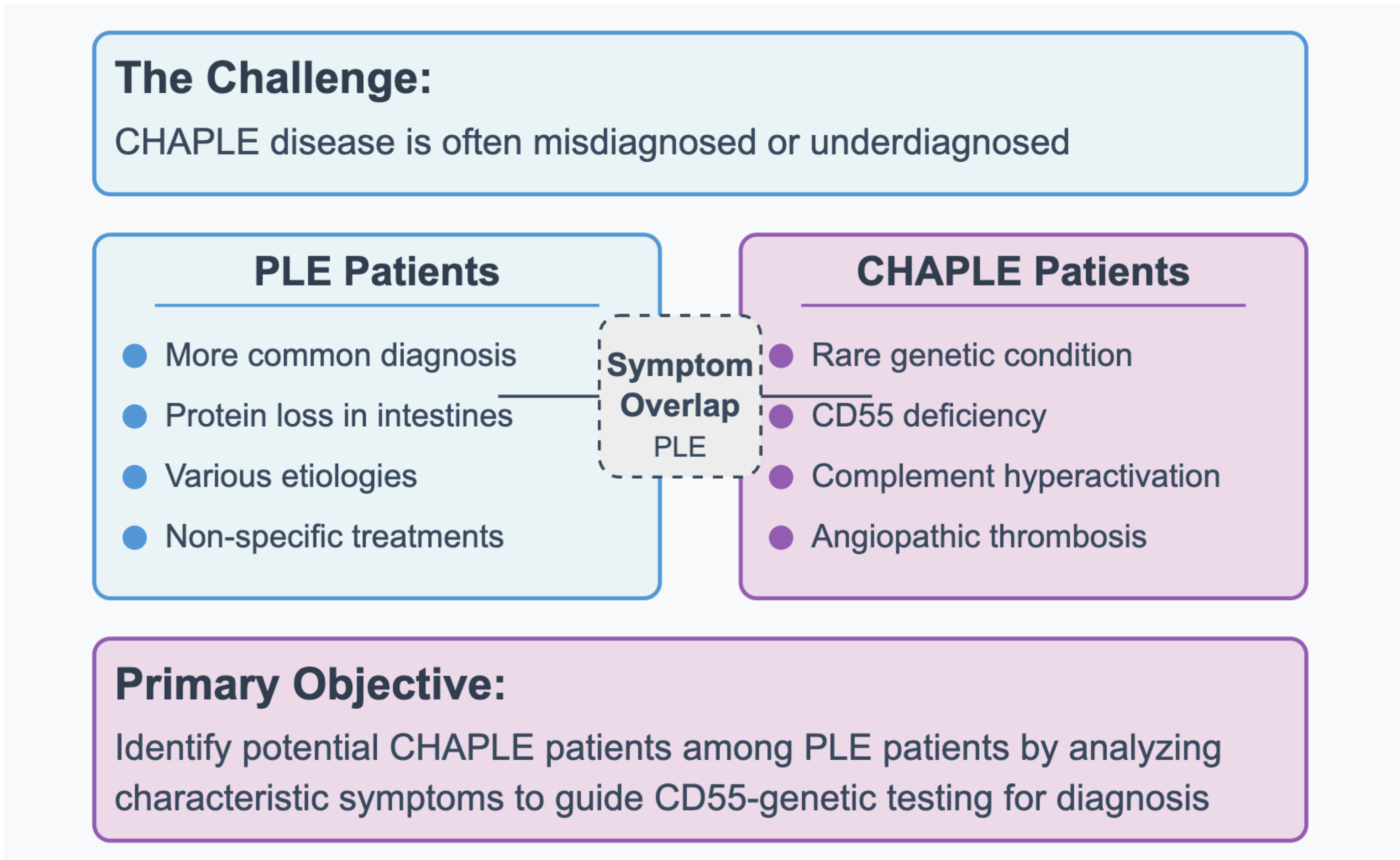
[1]IMO Health, Rosemont, IL, USA
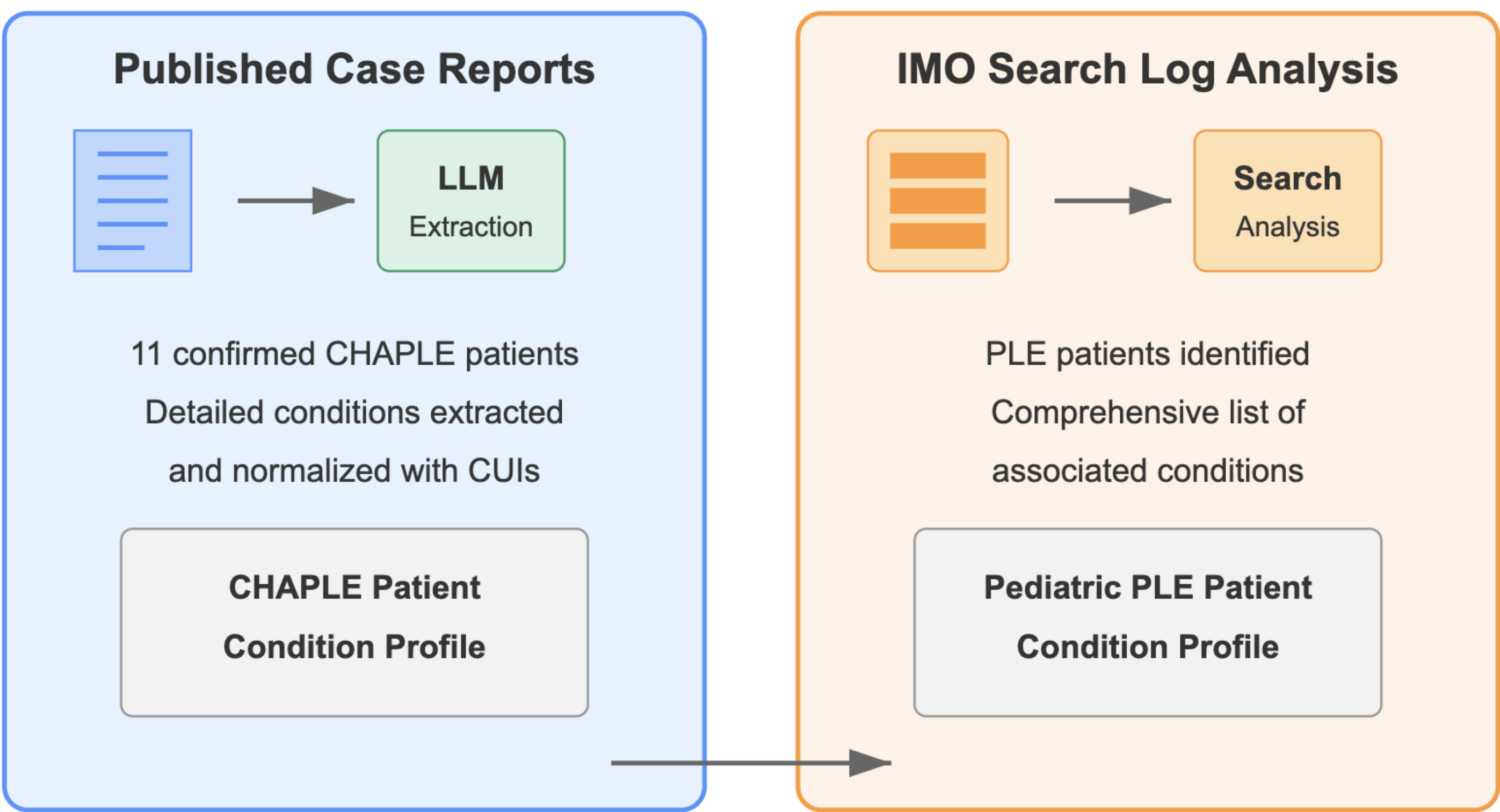
*Equal Contribution

MSR83

## Introduction

CHAPLE disease (CD55-deficiency with hyperactivation of complement, angiopathic thrombosis, and protein-losing enteropathy) is often misdiagnosed or underdiagnosed due to its rarity and overlapping symptoms with more common conditions like protein-losing enteropathy (PLE)
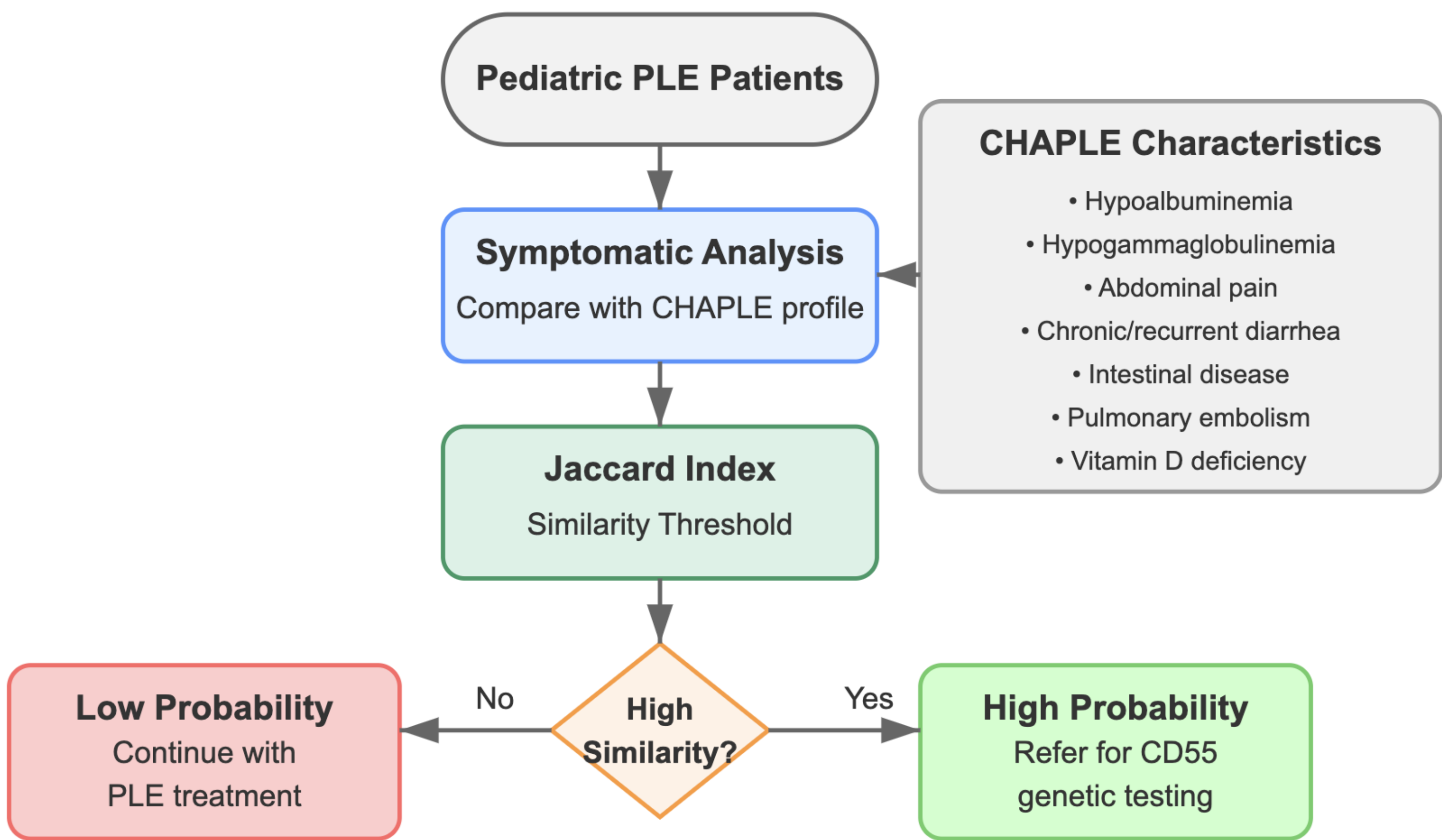
**The Challenge:**
CHAPLE disease is often misdiagnosed or underdiagnosed

**PLE Patients**
- More common diagnosis
- Protein loss in intestines
- Various etiologies
- Non-specific treatments

Symptom Overlap PLE

**CHAPLE Patients**
- Rare genetic condition
- CD55 deficiency
- Complement hyperactivation
- Angiopathic thrombosis

**Primary Objective:**
Identify potential CHAPLE patients among PLE patients by analyzing characteristic symptoms to guide CD55-genetic testing for diagnosis

## Methodology

We utilized the IMO-Health Terminology Search-log datasets and published CHAPLE case reports

**Published Case Reports**

[document icon] → **LLM** Extraction

11 confirmed CHAPLE patients
Detailed conditions extracted and normalized with CUIs

**CHAPLE Patient Condition Profile**

**IMO Search Log Analysis**

[list icon] → **Search** Analysis

PLE patients identified
Comprehensive list of associated conditions

**Pediatric PLE Patient Condition Profile**

### CHAPLE Diagnostic Process



**CHAPLE Characteristics**
- Hypoalbuminemia
- Hypogammaglobulinemia
- Abdominal pain
- Chronic/recurrent diarrhea
- Intestinal disease
- Pulmonary embolism
- Vitamin D deficiency

Pediatric PLE Patients → Symptomatic Analysis (Compare with CHAPLE profile) → Jaccard Index (Similarity Threshold) → High Similarity? → Yes → High Probability (Refer for CD55 genetic testing); No → Low Probability (Continue with PLE treatment)

## Contact Information

Kyeryoung Lee: klee@imoheal.com
Liang-Chin Huang: lhuang@imohealth.com
Hunki Paek : hpaek @imohealth.com
Xiaoyan Wang: xwang@imohealth.com

IMO Health

## Results

**Figure 1. Prevalence of key conditions in CHAPLE vs Pediatric PLE patients**



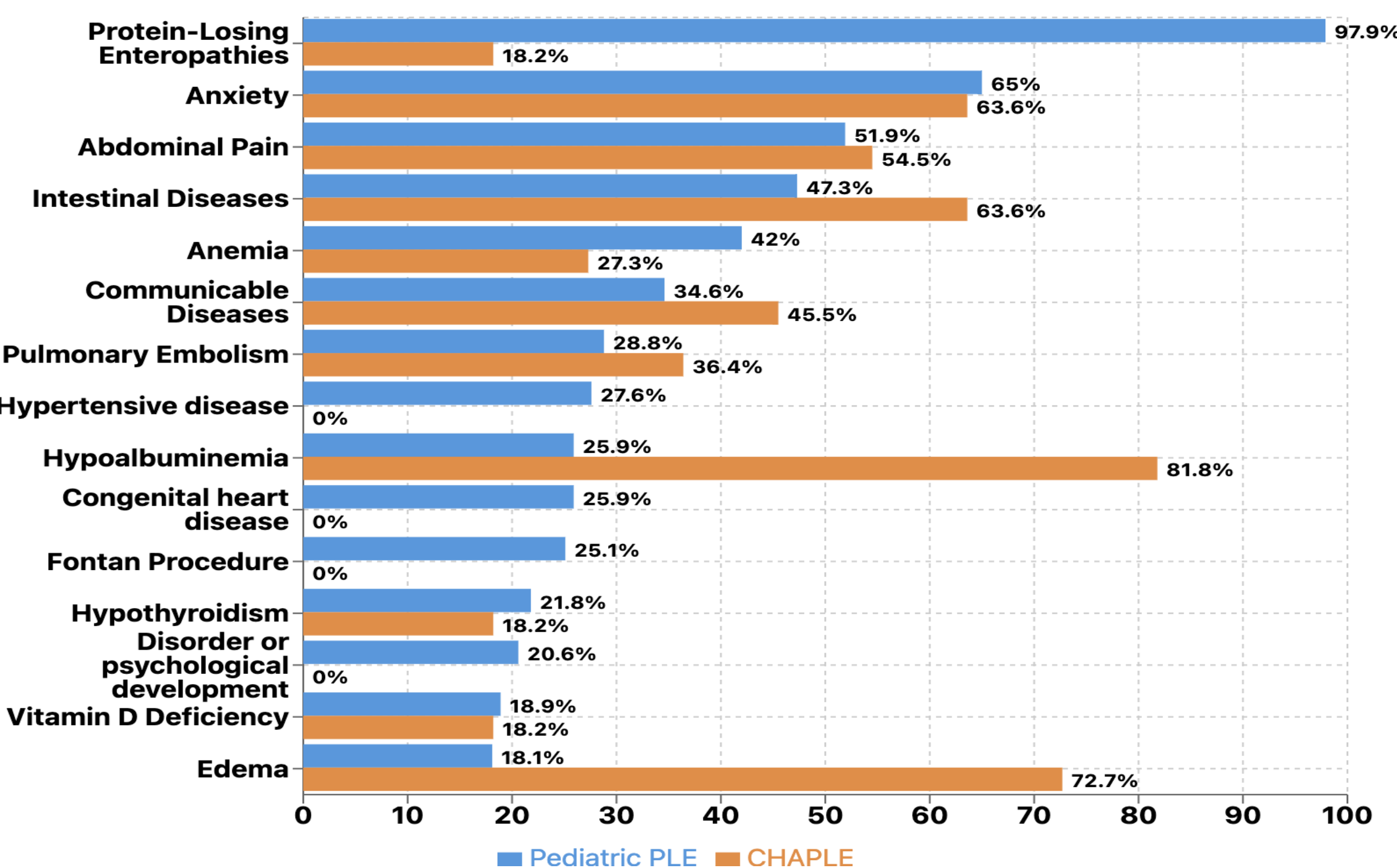| Condition | Pediatric PLE | CHAPLE |
|---|---|---|
| Protein-Losing Enteropathies | 97.9% | 18.2% |
| Anxiety | 65% | 63.6% |
| Abdominal Pain | 51.9% | 54.5% |
| Intestinal Diseases | 47.3% | 63.6% |
| Anemia | 42% | 27.3% |
| Communicable Diseases | 34.6% | 45.5% |
| Pulmonary Embolism | 28.8% | 36.4% |
| Hypertensive disease | 27.6% | 0% |
| Hypoalbuminemia | 25.9% | 81.8% |
| Congenital heart disease | 25.9% | 0% |
| Fontan Procedure | 25.1% | 0% |
| Hypothyroidism | 21.8% | 18.2% |
| Disorder or psychological development | 20.6% | 0% |
| Vitamin D Deficiency | 18.9% | 18.2% |
| Edema | 18.1% | 72.7% |

**Figure 2. Jaccard Similarity Analysis**

A) Patient-specific Jaccard similarity values
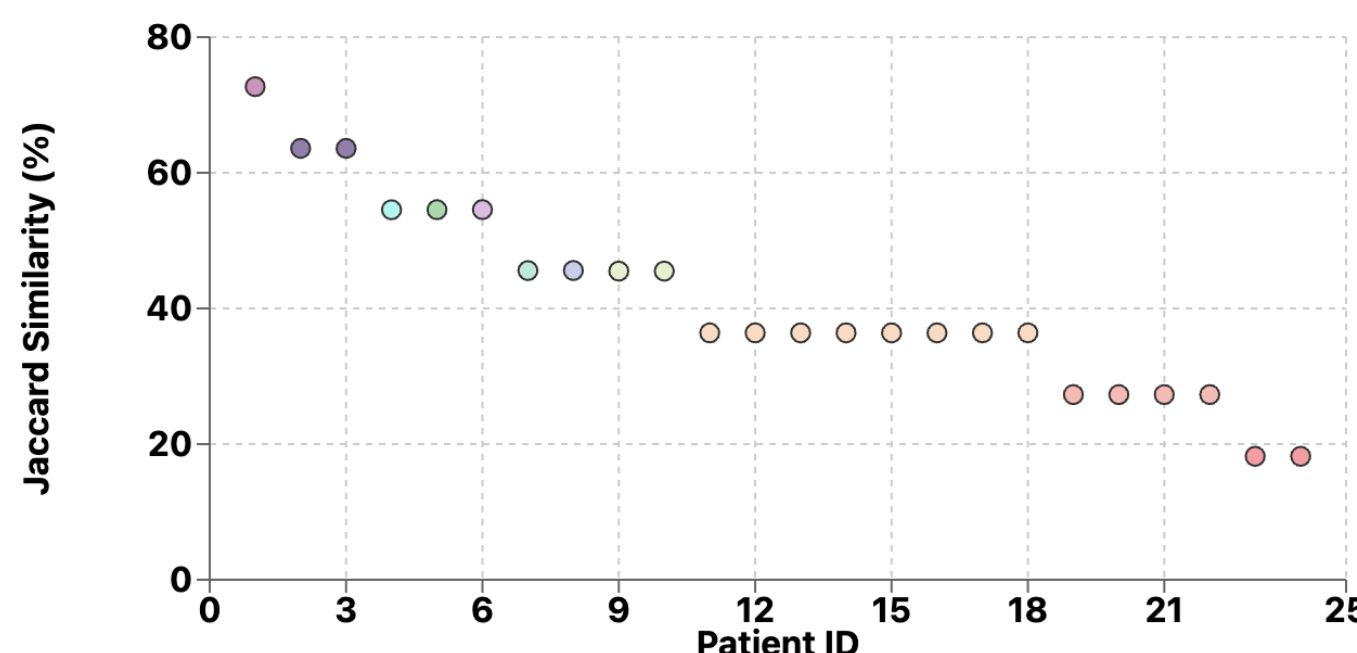


B) Distribution of Jaccard similarity values
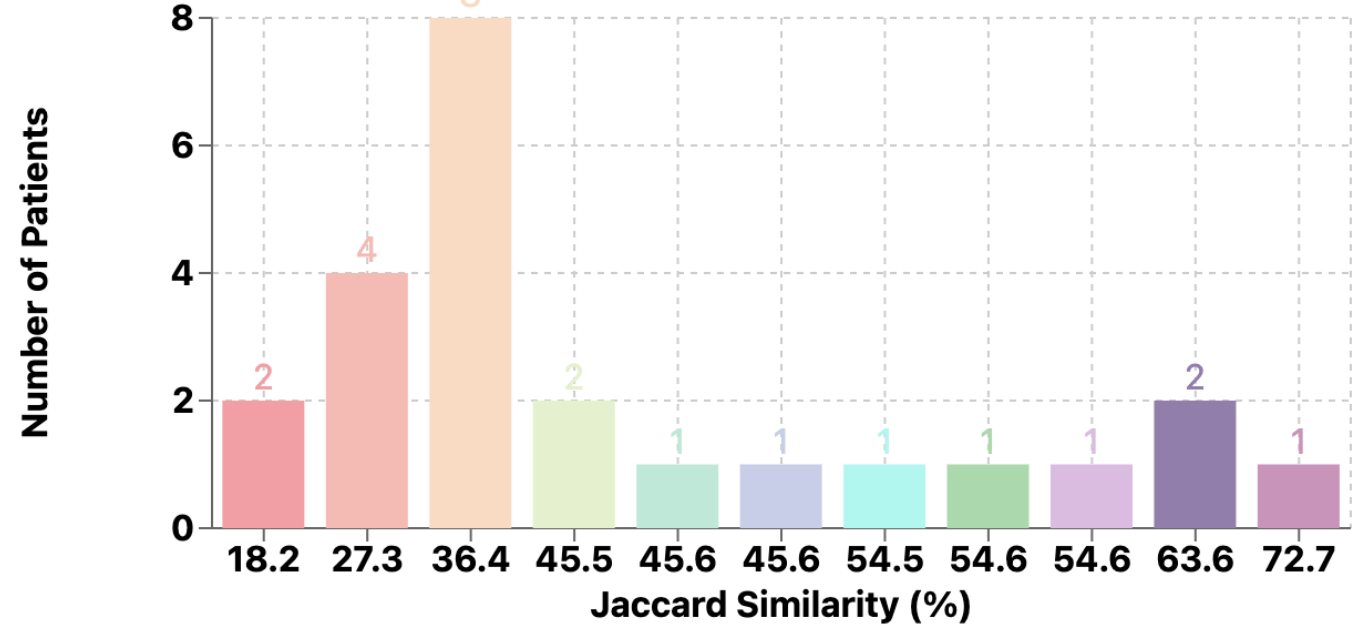


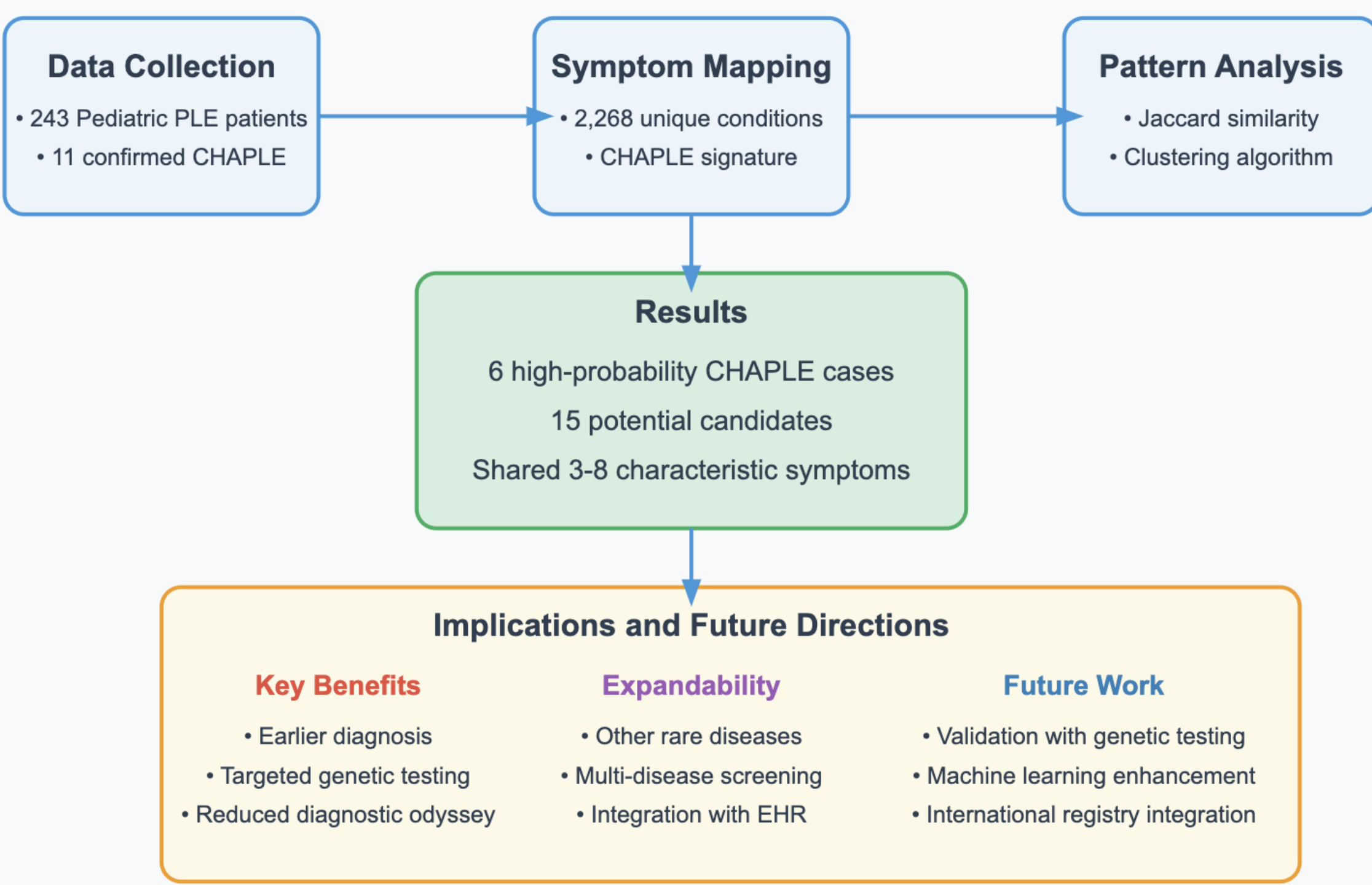C) Key symptoms of top-matched patients

| Patient # | Score | Key Symptoms |
|---|---|---|
| 21 | 8 | Chronic Diarrhea, Abdominal Pain, Vomiting, Hypoalbuminemia, Facial/Extremity Edema, Anemia, Vitamin Deficiency, Thrombosis |
| 7 | 7 | Chronic Diarrhea, Hypogammaglobulinemia, Anemia, Vitamin Deficiency, Thrombosis, Recurrent Infection, Hypothyroidism |
| 8 | 7 | Chronic Diarrhea, Abdominal Pain, Hypogammaglobulinemia, Vitamin Deficiency, Thrombosis, Recurrent Infection, Hypothyroidism |
| 2 | 6 | Chronic Diarrhea, Hypogammaglobulinemia, Growth Retardation, Anemia, Vitamin Deficiency, Recurrent Infection |
| 19 | 6 | Chronic Diarrhea, Growth Retardation, Vitamin Deficiency, Thrombosis, Recurrent Infection, Hypothyroidism |

## Conclusion

**Systematic Approach to Identifying Rare Disease Patients**
**CHAPLE Disease Case Study**

**Data Collection**
- 243 Pediatric PLE patients
- 11 confirmed CHAPLE

→ **Symptom Mapping**
- 2,268 unique conditions
- CHAPLE signature

→ **Pattern Analysis**
- Jaccard similarity
- Clustering algorithm

**Results**
6 high-probability CHAPLE cases
15 potential candidates
Shared 3-8 characteristic symptoms

**Implications and Future Directions**

| Key Benefits | Expandability | Future Work |
|---|---|---|
| • Earlier diagnosis | • Other rare diseases | • Validation with genetic testing |
| • Targeted genetic testing | • Multi-disease screening | • Machine learning enhancement |
| • Reduced diagnostic odyssey | • Integration with EHR | • International registry integration |

## Plan: Leveraging Knowledge Graph Techniques

An example of data extracted from a case report and represented in a knowledge graph format for further analysis.
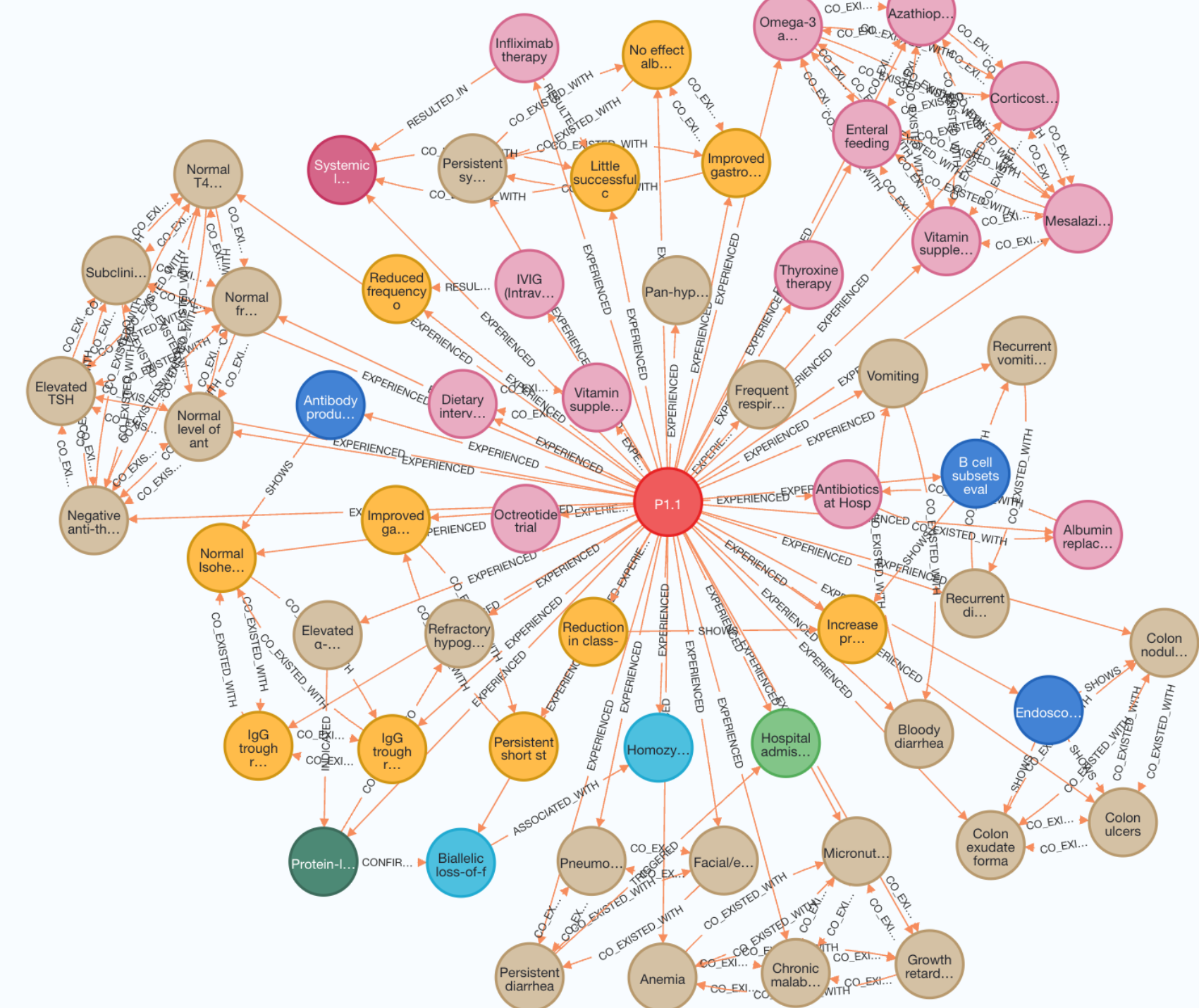


1. **Path Analysis**: This identifies common symptom-to-diagnosis pathways, helping understand progression patterns.

2. **Centrality Measures**: This reveals the most connected clinical events, highlighting pivotal points in disease progression.

3. **Community Detection**: This identifies clusters of related clinical events that frequently occur together.

4. **Temporal Analysis**: This reveals the typical timeline of disease progression.