**GOAL**

Use PubMed-derived ontologies to evaluate the **effectiveness and cost** of **existing ETG-based protocols**, and to suggest **better procedures or formulary options** by comparing with external evidence.

**Core Linking Strategy**

**1. Structured ETG Graph**

You likely have a claims-based graph like:

(:ETG)-[:INCLUDES]->(:Procedure)

(:ETG)-[:USES]->(:Drug)

(:ETG)-[:ASSOCIATED\_WITH]->(:Protocol)

(:Protocol)-[:FOLLOWED\_BY]->(:Member)

(:Member)-[:HAS\_COST]->(:DollarValue)

**2. Unstructured PubMed Graph**

Built from NLP/LLM processing of articles:

(:PubMedArticle)-[:MENTIONS]->(:Drug)-[:IN]->(:OntologyConcept)

(:PubMedArticle)-[:SHOWS\_EFFECT\_ON]->(:Outcome)

(:PubMedArticle)-[:COVERS]->(:Procedure)-[:IN]->(:OntologyConcept)

(:PubMedArticle)-[:INVOLVES]->(:Condition)

You map structured concepts to **common clinical ontologies** (e.g., UMLS, SNOMED, RxNorm, LOINC, MeSH).

**Step-by-Step Integration Plan**

**Step 1: Normalize with Ontologies**

* Use LLMs + BioPortal/UMLS APIs to normalize:
  + (:Procedure {code: "83036"}) → CPT → MeSH or SNOMED concept
  + (:Drug {name: "GLP-1"}) → RxNorm → MeSH
* Normalize both:
  + ETG-linked procedures and drugs
  + PubMed-extracted procedures and drugs

Now both sides share a common vocabulary via (:OntologyConcept)

**Step 2: Link Nodes via Ontologies**

// ETG side

MATCH (p:Procedure)-[:IN]->(o:OntologyConcept)<-[:IN]-(pd:Procedure)

RETURN p, o, pd

// Drug side

MATCH (d:Drug)-[:IN]->(o:OntologyConcept)<-[:IN]-(dd:Drug)

RETURN d, o, dd

Now an ETG drug/procedure is **linked to the same concept** in PubMed-derived evidence.

**Use Cases Unlocked**

**1. Evaluate Protocol Effectiveness**

Compare member outcomes to external evidence:

MATCH (etg:ETG)-[:USES]->(d:Drug)-[:IN]->(o:OntologyConcept)<-[:IN]-(pd:Drug)<-[:MENTIONS]-(a:PubMedArticle)-[:SHOWS\_EFFECT\_ON]->(o:Outcome)

RETURN etg.name, d.name, COUNT(a), COLLECT(DISTINCT o.name)

**2. Identify Cheaper or More Effective Alternatives**

// Same ontology concept, different drug in PubMed

MATCH (etg:ETG)-[:USES]->(d1:Drug)-[:IN]->(o:OntologyConcept)<-[:IN]-(d2:Drug)

WHERE NOT d1.name = d2.name

WITH etg, d2

MATCH (d2)<-[:MENTIONS]-(a:PubMedArticle)-[:SHOWS\_EFFECT\_ON]->(outcome:Outcome)

RETURN etg.name, d2.name, COUNT(DISTINCT a) AS support, COLLECT(DISTINCT outcome.name)

**3. Cost Overlay for Current ETG Protocols**

MATCH (m:Member)-[:FOLLOWED\_BY]-(p:Protocol)<-[:ASSOCIATED\_WITH]-(etg:ETG)

MATCH (m)-[:HAS\_COST]->(c:Cost)

RETURN etg.name, p.name, AVG(c.value) AS avg\_cost

**Implementation Tools**

| **Tool** | **Role** |
| --- | --- |
| **UMLS / RxNorm / MeSH** | Mapping structured codes to clinical concepts |
| **LLM (e.g. GPT-4 + LangGraph)** | Semantic normalization from PubMed text |
| **Graph model** | Connects structured & unstructured domains |
| **Cypher / GDS** | Scoring, similarity, and path analysis |
| **NeoDash or Streamlit** | Visualization of ETG cost-effectiveness dashboards |

**Strategic Impact**

* Identify **protocols with high cost but poor external support**
* Suggest **evidence-based procedures or drugs** that match ETG intent
* Defend or refine formularies based on outcome + cost + literature