



UNIVERSITY  
OF TRENTO - Italy



Dipartimento di Ingegneria e Scienza dell'Informazione

– KnowDive Group –

## **Knowledge Graph (KG) for Health Facilities in Trentino**

**Zehra Deniz Tas**

**Lydia Assefa Bekele**

**Cecilia Peccolo**

# 1. Informal Purpose

"I want to build a Knowledge Graph (KG) that provides comprehensive, accessible, and structured information about health facilities across Trentino. The KG will help residents locate essential healthcare services, such as hospitals, pharmacies, residential care, and semi-residential care, based on type, availability, and capacity. It will support informed healthcare choices, allowing users to find facilities suited to their specific needs, especially in cases requiring urgent or specialized care."

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## 2. Formal Purpose

The goal of this project is to develop a Knowledge Graph (KG) that aggregates, structures, and makes accessible comprehensive information on health facilities across Trentino. This KG will enable residents to locate healthcare services—including hospitals, pharmacies, residential care, and semi-residential care facilities—according to their type, availability, capacity, and specific services offered. By enhancing residents' ability to make informed choices, particularly in urgent or specialized care situations, the KG aims to improve community health awareness and accessibility. In addition, the KG will be designed to support data reusability, ensuring that the information remains accessible and applicable across various user contexts and scenarios.

### Contextualization:

- **Domain of Interest:** The domain of the KG is health services within the geographic scope of the Trentino region, focusing on both public and private facilities offering a wide range of health and care services.
- **Geographical Boundaries:** The KG will cover the entire autonomous province of Trentino, addressing healthcare needs in both urban and rural areas.
- **Temporal Boundaries:** The KG will be updated with real-time data to reflect current facility availability and services, with regular revisions to maintain accuracy.
- **Domain Boundaries:** The KG focuses exclusively on healthcare facilities, categorizing them by type (e.g., hospitals, pharmacies) and specific capabilities (e.g., emergency services, specialized care).

### Personas:

1. **Lucia:** A 65-year-old retired teacher from Trentino seeking a memory care facility for her spouse recently diagnosed with Alzheimer's. Lucia, who values clear information, feels overwhelmed by the options and needs a way to easily compare nearby facilities by services, availability, and location.
2. **Marco:** A 40-year-old father with a busy schedule, living in suburban Trentino. He needs a pharmacy that offers family services, like vaccinations, with flexible hours and online booking options, to fit around his work and family commitments.
3. **Dr. Rossi:** A 50-year-old general practitioner in Trentino who often refers patients to specialized or urgent care facilities. He needs quick, reliable access to data on local healthcare options to make efficient referral decisions.
4. **Elena:** A 30-year-old public health researcher focusing on healthcare accessibility in Trentino. She requires structured data on healthcare facility distribution and services to analyze regional trends in access and availability for her research.

## Scenarios:

1. **Lucia's Search for Memory Care:**

Lucia uses the KG to locate nearby residential care facilities that specialize in memory care for her spouse. She filters options by distance, memory care availability, and user reviews, using the KG's comparative analysis feature to select a suitable facility.

2. **Marco's Family Health Needs:**

Marco queries the KG for nearby pharmacies that offer family health services, such as vaccinations. He filters for extended hours and online appointment options, allowing him to select a facility that meets his needs and fits into his schedule.

3. **Dr. Rossi's Patient Referrals:**

Dr. Rossi needs to refer a patient for orthopedic care. Using the KG, he quickly finds nearby hospitals with relevant specialties and current availability, enabling a timely referral.

4. **Elena's Research on Healthcare Access:**

For her research on healthcare access disparities, Elena uses the KG to gather data on the distribution and types of healthcare facilities across Trentino. The structured data helps her analyze service availability and identify areas where residents may lack adequate access.

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## 4. Competency Questions (CQs)

1. What are the nearest hospitals to a specific location?
  2. Which pharmacies in Trentino offer home delivery services?
  3. How many beds are available in residential care facilities in a specific area?
  4. What specialized services are offered by hospitals in Trentino?
  5. Which health facilities provide 24/7 emergency care within a certain radius?
  6. Are there facilities offering memory care within a specific distance?
  7. What are the average wait times for non-emergency services at local hospitals?
  8. Are there health services in Trentino that offer online booking?
  9. What are the comparative reviews of nearby pharmacies?
  10. How does the availability of transportation impact access to healthcare in rural areas?
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## 5. Concept Identification

Based on the CQs and the formal purpose, key concepts and entity types are identified, organized by Focus Levels:

### Core Concepts

- Health Facility: Represents various healthcare providers, including hospitals, pharmacies, residential and semi-residential care facilities.
- Service Type: Different types of healthcare services provided at each facility (e.g., ICU, memory care, pharmacy services).
- Location: Geographic details such as address and GPS coordinates of each facility.
- Capacity: Availability indicators like bed count, memory care units, or pharmacy stock levels.

### Contextual Concepts

- Availability: Operational hours and open/closed status, especially relevant for pharmacies and urgent care centers.
- Service Capacity: Specific to services like ICU availability or specialized care units, indicating the facility’s ability to accommodate additional patients.

### Common Concepts

- Region: Subdivisions within Trentino to group healthcare resources by area.
- Facility Type Classification: A standardized classification (e.g., Hospital, Pharmacy) to facilitate querying by facility type.

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Scenarios	Personas	Competency Questions	Entities	Properties	Focus
1, 2	Lucia, Marco	1, 2, 3, 4, 6	Health Facility	name, address, type, GPS coordinates, services provided	Core
1	Lucia	2, 3, 6	Residential Care Facility	memory care availability, bed count, user reviews, distance	Contextual
2	Marco	2, 8	Pharmacy	family health services, vaccination availability, online booking, hours of operation	Core
3	Dr. Rossi	4, 5	Hospital	specialized services, emergency care, capacity, location	Core
4	Elena	1, 9, 10	Region	healthcare facility distribution, service availability by region	Common
1, 3	Lucia, Dr. Rossi	1, 3, 5, 7	Service Type	emergency care, ICU availability, memory care	Core
4	Elena	4, 6, 10	Transportation	public transport proximity, impact on healthcare access	Contextual
3, 4	Dr. Rossi, Elena	1, 4, 7	Location	geographic details (address, GPS coordinates), proximity to public transport	Core
5	All Personas	6, 7, 8	Service Capacity	availability indicators, bed count, pharmacy stock levels	Common

## 6. ER Modeling

The ER model provides a structured foundation for implementing the KG, defining core entities and relationships based on focus levels and competency questions.

### Entity Classification

#### Strong Entities

- **HEALTH\_FACILITIES**: Independent entity representing various health facilities. It serves as a central link to other entities based on facility type and location.
- **PHARMACIES**: Independent entity with unique location attributes that can exist without any associated entities.
- **HOSPITAL\_FACILITIES**: An independent entity with unique location and facility-specific details.
- **SPECIALIST\_SERVICES\_PRIVATE** and **SPECIALIST\_SERVICES\_PUBLIC**: These entities can exist independently but are related by service code to allow mapping between public and private services.
- **DRG\_HOSPITAL\_ADMISSIONS**: Represents hospital admissions data, independent of any other entities.

#### Weak Entities

- **SEMI\_RESIDENTIAL\_CARE**: Depends on **RESIDENTIAL\_CARE** as it uses the same facility ID. It cannot exist independently without a related residential care facility.
- **RESIDENTIAL\_CARE**: Although semi-dependent, it is meaningful only in the context of a **HEALTH\_FACILITY** that provides residential care.
- **PARAPHARMACIES**: Dependent on **PHARMACIES** for the location information.
- **REHABILITATION\_FACILITIES**: Dependent on **HEALTH\_FACILITIES** or **HOSPITAL\_FACILITIES** for the location, indicating its dependence on a hospital or healthcare facility.

#### Cardinalities

- **One-to-Many** (| | -- | {}): Indicates that one instance of the first entity can relate to multiple instances of the second entity.
- **Many-to-Many** (| o -- o |): Indicates that multiple instances of both entities can relate to each other.
- **One-to-One** (| | -- | |): Indicates that one instance can relate to one.

SEMI_RESIDENTIAL_CARE	
string	COD_STRUTTURA_OD
string	COD_STRUTTURA
string	STRUTTURA
string	COD_TIPO_ASSISTENZA
string	ASSISTENZA
string	COD_TIPO_RAPPORTO
string	TIPO_RAPPORTO
string	TIPO_STRUTTURA
int	ANNO
int	NUM_UTENTI
int	NUM_POSTI
int	NUM_GIORNATE

facility\_type

RESIDENTIAL_CARE	
string	COD_STRUTTURA_OD
string	COD_STRUTTURA
string	STRUTTURA
string	COD_TIPO_ASSISTENZA
string	ASSISTENZA
string	COD_TIPO_RAPPORTO
string	TIPO_RAPPORTO
string	TIPO_STRUTTURA
int	ANNO
int	NUM_UTENTI
int	NUM_POSTI
int	NUM_GG_ASSISTENZA
int	NUM_AMMISSIONI
int	NUM_DIMISSIONI

report\_type

HEALTH_FACILITIES	
string	COD_STRUTTURA_OD
string	COD_STRUTTURA
string	COD_REGIONE
string	COD_ASL
string	STRUTTURA
string	PARTITA_IVA
string	SITO_WEB
string	E_MAIL
string	COD_COMUNE
string	COMUNE
string	INDIRIZZO
string	CAP
string	TELEFONO
string	FAX
string	COD_TIPO_ASSISTENZA
string	ASSISTENZA
string	COD_TIPO_RAPPORTO
string	TIPO_RAPPORTO
string	TIPO_STRUTTURA
string	LATITUDINE_P
string	LONGITUDINE_P
string	LATITUDINE_V
string	LONGITUDINE_V

HOSPITAL_FACILITIES	
string	COD_OSP_OD
string	COD_OSP
string	COD_REGIONE
string	COD_ASL
string	OSPEDALE
string	COD_COMUNE
string	COMUNE
string	INDIRIZZO
string	CAP
string	TELEFONO
string	COD_TIPO_OSP
string	TIPO_OSP
string	PARTITA_IVA
string	FAX
string	SITO_WEB
string	E_MAIL
string	LATITUDINE_P
string	LONGITUDINE_P
string	LATITUDINE_V
string	LONGITUDINE_V

report\_type

report\_type

SPECIALIST_SERVICES_PUBLIC	
string	COD_TIPO_RAPPORTO
string	TIPO_RAPPORTO
string	COD_PRESTAZIONE
string	DESC_PRESTAZIONE
int	ANNO
int	NUMERO

report\_type

DRG_HOSPITAL_ADMISSIONS	
string	COD_TIPO_RAPPORTO
string	TIPO_RAPPORTO
string	COD_DRG
string	DRG
int	ANNO
int	NUMERO

location

location

location

PHARMACIES	
string	COD_FARMACIA_OD
string	COD_FARMACIA
string	FARMACIA
string	IVA
string	CAP
string	COD_COMUNE
string	COMUNE
string	FRAZIONE
string	COD_PROVINCIA
string	PROVINCIA
string	COD_REGIONE
string	REGIONE
string	DATA_INIZIO
string	INDIRIZZO
string	TIPOLOGIA
string	LATITUDINE_P
string	LONGITUDINE_P
string	LATITUDINE_V
string	LONGITUDINE_V

location\_and\_pharmacy\_code

PARAPHARMACIES	
string	COD_PARAFARMACIA_OD
string	COD_PARAFARMACIA
string	PARAFARMACIA
string	IVA
string	CAP
string	COD_COMUNE
string	COMUNE
string	INDIRIZZO
string	FRAZIONE
string	COD_PROVINCIA
string	PROVINCIA
string	COD_REGIONE
string	REGIONE
string	DATA_INIZIO
string	LATITUDINE_P
string	LONGITUDINE_P
string	LATITUDINE_V
string	LONGITUDINE_V

REHABILITATION_FACILITIES	
string	COD_RIA_OD
string	COD_RIA
string	COD_REGIONE
string	COD_ASL
string	STRUTTURA
string	COD_COMUNE
string	COMUNE
string	TELEFONO
string	LATITUDINE_P
string	LONGITUDINE_P
string	LATITUDINE_V
string	LONGITUDINE_V

code\_prestazione

SPECIALIST_SERVICES_PRIVATE	
string	COD_TIPO_RAPPORTO
string	TIPO_RAPPORTO
string	COD_PRESTAZIONE
string	DESC_PRESTAZIONE
int	ANNO
int	NUMERO