



# Harmonizing EHR Databases with SNOMED CT

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*30<sup>th</sup> October 2014*

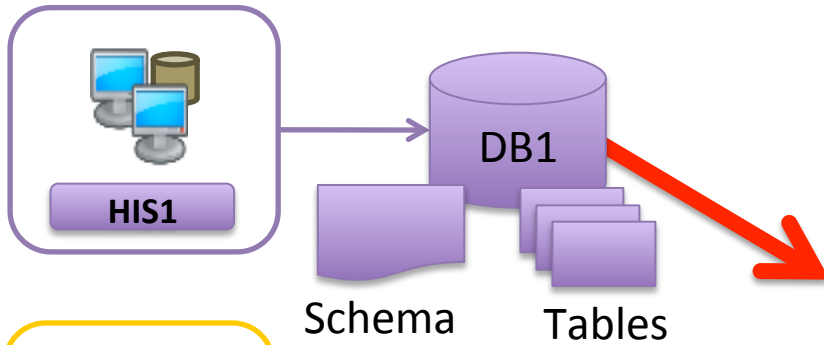
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# Outline

- Challenges of Data Harmonization in Malaysia
- Mi-Harmony Tool
- Result and Findings
- Summary & Conclusion

# Data Harmonization Process



IT Staff

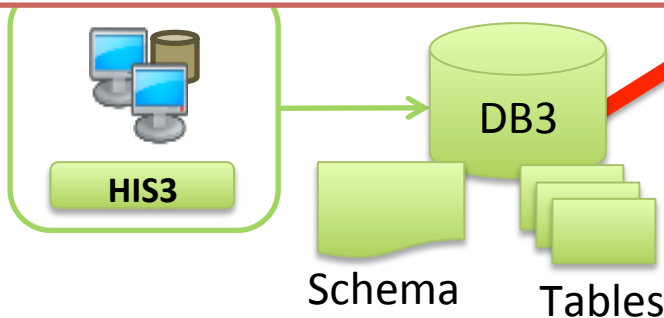
Role: Consolidate the data



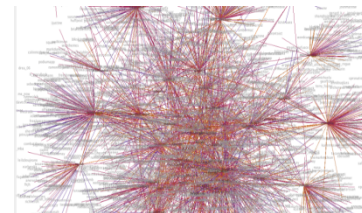
- Time Consuming
- Limited Resources

# Freetext Challenge

Role: Interpret the data



Subject Matter Expert



SNOMED CT

- Automate processes
- Enable Semantic
- Most Knowledgeable
- Multilingual

# Challenge of freetext

## HIS1

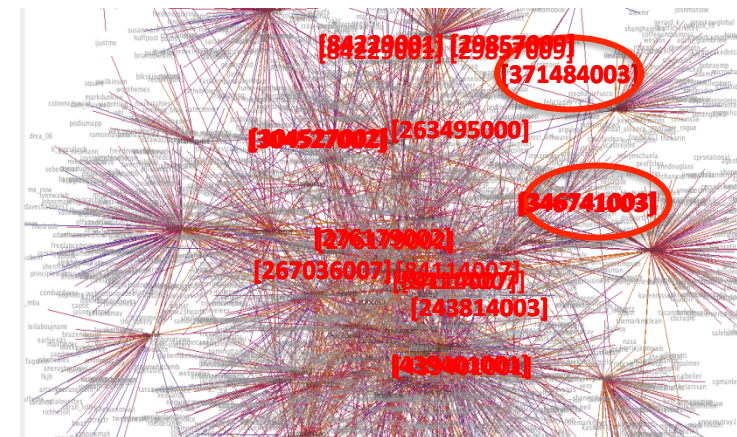
ID	Patient Name	Gender	Symptoms	Diagnosis
1	xx	M	Fatigue, Chest pain	Heart failure
2	yy	F	Breathlessness	Acute athma

## HIS2

ID	Nama Pesakit	Jantina	Tanda-tanda	Diagnosis
1	aa	L	Letih, Sakit dada	Lemah jantung
2	bb	P	Sesak nafas	Lelah

## HIS3

ID	Pat.Name	Sex	Disorder	Diagnosis
1	kk	Male	Tiredness, Pain in chest	Cardiac failure
2	ll	Female	Dyspnea	Acute bronchitis



# SNOMED CT



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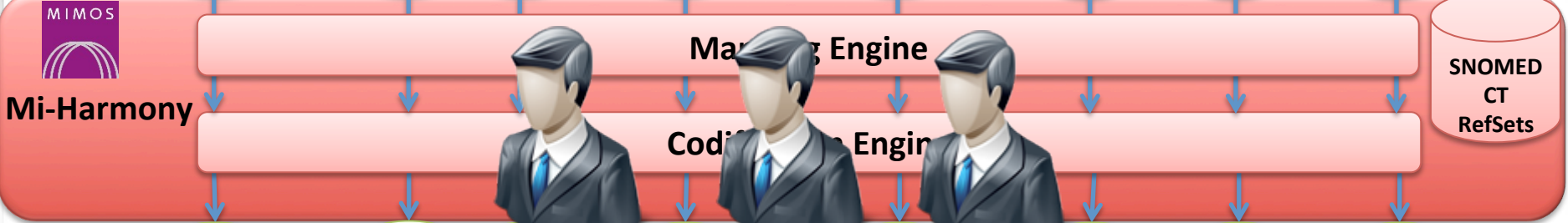


# SNOMED CT based Clinical Data Harmonization

Existing HIS



Un-coded  
Databases



MIMOS  
Mi-Harmony

Mapping Engine

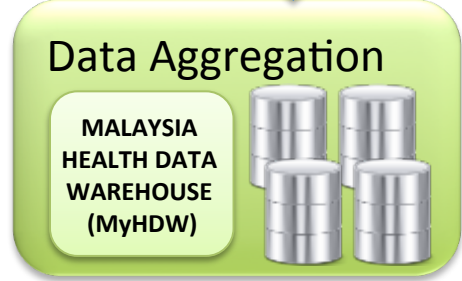
Coding Engine

SNOMED  
CT  
RefSets



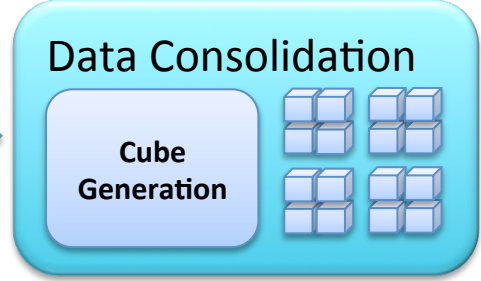
Coded  
Databases

ETL



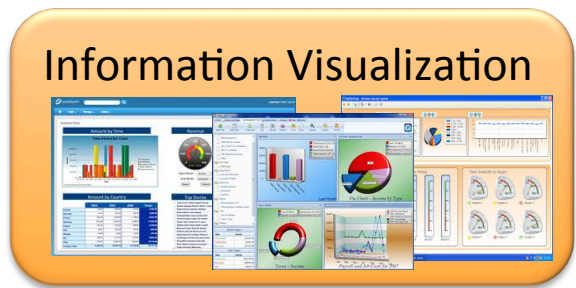
Data Aggregation

MALAYSIA  
HEALTH DATA  
WAREHOUSE  
(MyHDW)



Data Consolidation

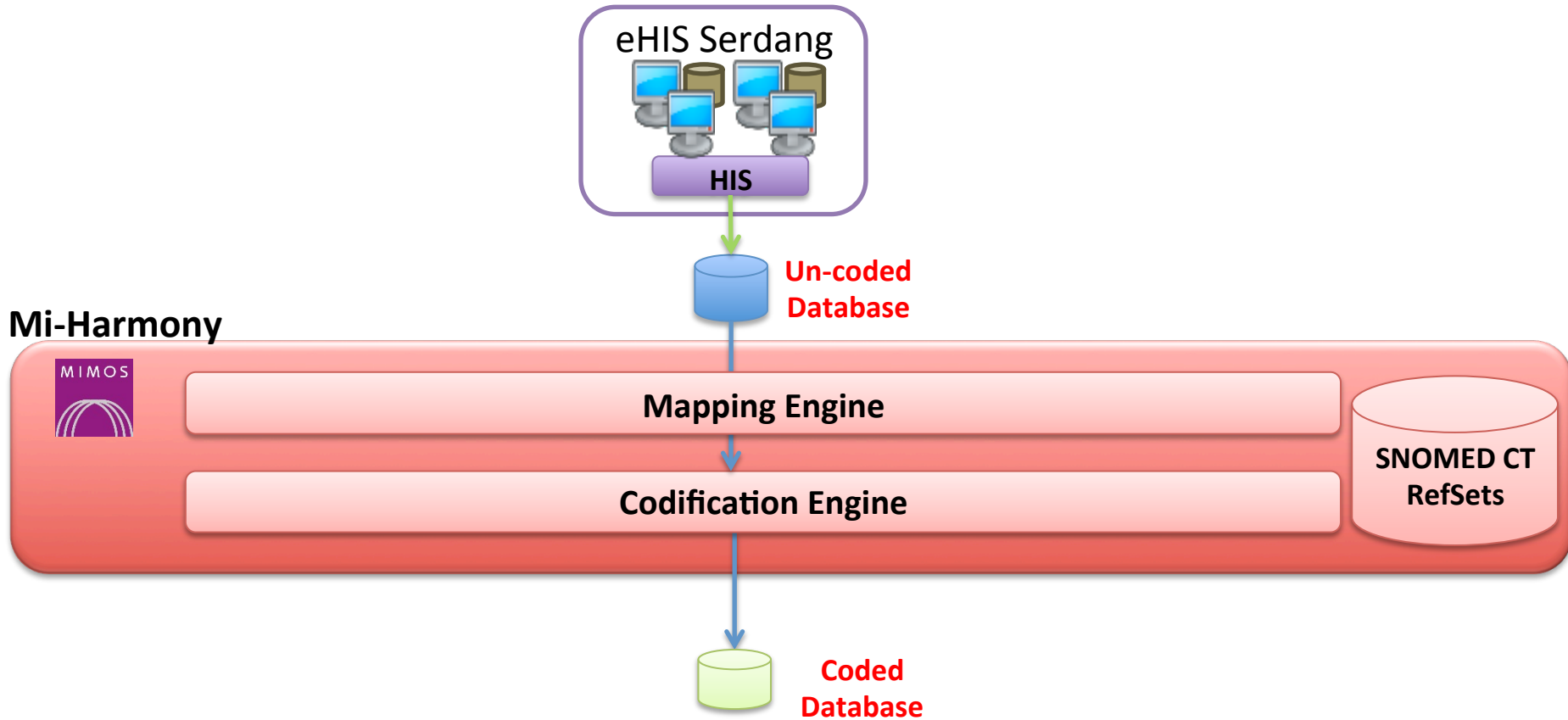
Cube  
Generation



Information Visualization

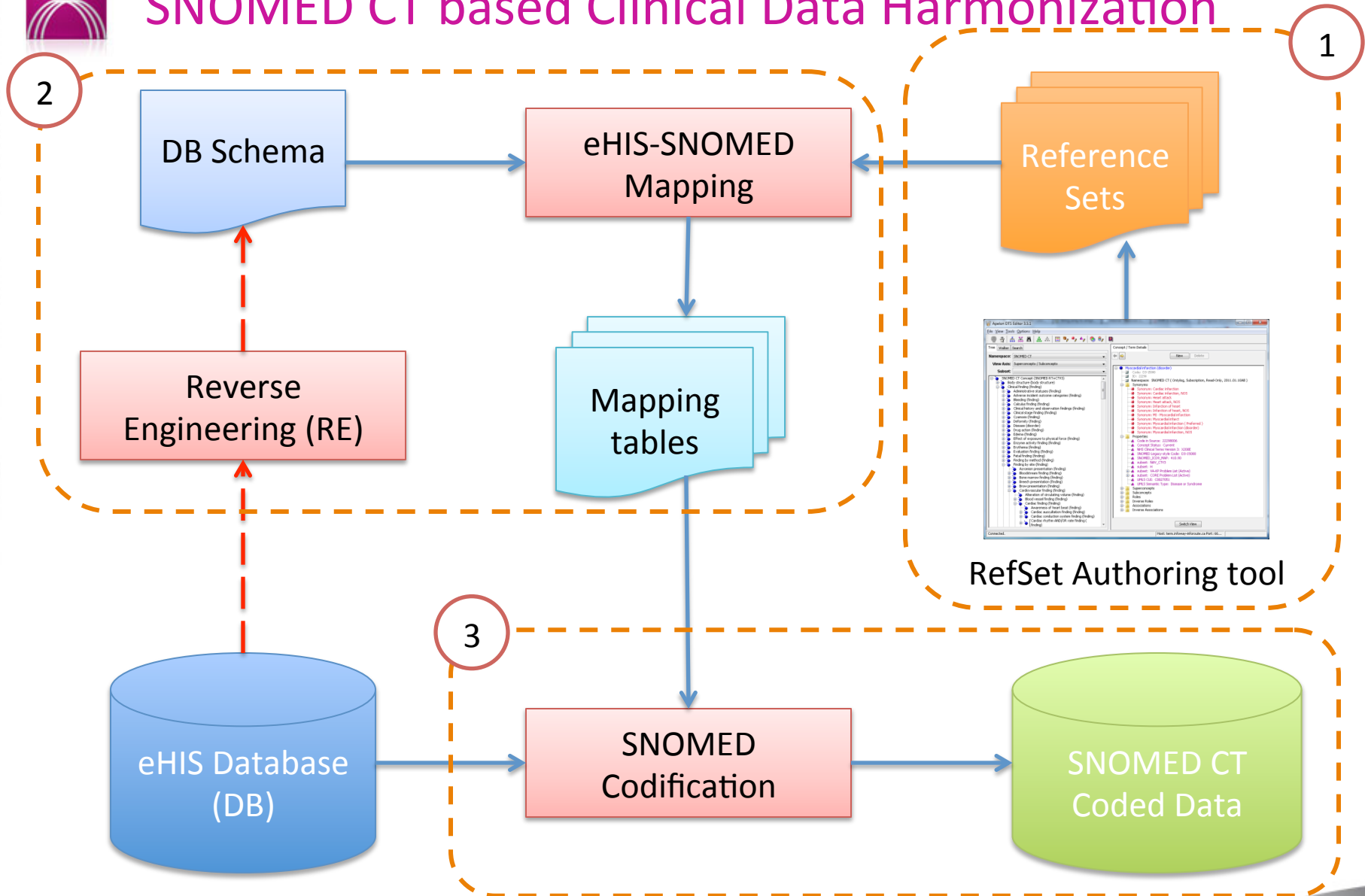


# SNOMED CT based Clinical Data Harmonization



- Semi-automated
- Auto-suggestion of SNOMED CT codes

# SNOMED CT based Clinical Data Harmonization







# Mi-Harmony

Username  Password

**Mi-Harmony**

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# Mi-Harmony: Mapping Table Columns

**Mi-Harmony** Username: mimos  
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Home Connection **Mapping** Codification

Mapping Columns Mapping Reference Tables Save Database: ehis\_Serdang

<b>Database Table(s)</b> AA_PATIENT_DIAGNOSIS AE_ACCS_RIGHTS_BY_PAC_TYPE AE_BAY_TYPE AE_BED_FOR_TRMT_AREA AE_CURRENT_PATIENT AE_CURR_EMERG_PAT_RESULT AE_DISASTER_PAT_REGN AE_DISASTER_TYPE AE_GCS_FOR_RESPONSE	<b>Mapping</b> Selected Column <input type="text"/> Mapped Concept <input type="text"/> OK	<b>Refset: Cardiology_Refset_1.1</b> <ul style="list-style-type: none"><li>243796009 Situation with explicit context</li><li>363787002 Observable entity</li><li>365580001 Finding of personal status</li><li>404684003 Clinical finding</li><li>71388002 Procedure</li></ul>						
<b>Table Column(s)</b> PAT_ID ENCNTR_ID <b>PAT_NAME</b> AGE MAR_STAT DIAGNOSIS	<b>Mapping Concept(s)</b> <table border="1"><thead><tr><th></th><th>Selected Column</th><th>Mapped Concept</th></tr></thead><tbody><tr><td>✖</td><td>PAT_NAME</td><td>371484003 (patien</td></tr></tbody></table>		Selected Column	Mapped Concept	✖	PAT_NAME	371484003 (patien	<b>Suggested Concept(s)</b> <ul style="list-style-type: none"><li>195069001 PAT (85.36%)</li><li>371484003 Patient name (90.71%)</li></ul> <input type="text"/> Search
	Selected Column	Mapped Concept						
✖	PAT_NAME	371484003 (patien						

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# Mi-Harmony: Mapping Reference Table

**Mi-Harmony** Username: mimos  
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Home Connection **Mapping** Codification

Mapping Columns **Mapping Reference Tables**  Database: ehis\_Serdang

<p>Database Table(s)</p> <ul style="list-style-type: none"><li>AE_BAY_TYPE</li><li>AE_DISASTER_TYPE</li><li>AE_GCS_FOR_RESPONSE</li><li>AE_GCS_RESPONSE</li><li>AE_GCS_SCORE</li><li>AE_IMMOBILIZATION</li><li>AE_INJURY_CATEGORY</li><li>AE_INJURY_SUBCATEGORY</li><li>AE_PARAM</li></ul>	<p>Mapping</p> <p>Selected Value <input type="text"/></p> <p>Mapped Concept <input type="text"/></p> <p><input type="button" value="OK"/></p>	<p>Refset: Cardiology_Refset_1.1</p> <ul style="list-style-type: none"><li><a href="#">243796009 Situation with explicit context</a></li><li><a href="#">363787002 Observable entity</a></li><li><a href="#">365580001 Finding of personal status</a></li><li><a href="#">404684003 Clinical finding</a></li><li><a href="#">71388002 Procedure</a></li></ul>																												
<table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th>Table Column(s)</th><th>Column Value(s)</th></tr></thead><tbody><tr><td>DISASTER_TYPE_CODE</td><td>Air Crash</td></tr><tr><td>LONG_DESC</td><td>Chemical Warfare</td></tr><tr><td>SHORT_DESC</td><td>Explosion</td></tr><tr><td>EFF_STATUS</td><td>Landslide</td></tr><tr><td>ADDED_BY_ID</td><td>Biochemical Warfare</td></tr><tr><td>ADDED_DATE</td><td>Collapsed Building</td></tr><tr><td>ADDED_AT_WS_NO</td><td>Fire</td></tr><tr><td>ADDED_FACILITY_ID</td><td>Maritime Accident</td></tr><tr><td>MODIFIED_BY_ID</td><td>Biological Warfare</td></tr></tbody></table>	Table Column(s)	Column Value(s)	DISASTER_TYPE_CODE	Air Crash	LONG_DESC	Chemical Warfare	SHORT_DESC	Explosion	EFF_STATUS	Landslide	ADDED_BY_ID	Biochemical Warfare	ADDED_DATE	Collapsed Building	ADDED_AT_WS_NO	Fire	ADDED_FACILITY_ID	Maritime Accident	MODIFIED_BY_ID	Biological Warfare	<table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th colspan="2">Mapping Concept(s)</th></tr><tr><th></th><th></th></tr></thead><tbody><tr><td><input checked="" type="checkbox"/></td><td>Air Crash</td></tr><tr><td><input checked="" type="checkbox"/></td><td>Fire</td></tr></tbody></table>	Mapping Concept(s)				<input checked="" type="checkbox"/>	Air Crash	<input checked="" type="checkbox"/>	Fire	<p>Suggested Concept(s)</p> <ul style="list-style-type: none"><li><a href="#">725933000 Fire (85.36%)</a></li><li><a href="#">136953001 Fireman (87.14%)</a></li><li><a href="#">423624000 Fireback (85.00%)</a></li><li><a href="#">217177006 House fire (85.36%)</a></li><li><a href="#">30348005 Fir (91.25%)</a></li><li><a href="#">10727001 Fire salamander (85.36%)</a></li><li><a href="#">257195008 Fire (100.00%)</a></li></ul> <p><input type="text"/> <input type="button" value="Search"/></p>
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<input checked="" type="checkbox"/>	Air Crash																													
<input checked="" type="checkbox"/>	Fire																													

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# Mi-Harmony: Codification

## Mi-Harmony

Username: mimos

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Home Connection Mapping **Codification**

Table Selection   Database: ehis\_Serdang

Database Table(s)	
<a href="#">AE BED FOR TRMT AREA</a>	<input type="checkbox"/>
<a href="#">AE_CURRENT_PATIENT</a>	<input type="checkbox"/>
<a href="#">AE_CURR_EMERG_PAT_RESULT</a>	<input type="checkbox"/>
<a href="#">AE_DISASTER_PAT_REGN</a>	<input type="checkbox"/>
<a href="#">AE_DISASTER_TYPE</a>	<input type="checkbox"/>
-----	

OK

Table Column(s)	
LONG_DESC	<input checked="" type="checkbox"/>
SHORT_DESC	<input type="checkbox"/>
EFF_STATUS	<input type="checkbox"/>
ADDED_BY_ID	<input type="checkbox"/>
ADDED_DATE	<input type="checkbox"/>

OK

Selected Table(s) & Column(s)	
Table Name	Column Name
<input checked="" type="checkbox"/> AA_PATIENT_DIAGNOSIS	DIAGNOSIS
<input checked="" type="checkbox"/> AE_DISASTER_TYPE	LONG_DESC

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# Mi-Harmony: Sample codified result

Result Set Filter:  Export: Wrap Cell Content:

	COMPLAINT_ID	COMPLAINT_DESC	COMPLAINT_TEXT
▶	CC003	Cardiac arrest (traumatic)	[cardiac arrest\$397912004\$], [unspecified\$10003008\$]
	CC04	Chest pain	[chest pain\$139228007\$], [unspecified\$10003008\$]
	CC08	Edema, generalized	[Generalized edema\$442433009\$]
	CC11	Unilateral reddened hot limb: DVT symptoms	[other specified soft tissue\$181789000\$] [disorders\$64572001\$], unspecified site
	CC12	Earache	[Otagia\$155251005\$]
	CC13	Foreign body	[Foreign body in ear\$75441006\$]
	CC14	Loss of hearing	[hearing loss\$155242002\$] ¿ [unspecified\$10003008\$]
	CC15	Tinnitus / Dysacusis	[Tinnitus\$60862001\$]
	CC16	Discharge	[Otorrhea\$65668001\$]
	CC17	Ear injury	[Superficial injury of the ear\$1910005\$]
	CC18	Dental / Gum problem	Disorder of gingiva [and\$421829000\$] [edentulous alveolar ridge\$93446008\$],...
	CC19	Facial trauma	Superficial injury [of\$18720000\$] other parts [of\$18720000\$] the [head\$69536...
	CC20	Sore throat	[acute pharyngitis\$155502006\$], [unspecified\$10003008\$]
	CC21	Neck swelling/pain	Localized [swelling\$65124004\$], mass and [lump\$300848003\$], [neck\$30255...
	CC23	Difficulty swallowing / Dyspahiga	Other unspecified dysphasia
	CC25	Epistaxis	[Epistaxis\$12441001\$]
	CC27	Foreign body, nose	[Foreign body in nostril\$33890007\$]
	CC28	URTI complaints	[acute upper respiratory infection\$155516001\$], [unspecified\$10003008\$]

CA\_CHIEF\_COMPLAINT 1 x



# Outline

- Challenges of Data Harmonisation in Malaysia
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# Evaluation & Validation: Methodology

## 1. Prepare Gold Standard:

- Identified 100 terms/phrases from HIS database table
  - Chief complaints
- Manually tagged the relevant SNOMED CT codes for the terms/phrases
  - 3 medical officers were tasked to perform this task

## 2. Compare with Gold Standard:

- Compare the codes generated by Mi-Harmony tool with the one produced in Gold Standard



# Evaluation & Validation: Findings

- Precision: 90%
  - 10% of the terms/phrases are coded incorrectly
    - Concept selected from incorrect hierarchy
      - Eg: *Superficial injury of unspecified body region* was codified with *243928005* which refers to *Entire body region (body structure)*
    - Concept selected more specific rather than generic
      - Eg: *Cyanosis* was codified with *119419001* which refers to *Cyanosis of skin (finding)* instead of *3415004 Cyanosis (finding)*
- Recall: 70%
  - 30% of the terms/phrases are not coded even though the concept exists in SNOMED CT
    - Use of abbreviations and acronyms in the medical text
    - No exact matching of the phrases in SNOMED CT



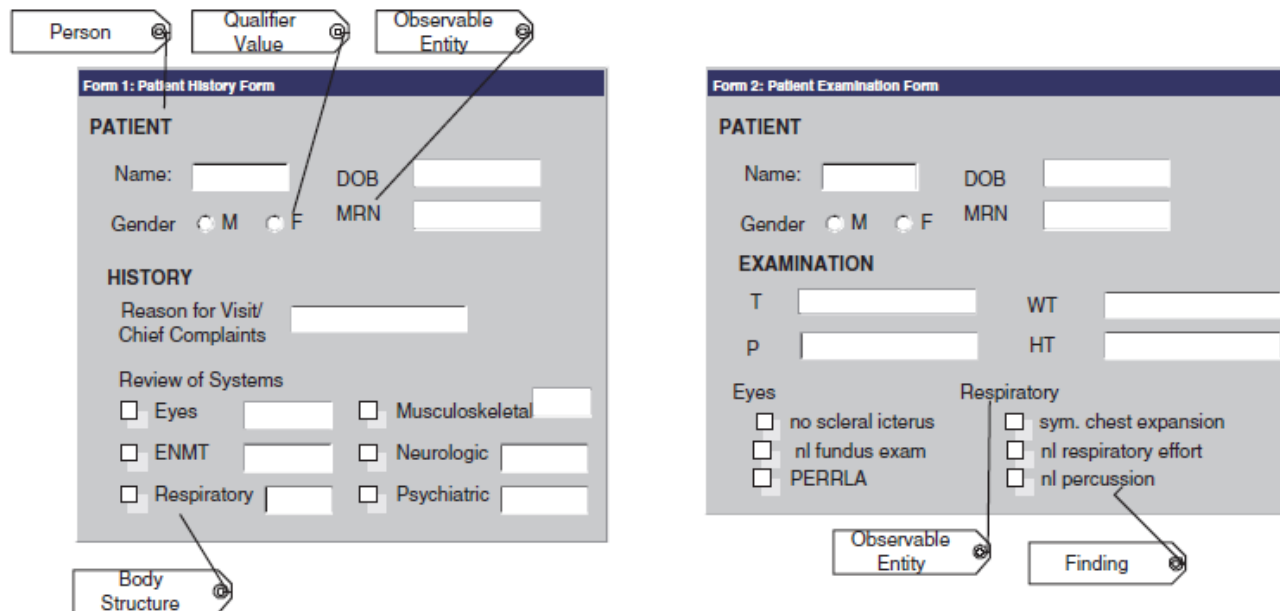


# Mi-Harmony: Ongoing Enhancement

- Improving the concept matching algorithm
  - Include context-based concept matching
    - To solve the problem of concept selection from incorrect hierarchy
- Improving and enhancing the list of commonly used acronyms, abbreviations and local terms that can be found in HIS databases
  - To improve natural language understanding of the free-text in medical records

# Mi-Harmony: Ongoing Enhancement

- Ref Set authoring activity – Cardiology
- Identify the relevant SNOMED CT semantic category for the Patient Registry form





# Summary & Conclusion

- Current challenges in data harmonisation for HIS in Malaysia
- Mi-Harmony as a tool for data harmonisation utilizing SNOMED CT and data from HIS databases
- Further enhancement and validation required to improve the accuracy of the tool



# Q & A

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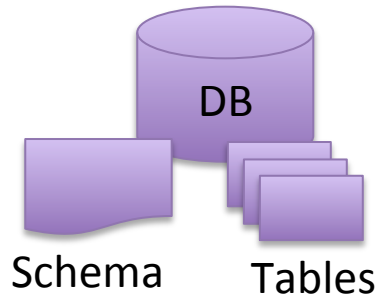
**TERIMA KASIH**  
THANK YOU

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# Enabling the future



## Freetext Challenge

Today



Subject Matter Expert



- Time Consuming
- Limited Resources
- Skills-dependent
- Prone to errors

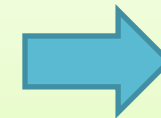


Inaccurate Information

Tomorrow



- Automate processes
- Deal with freetext
- Standardize content



Accurate Information