## **Appendix A:**

### TECI Toolkit Setup

This document provides the steps to install TECI toolkit and generate Elixhauser comorbidity score on a test data set. All required job scripts, tables, and stored procedures are in TECI\_toolkit.zip that is provided along this document. The installation is divided into three categories.

Step 1: Create audit objects, run script in teci\_create\_audit\_object.sql

Step 3: Create Stored Procedures, run teci\_spx\_load\_icd.sql teci\_spx\_load\_drg.sql

teci\_spx\_stg\_scorecalc.sql

teci\_comrb\_index\_score.sql

Step 5: Create Test Data, run

test\_input\_cdr.sql

Step 2: Creating Stored Procedures, execute script in teci\_spx\_toolkit\_setup.sql

Step 6: Load test data into table teci\_input\_source

Step 4: Execute Stored Procedure

teci\_spx\_toolkit\_setup

Step 7: Execute stored procedure teci\_spx\_stg\_scorecalc

Step 8: Execute script in test\_date\_specific\_dataset.sql

Step 9: Execute stored procedure teci\_comrb\_index\_score

Step 10: Result in table teci\_comorb\_van\_score\_op

### Install and Set Up

The set up steps are required for the first time installation:

**Step 1:** Create Audit objects by executing scripts present in file teci\_create\_audit\_object.sql. A list of tables will be created, as in table 1.

**Step 2:** Create TECI objects by creating stored procedures from file teci\_spx\_toolkit\_setup.sql

**Step 3:** Create stored procedures by executing scripts present in below files

* teci\_spx\_load\_icd.sql
* teci\_spx\_load\_drg.sql
* teci\_spx\_stg\_scorecalc.sql
* teci\_comrb\_index\_score.sql

**Step 4:** Execute stored procedure teci\_spx\_toolkit\_setup

### Testing First time Installation

These steps will ensure the toolkit was installed successfully

**Step 5:** Execute script from file test\_input\_cdr.sql to create test data

**Step 6:** Run below script to load test data into table teci\_input\_source. To capture first instance of diagnosis and DRG records of patients in test data.

if (object\_id('dbo.teci\_input\_source') is not null)

Begin

Truncate table dbo.teci\_input\_source;

insert into dbo.teci\_input\_source

(patient\_id,code\_type,code,dx\_drg\_prim\_sec,first\_dx\_drg\_date)

select patient\_id,code\_type,code,dx\_type as dx\_drg\_prim\_sec, first\_dx\_drg\_date

from

(

select patient\_id,code\_type,code,dx\_type, min(dx\_date) as first\_dx\_drg\_date

From dbo.test\_input\_cdr

group by patient\_id,code\_type,code,dx\_type

) x

End

**Step 7:** Execute stored procedure teci\_spx\_stg\_scorecalc, this will identify first Elixhauser comorbidities of pateints.

**Step 8:** Execute script from file test\_date\_specific\_dataset.sql to create date-specific dataset

**Step 9:** Execute stored procedure teci\_comrb\_index\_score, this will calculate time specific Elixhauser comorbidity Index and Van Walraven scores for test patients. Use below parameters to execute teci\_comrb\_index\_score

exec dbo.teci\_spx\_comrb\_index\_score 'teci\_date\_specf\_dataset', '2016-12-31',1,0,1

### Verification

This step will verify the results

**Step 10:** Check the result in table teci\_comorb\_van\_score\_op for study\_name ="test\_teci\_installation", column “comorbidity\_score” should have value "4" and “van\_index” as "0"

Select \* from teci\_comorb\_van\_score\_op where study\_name ='test\_teci\_installation'

### TECI Objects

Audit Objects: Audit related Tables and Stored procedure

|  |  |  |  |
| --- | --- | --- | --- |
| Object Name | Type | Source File | Description |
| teci\_job\_master | Table | teci\_create\_audit\_object.sql | Holds high level stored procedure audit details. Procedure start time, end time and execution status |
| teci\_job\_audit | Table | teci\_create\_audit\_object.sql | Logs execution details of every step of the stored procedure. |
| teci\_job\_error | Table | teci\_create\_audit\_object.sql | Holds error messages occurred while executing a stored procedure |
| teci\_spx\_start\_audit | Stored Procedure | teci\_create\_audit\_object.sql | Stored procedure to write to table teci\_job\_master. |
| teci\_spx\_write\_audit | Stored Procedure | teci\_create\_audit\_object.sql | Stored procedure to write to table teci\_job\_audit. Writes execution details of every step of the stored procedure |
| teci\_spx\_end\_audit | Stored Procedure | teci\_create\_audit\_object.sql | Stored procedure to write to table teci\_job\_master |
| teci\_spx\_write\_error | Stored Procedure | teci\_create\_audit\_object.sql | Stored procedure to write to table teci\_job\_error |

**Table 1: Audit related Tables and Stored procedure**

### Mapping Objects

Tables that store ICDs, DRG, Elixhauser and van Walraven codes

|  |  |  |  |
| --- | --- | --- | --- |
| Object Name | Type | Source File | Description |
| teci\_icd\_codes | Table | teci\_spx\_toolkit\_setup.sql | Table stores ICD9 and ICD10 codes used to identitfy Elixhauser comorbidities |
| teci\_drg\_codes | Table | teci\_spx\_toolkit\_setup.sql | Table holds DRG codes used to identitfy Elixhauser comorbidities |
| teci\_comorb\_codes | Table | teci\_spx\_toolkit\_setup.sql | Table holds Elixhauser comorbidities along with the binary code assigned to them |
| teci\_vwindex\_weights | Table | teci\_spx\_toolkit\_setup.sql | Table holds van Walraven index for each comrobidity |

**Table 2: Mapping related tables**

### Data Objects

All intermediate and final data table and stored procedures

|  |  |  |  |
| --- | --- | --- | --- |
| Object Name | Type | Source File | Description |
| teci\_input\_source | Table | teci\_spx\_toolkit\_setup.sql | Table stores first instance of diagnosis and DRG records of all CDR patients. This is provided by Toolkit users |
| teci\_cdr\_pat\_comorb | Table | teci\_spx\_toolkit\_setup.sql | Table holds first occurrence dates of Elixhauser comrobidities for all CDR patients |
| teci\_cdr\_pat\_comorb\_bincode | Table | teci\_spx\_toolkit\_setup.sql | Table holds first occurrence dates of comrobidities for all CDR patients same as that of teci\_cdr\_pat\_comorb. Along with all ICD/DRG codes associated with Elixhauser comorbidity codes |
| teci\_date\_specf\_dataset | Table | teci\_spx\_toolkit\_setup.sql | Table holds date-specific study data on which Elixhauser comorbidity Index and van walraven scores are needed. This is provided by Toolkit users. \*\* To calculate scores on complete CDR patients, patient diagnosis and DRGs should be loaded into this table. (Note: this table differs from teci\_input\_source, where the later contains first instance of diagnosis and DRGs) |
| teci\_comorb\_van\_score\_op | Table | teci\_spx\_toolkit\_setup.sql | Output table that holds Elixhauser comorbidity Index and van walraven scores |
| teci\_spx\_toolkit\_setup | Stored Procedure | teci\_spx\_toolkit\_setup.sql | Stored procedure creates tables that TECI toolkit will use. It also populates mapping tables. |
| teci\_spx\_load\_icd | Stored Procedure | teci\_spx\_load\_icd.sql | Stored procedure loads ICD9 and ICD10 codes into table teci\_icd\_codes. These codes are used to identify Elixhauser comorbidities |
| teci\_spx\_load\_drg | Stored Procedure | teci\_spx\_load\_drg.sql | Stored procedure loads DRG codes into table teci\_drg\_codes. These codes are used to identify Elixhauser comorbidities |
| teci\_spx\_stg\_scorecalc | Stored Procedure | teci\_spx\_stg\_scorecalc.sql | Stored procedure identifies first occurrence of Elixhauser comorbidity dates for all CDR patient and loads in to tables teci\_cdr\_pat\_comorb and teci\_cdr\_pat\_comorb\_bincode |
| teci\_spx\_comrb\_index\_score | Stored Procedure | teci\_spx\_comrb\_index\_score.sql | Stored procedure calculates time specific Elixhauser comorbidity Index and van walraven scores. The results are stored into table teci\_comorb\_van\_score\_op |

**Table 3: All intermediate and final data table and stored procedures**

## **Appendix B:**

To add new versions of DRGs, download the DRG codes from CMS (Centers for Medicare and Medicaid Services) website. For DRGs related to Elixhauser comorbidities, group DRGs code by disease. For example **DRG: 32 as “NERVDRG”, DRG: 190 as “PULMDRG”**. The START DATE of DRGs should be 1 October of the year of release (example: 2019-10-01 for DRG version 37). The END DATE should be “2099-09-30”, until the next DRG release.

Add insert statement for each DRG codes to the stored procedure **teci\_spx\_load\_drg.** Below is an example

INSERT [dbo].[teci\_drg\_codes] ([DRG], [CODE], [VER], [start\_date], [end\_date]) VALUES ('032', 'NERVDRG', 38, '2020-10-01', '2099-09-30' );

After updating TECI\_SPX\_LOAD\_DRG stored procedure script, execute the stored procedure. This will truncate and reload the table TEC\_DRG\_CODES. Confirm if the table has latest version of DRG codes

## **Appendix C:**

### I2B2 Extension:

**PATEINT DIMENSION:** The patient\_dimension DDL table should be modified to add column “VW\_SCORE”. The computed van Walraven (VW) score is loaded into PATIENT\_DIMENSION.VW\_SCORE. The sample query below will load VW scores for all Clinical Data Repository (CDR) patients into I2B2’s dimension table.

Alter table dbo.patient\_dimension

add [I2B2\_server\_name].[schema\_name].vw\_score int; -- Change the I2B2\_server\_name to server that host I2B2.

UPDATE c

set c.vw\_score = a.van\_index

FROM [TECI\_server\_name].[schema\_name].[TECI\_COMORB\_VAN\_SCORE] a -- Change the TECI\_server\_name to server that host TECI toolkit

join [PATIENT\_LOOKUP\_server\_name].[schema\_name].PATIENT\_LOOKUP b -- Change the PATIENT\_LOOKUP\_server\_name to server that host PATIENT\_LOOKUP table.

on a.patient\_id = b.patient\_id

join [I2B2\_server\_name].[schema\_name].PATIENT\_DIMENSION c -- Change the I2B2\_server\_name to server that host I2B2.

on c.PATIENT\_NUM = b.PATIENT\_NUM

where a.study\_name = 'CDR\_ALL\_Patient\_Score' --Change the study name to the name used.

**OBSERVATION\_FACT**: The Elixhauser code for all CDR patient is computed and stored in table “TECI\_COMORB\_VAN\_SCORE”. To append first comorbidity date, table TECI\_COMORB\_VAN\_SCORE should be joined to staging table “teci\_cdr\_pat\_comorb\_bincode”, as shown below. Join these table to patient\_lookup and encounter\_lookup table to get associated patient\_num and encounter\_num.

Select c.patient\_num,

--d.encounter\_num ----join to respective table to get encounter\_id

'elix:'+ a.comorb\_code as concept\_cd,b.first\_comrob\_date as start\_date,

case

when b.comorb\_prim\_sec = 'primary' then 1

else 2

end as MODIFIER\_CD,

1 as INSTANCE\_NUM,

'prov:0' as provider\_id -- replace prov:0 name with any defualt value

from

(

SELECT patient\_id,comorb\_code,comorb\_score

FROM

(

SELECT patient\_id, AIDS,ALCOHOL,ANEMDEF,ARTH,BLDLOSS,CHF,CHRNLUNG,COAG,DEPRESS,DM,DMCX,DRUG,HTN\_C,

HYPOTHY,LIVER,LYMPH,LYTES,METS,NEURO,OBESE,PARA,PERIVASC,PSYCH,PULMCIRC,RENLFAIL,TUMOR,ULCER,

VALVE,WGHTLOSS,ARRHYTH

from [TECI\_server\_name].[schema\_name].teci\_comorb\_van\_score\_op

where study\_name ='study\_name’

)

p

UNPIVOT

(

comorb\_score FOR comorb\_code IN

( AIDS,ALCOHOL,ANEMDEF,ARTH,BLDLOSS,CHF,CHRNLUNG,COAG,DEPRESS,DM,DMCX,DRUG,HTN\_C,

HYPOTHY,LIVER,LYMPH,LYTES,METS,NEURO,OBESE,PARA,PERIVASC,PSYCH,PULMCIRC,RENLFAIL,TUMOR,ULCER,

VALVE,WGHTLOSS,ARRHYTH

)

)AS unpvt

where comorb\_score <>0

)

a

join

(

Select patient\_id, comorb\_code, min(min\_comorb\_date) as first\_comrob\_date,comorb\_prim\_sec

from [TECI\_server\_name].[schema\_name].teci\_cdr\_pat\_comorb\_bincode

group by patient\_id, comorb\_code,comorb\_prim\_sec

)

b

on a.patient\_id = b.patient\_id

and a.comorb\_code = b.comorb\_code

join [PATIENT\_LOOKUP\_server\_name].[schema\_name].PATIENT\_LOOKUP c -- Change the PATIENT\_LOOKUP\_server\_name to server that host PATIENT\_LOOKUP table.

on a.patient\_id = c.patient\_id

--join to (encoutner lookup) d table to get encounter\_num

### OMOP Extension:

#### **Add Elixhauser scores to Measurement table**: The Elixhauser code for all CDR patient is computed and stored in table “TECI\_COMORB\_VAN\_SCORE”. To append first comorbidity date, table TECI\_COMORB\_VAN\_SCORE should be joined to staging table “teci\_cdr\_pat\_comorb\_bincode”, as shown below. Join these table to patient\_crosswalk table to get associated person\_id

Select

--measurement\_id, -- add default or auto increment value.

c.patient\_id as person\_id,

0 as measurement\_concept\_id,

0 as measurement\_type\_concept\_id,

0 as measurement\_source\_concept\_id,

a.comorb\_code as measurement\_source\_value,

b.first\_comrob\_date as measurement\_datetime,

case

when b.comorb\_prim\_sec = 'primary' then 1

else 2

end as value\_source\_value

from

(

SELECT patient\_id,comorb\_code,comorb\_score

FROM

(

SELECT patient\_id, AIDS,ALCOHOL,ANEMDEF,ARTH,BLDLOSS,CHF,CHRNLUNG,COAG,DEPRESS,DM,DMCX,DRUG,HTN\_C,

HYPOTHY,LIVER,LYMPH,LYTES,METS,NEURO,OBESE,PARA,PERIVASC,PSYCH,PULMCIRC,RENLFAIL,TUMOR,ULCER,

VALVE,WGHTLOSS,ARRHYTH

from [TECI\_server\_name].[schema\_name].teci\_comorb\_van\_score\_op

where study\_name ='study\_name'

)

p

UNPIVOT

(

comorb\_score FOR comorb\_code IN

( AIDS,ALCOHOL,ANEMDEF,ARTH,BLDLOSS,CHF,CHRNLUNG,COAG,DEPRESS,DM,DMCX,DRUG,HTN\_C,

HYPOTHY,LIVER,LYMPH,LYTES,METS,NEURO,OBESE,PARA,PERIVASC,PSYCH,PULMCIRC,RENLFAIL,TUMOR,ULCER,

VALVE,WGHTLOSS,ARRHYTH

)

)AS unpvt

where comorb\_score <>0

)

a

join

(

Select patient\_id, comorb\_code, min(min\_comorb\_date) as first\_comrob\_date,comorb\_prim\_sec

from [TECI\_server\_name].[schema\_name].teci\_cdr\_pat\_comorb\_bincode

group by patient\_id, comorb\_code,comorb\_prim\_sec

)

b

on a.patient\_id = b.patient\_id

and a.comorb\_code = b.comorb\_code

join [PATIENT\_CROSSWALK\_server\_name].[schema\_name].PATIENT\_CROSSWALK c -- Change the PATIENT\_CROSSWALK\_server\_name to server that host PATIENT\_CROSSWALK table.

on a.patient\_id = c.patient\_id;

#### **Add van Walraven (VW) score to Measurement table**: The computed van Walraven (VW) score is loaded into OMOP’s Measurement table. The sample query below will load VW scores for all Clinical Data Repository (CDR) patients into the table.

Select

--measurement\_id, -- add default or auto increment value.

b.patient\_id as person\_id,

0 as measurement\_concept\_id,

0 as measurement\_type\_concept\_id,

0 as measurement\_source\_concept\_id,

a.comorb\_code as measurement\_source\_value,

getdate() as measurement\_datetime,

a.van\_index as value\_source\_value,

a.van\_index as value\_as\_number

FROM [TECI\_server\_name].[schema\_name].[TECI\_COMORB\_VAN\_SCORE] a -- Change the TECI\_server\_name to server that host TECI toolkit

join [PATIENT\_CROSSWALK\_server\_name].[schema\_name].PATIENT\_CROSSWALK b -- Change the PATIENT\_CROSSWALK\_server\_name to server that host PATIENT\_CROSSWALK table.

on a.patient\_id = b.patient\_id

where a.study\_name = 'CDR\_ALL\_Patient\_Score' --Change the study name to the name

## **Appendix D:**

To query Elixhauser comorbidities and van Walraven scores please refer to I2B2 taxonomy available in the file “i2b2\_taxonomy.sql”.