Supplementary Materials

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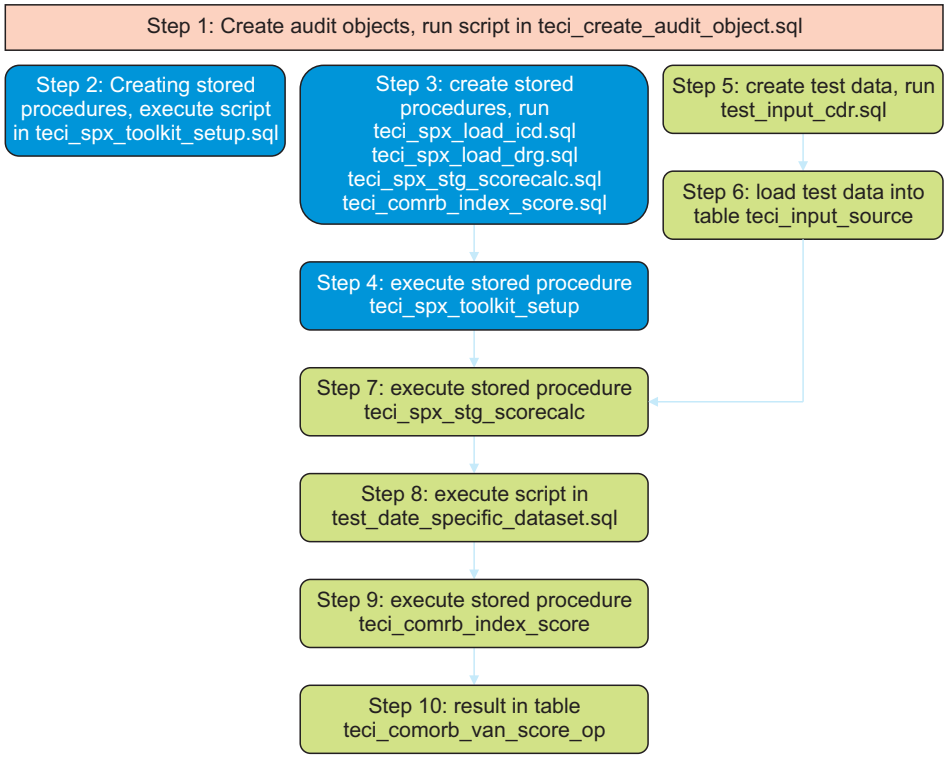
Supplementary A

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.



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

Table 1. 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.

Mapping Objects

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

Table 2. Mapping related tables

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

Data Objects

All intermediate and final data table and stored procedures

Table 3. 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

Supplementary 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

Supplementary 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,REN
LFAIL,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,REN
LFAIL,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,REN
LFAIL,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,REN
LFAIL,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
```

Supplementary D

To query Elixhauser comorbidities and Van Walraven scores please refer to I2B2 taxonomy available in the file “i2b2_taxonomy.sql”.