

Efficient & Accurate Reporting with a Dedicated Telehealth Data Mart

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ABSTRACT

Given the nature of telehealth programs, data is collected and stored in disparate systems owned by numerous telehealth vendors, separate institutions participating in services and various institutional departments who own different reporting databases and software systems. Several challenges result from this architecture including inconsistent methodologies used to merge and clean data sets, variation in metrics reported depending on the source of the data, and redundant work required to build different reporting outputs.

At the Medical University of South Carolina, (MUSC) Center for Telehealth, a dedicated data mart was designed for our telehealth programs to create a more efficient, consistent, and accurate reporting process to address these challenges. Data are obtained numerous ways including: vendors sharing flat files and transferring them to MUSC via Secure File Transfer Protocol (SFTP); data are transferred from a direct database connection from a software system's database; or files are manually downloaded from software system. Data are then loaded and stored in a SQL Server database and cleaned through a set of Extract, Transform, Load (ETL) processes built in SQL Server Integration Services (SSIS) components through Microsoft Visual Studio. Merged and cleaned data sets are built and stored in the database from the source data loaded in the data mart. The same cleaned data are then used for all subsequently built reports in different analytical tools such as Tableau or Microsoft BI.

METHODS

For each new data source, analysts must complete the following steps

- 1. Obtain access to the data source
- 2. Define data elements of interest
- 3. Create DDL (Data Definition Language) to store data
- 4. Create transformation process from data at source to target data format
- 5. Load historical data as one time test of processes
- 6. Validate data was loaded correctly
- 7. Determine refresh frequency and type (incremental or full refresh)
- 8. Create and test refresh process
- 9. Automate process
- 10.Add error handling and notifications to automation process

Naming Conventions

All table names include the source system of the data when feasible to know which software system the data is from. Tables created during the ETL process to clean or merge data from multiple source systems together do not have a source related table name. When possible, we create column names that are consistent with how they are named in the source data.

Security and Access

Only database administrators and reporting analysts have user account access to the data mart. SQL knowledge is required to obtain this access. For managers, leaders, vendors and other stakeholders we build and provide data feeds or business intelligence reporting dashboards that connect to the database for self-service access to the data. The database is backed up weekly and user accounts are reviewed yearly. A reporting user was created for business intelligence tools to connect to the data mart.

Entity Relationship Diagram (ERD)

Entity relationship diagrams show the structure of the objects that make up a database. Each rectangle below represents a table in our telehealth data mart with PK specifying the primary key or columns that form a unique identifier for each row of data within the table.

SMART_DATA_ELEMENT

hlv_id varchar NOT NULL line int NOT NULL

ANDOR_BILLING	PK account_id int NOT NULL
K billing_id int NOT NULL	
	APPT_SURVEY
ANDOR_CALL_LOGS	PK pat_enc_csn_id numeric NOT NULL
mrn varchar NOT NULL statscollected datetime NOT NULL	
	DEPARTMENT_INFO
ANDOR_CONSULTS	PK department_id numeric NOT NULL
order_id smallint NOT NULL	
	EMP_INFO
ANDOR_INTERACTIONS	PK user_id varchar NOT NULL
careplan_timer_id int NOT NULL	
	HSP_ACCT_DX_LIST hsp_account_id numeric NOT NULL
ANDOR_PATIENT_COMMENTS	PK line int NOT NULL
account varchar NOT NULL	
	MARKETING_REGION
ANDOR_VIRTUAL_VISITS	PK zipcode int NOT NULL
ntment_accountnumber varchar NOT NULL	
	ORDERS
	PK order_id varchar NOT NULL
ANDOR_LTW_OUTREACHES andorpatientid int NOT NULL	
outreachdatetime datetime NOT NULL	PAT_ENC_DX PK pat_enc_csn_id numeric NOT NULL line int NOT NULL
ANDOR_LTW_PATIENT	
andorpatientid int NOT NULL	PATIENT
	PK pat_id varchar NOT NULL
ANDOR_LTW_RESPONSES	
andorpatientid int NOT NULL formname varchar NOT NULL	PATIENT_APPT
	PK pat_enc_csn_id numeric NOT NULL line int NOT NULL
ANDOR_LTW_VIRTUAL_VISITS	
andorpatientid int NOT NULL appointmentdatetime datetime NOT NULL	PATIENT_ENCOUNTER
	PK pat_enc_csn_id numeric NOT NULL
	PROB_LIST
	PK pat_enc_csn_id numeric NOT NULL
LOOKUP_FORHP_ELIGIBLE_RURAL	
K zip_code int NOT NULL	PROVIDER_INFO
	PK prov_id varchar NOT NULL
LOOKUP_RUCA_2010_RURAL	
zip_code int NOT NULL	REF_DEPT
	PK department_id varchar NOT NULL
MUSCL	
visit_id varchar NOT NULL	REF_ICCE

CCOUNT	HOSPITALIST_REDCAP
int NOT NULL	PK record_id varchar NOT NULL
T_SURVEY	NEWBORN_HOME_REDCAP
n_id numeric NOT NULL	PK record_id varchar NOT NULL
RTMENT INFO	REACH REDCAP
id numeric NOT NULL	PK reach id varchar NOT NULL
_id ildilicito ito i ito EE	THE TOUGH_TO VOI HOLD
MP_INFO	SBT_REFERRAL_REDCAP
char NOT NULL	PK record_id varchar NOT NULL
CCT_DX_LIST	SOLO_REDCAP
nt_id numeric NOT NULL NULL	PK record_id varchar NOT NULL
TING_REGION	TELE_HOSPITALIST_REDCAP
NOT NULL	PK record_id varchar NOT NULL
ORDERS	VIRTUAL_RN_REDCAP
rchar NOT NULL	PK record_id varchar NOT NULL
Γ_ENC_DX	VRN FEEDBACK REDCAP
n_id numeric NOT NULL	PK record id varchar NOT NULL
NULL	
PATIENT	
nar NOT NULL	
	PRESS_GANEY
IENT_APPT	PK itunique int NOT NULL
n_id numeric NOT NULL	
Γ_ENCOUNTER	ZIPNOSIS
n_id numeric NOT NULL	PK id varchar NOT NULL
	FIX TO VAICHAL NOT NOLL
ROB_LIST	

Data Marts require ongoing maintenance from both a technical and workflow prospective. As vendors change or new vendors are utilized, new feeds to and from the data mart will be required to enhance reporting capabilities. Backups, storage requirements and ETL processes will need to be monitored and updated periodically. We also anticipate moving the data mart from an on-premise server to cloud based technology on Microsoft Azure in the next year or two in line with enterprise initiatives. More immediate enhancements include: 1. Adding in additional billing data from EPIC to help monitor billing compliance.

Future Plans

- Adding in additional billing data from EPIC to help monitor billing compliance and improve operational processes and ROI reporting
- 2. Adding Vizient benchmarking data
- 3. Adding Neuroflow vendor data
- 4. Adding new Andor data as functionality continues to be developed on the platform
- 5. Increasing frequency of data refreshes
- 6. Building tableau self-service dashboards for stakeholders to have consistent and immediate access to the data

archar NOT NULL CC

PK	id int NOT NULL
	TSIM_SITE
PK	id int NOT NULL
	TSIM_VOLUME_TRACKING
FK	service id int NOT NULL

TSIM SERVICES

CONCLUSIONS

This work reduces the amount of effort needed from analysts to build reports and ensures all reports utilize consistent definitions and methodologies to present the data to stakeholders. Validated and consistent reporting allows stakeholder focus to shift from investigating and explaining data discrepancies between data sources to utilizing reports for data driven decision making with confidence.