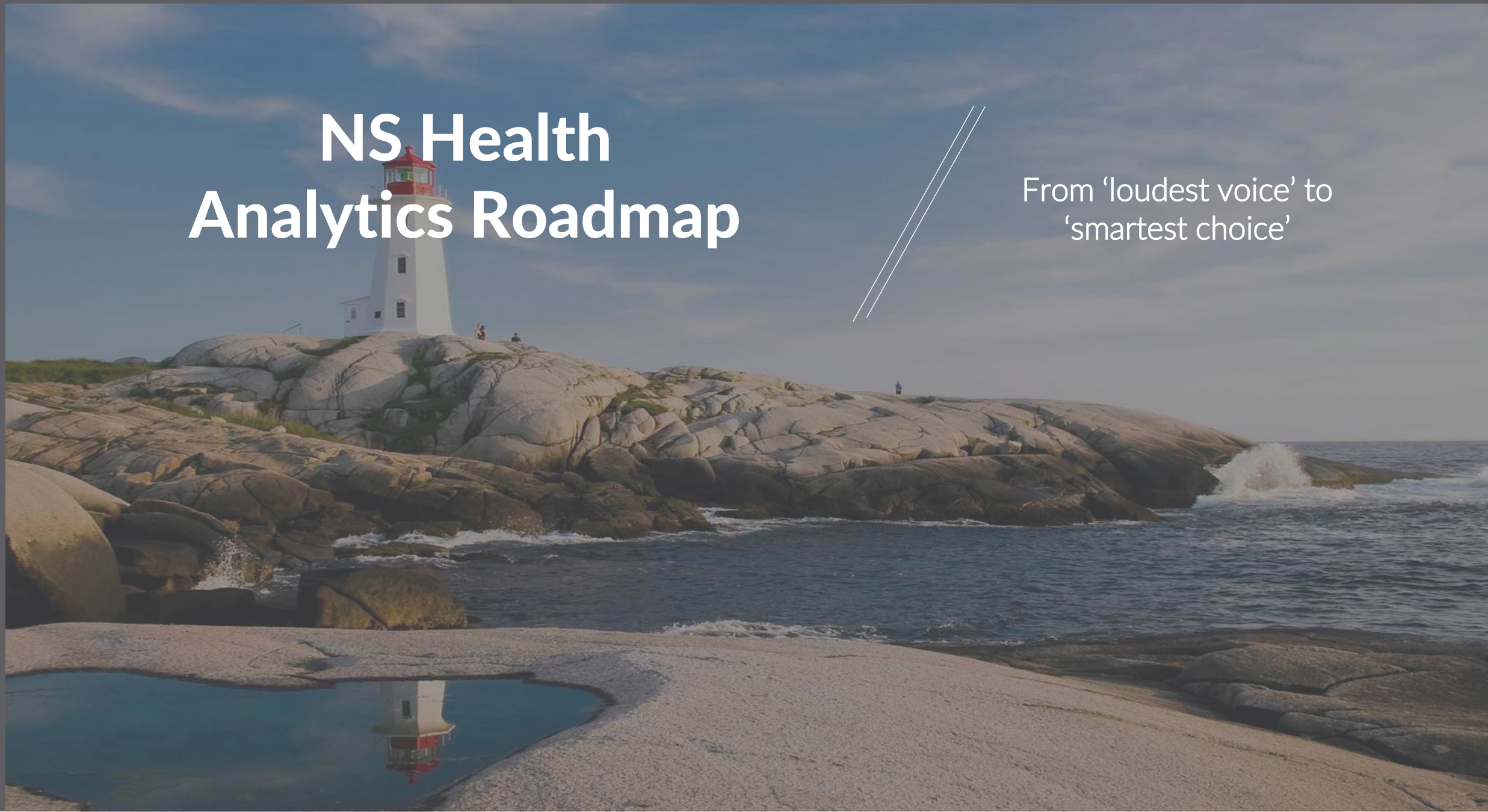
Let's Talk Informatics

NS Health Analytics Roadmap

- Audience audio and video options have been disabled.
- To interact in the Q & A portion of the presentation, type your question in the chat window **and select the "all panelist" option to direct your question**.
- Today's session is being recorded and registered guests will be emailed a link to access from EventBrite.
- Want to stay informed about future sessions? Get on our mailing list here: **letstalkinformatics@nshealth.ca.**



NS Health Analytics Roadmap

From ‘loudest voice’ to ‘smartest choice’

Acknowledgement

We acknowledge we are gathered today
in Mi’kma’ki (*Mig-***_maw_**-gee), the traditional ancestral
unceded territory of the Mi’kmaq (*Mig-**maw**) people.

Informatics

Informatics utilizes health information and health care technology to enable patients to receive best treatment and best outcome possible.

Let’s Talk Informatics Objectives

This series is designed to enable participants to:

- Identify knowledge and skills healthcare providers need in order to use information now, and in the future.
- Prepare health care providers through an introduction to concepts and experiences in Informatics.
- Acquire knowledge to remain current by becoming familiar with new trends, terminology, studies, data and news.
- Collaborate with a network of colleagues to establishing connections with leaders who can provide advice on business issues, best-practice and knowledge sharing.

Conflict of Interest Declaration

I do not have an affiliation (financial or otherwise) with a pharmaceutical , medical device, health care informatics organization, or other for-profit funder of this program.

Session Specific Objectives

At the conclusion of this activity, you will be able to:

- Identify progress to date on Analytics Roadmap
- Familiarize audience with new priorities for analytics in NS Health for next 2 years
- Highlight interconnectedness between analytics and other portfolios within NS health

Let’s Talk Informatics Certifications

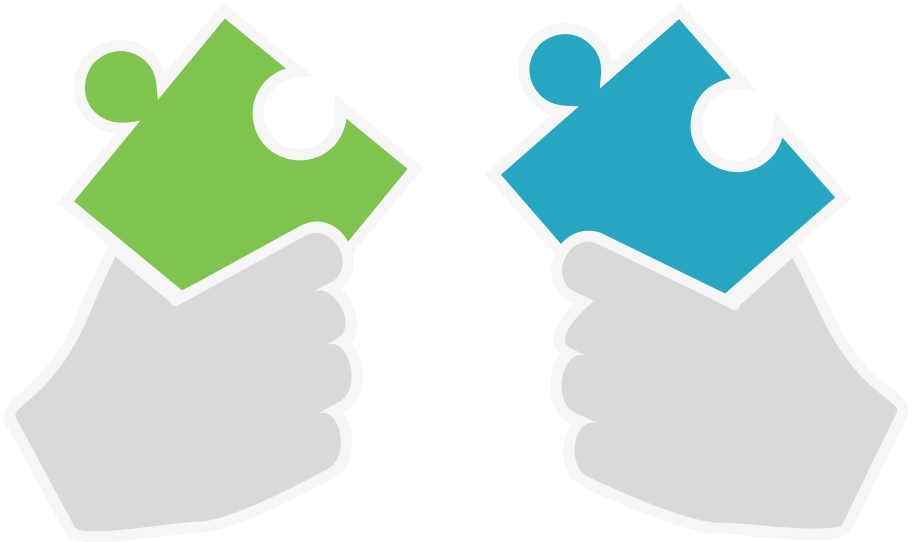
- **Digital Health Canada -** participants can claim 1CE hour for each presentation attended.
- **College of Family Physicians of Canada and Nova Scotia Chapter -** participants can earn one Mainpro+ credit by providing proof of content aimed at improving computer skills applied to learning and access to information.
- **Canadian College of Health Information Management -** approves 1 CPE credit per hour for this series for professional members of Canada’s Health Information Management Association (CHIMA).

Vision for NS Health Analytics

Enabling an organization where data is core to every decision

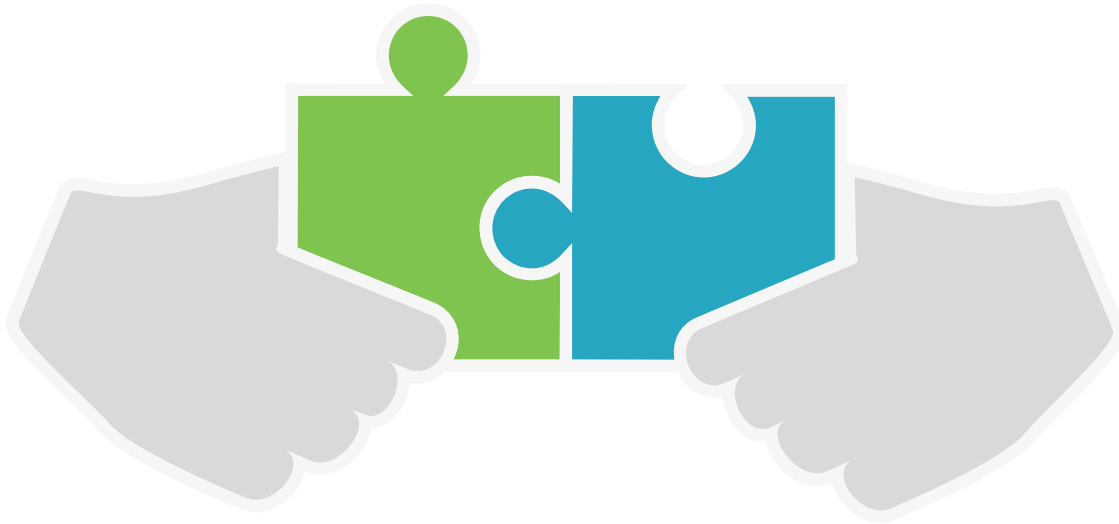
Objective of Analytics

From Data to Insight



Data

Data in different forms and formats held in disparate system across NSHA clinical and corporate domains



Insight

Data joined together to create metrics and insights for ongoing monitoring and improvement

Components of NS Health's Analytics Model

Understanding Analytics

Analysis

Progression from descriptive to cognitive analyses, Statistical approaches (tests of association, confidence intervals, etc.)

Infrastructure

Technology environment, servers, disaster recovery

Governance

Privacy, standardization, engagement with subject matter experts

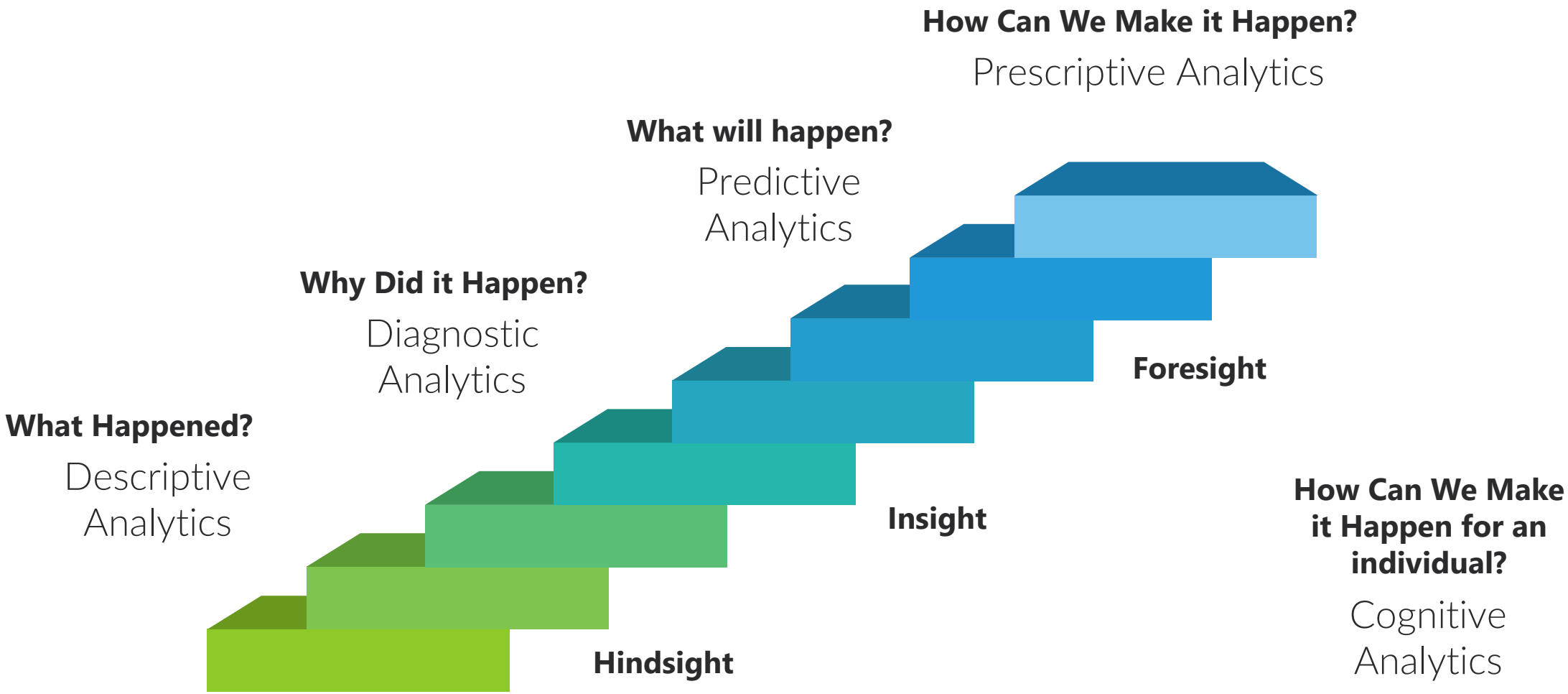
Data Management

Integration of data sources across varying types of data

Organization

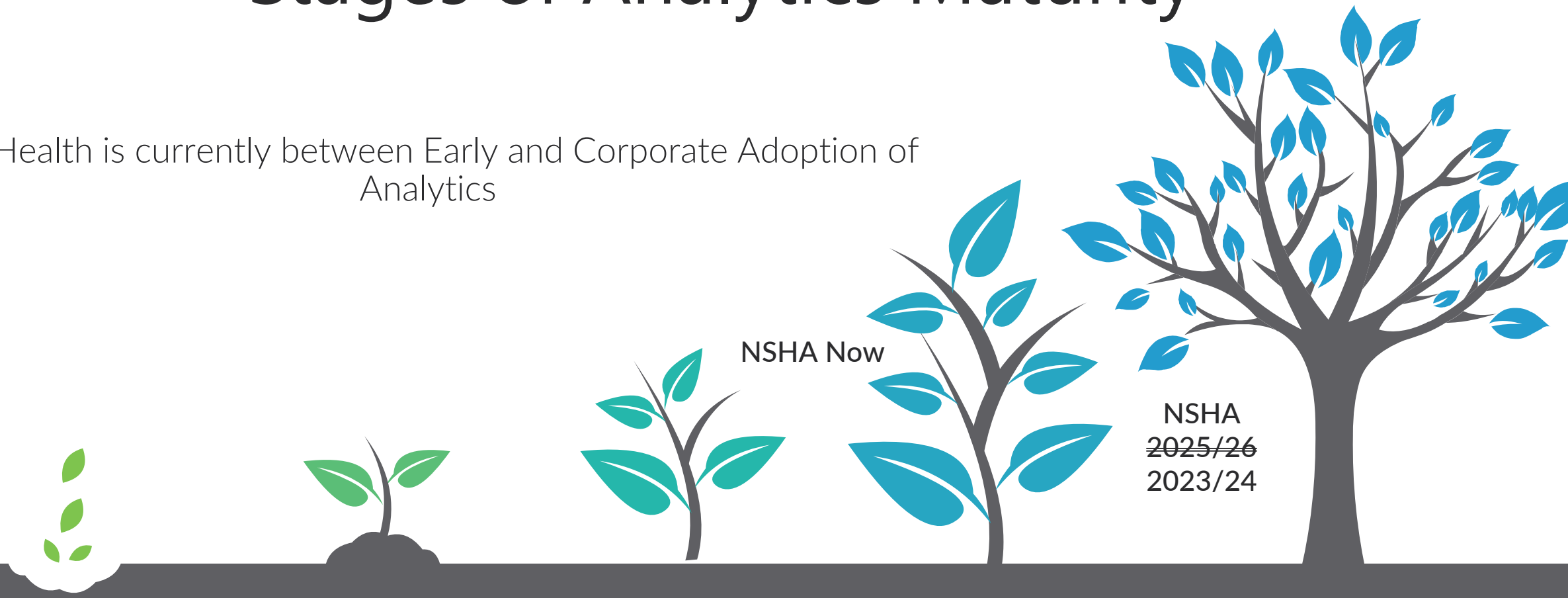
Data Fluency, analytic workforce, structure of analytics

Steps of the Analytics Continuum



Stages of Analytics Maturity

NS Health is currently between Early and Corporate Adoption of Analytics



Nascent

Pre-analytics, decisions are not data driven, made based on gut instinct rather than on fact

Pre-Adoption

Starting to understand the power of analytics for improved decision making and outcomes

Early Adoption

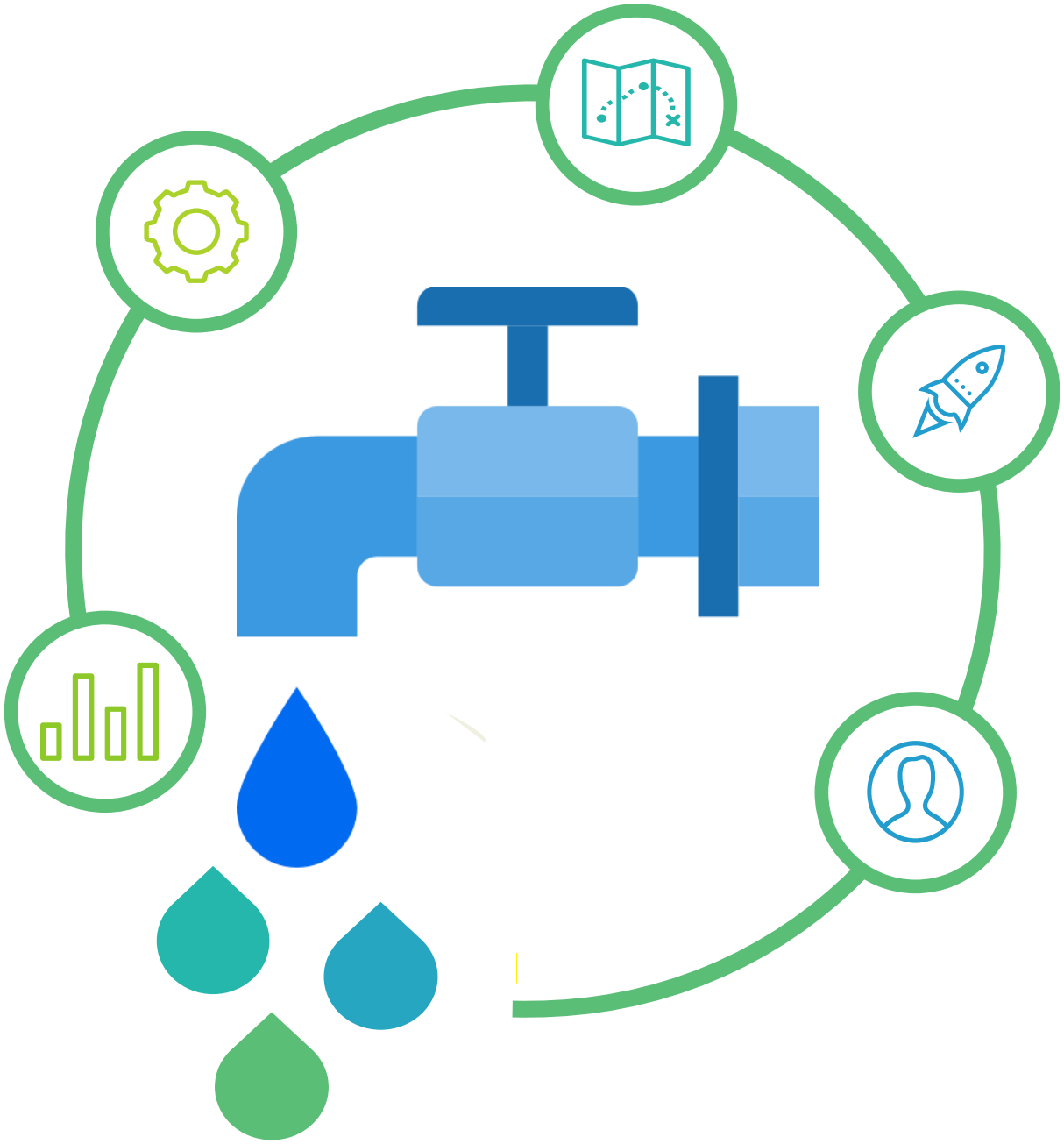
IT and Analytics begin to work together, focusing analytics on the business problems that need to be solved

Corporate Adoption

Wide range of end users get involved and the analytics transforms how they do business.

Mature

Executing analytics programs smoothly using a highly tuned infrastructure with well-established program and data governance strategies



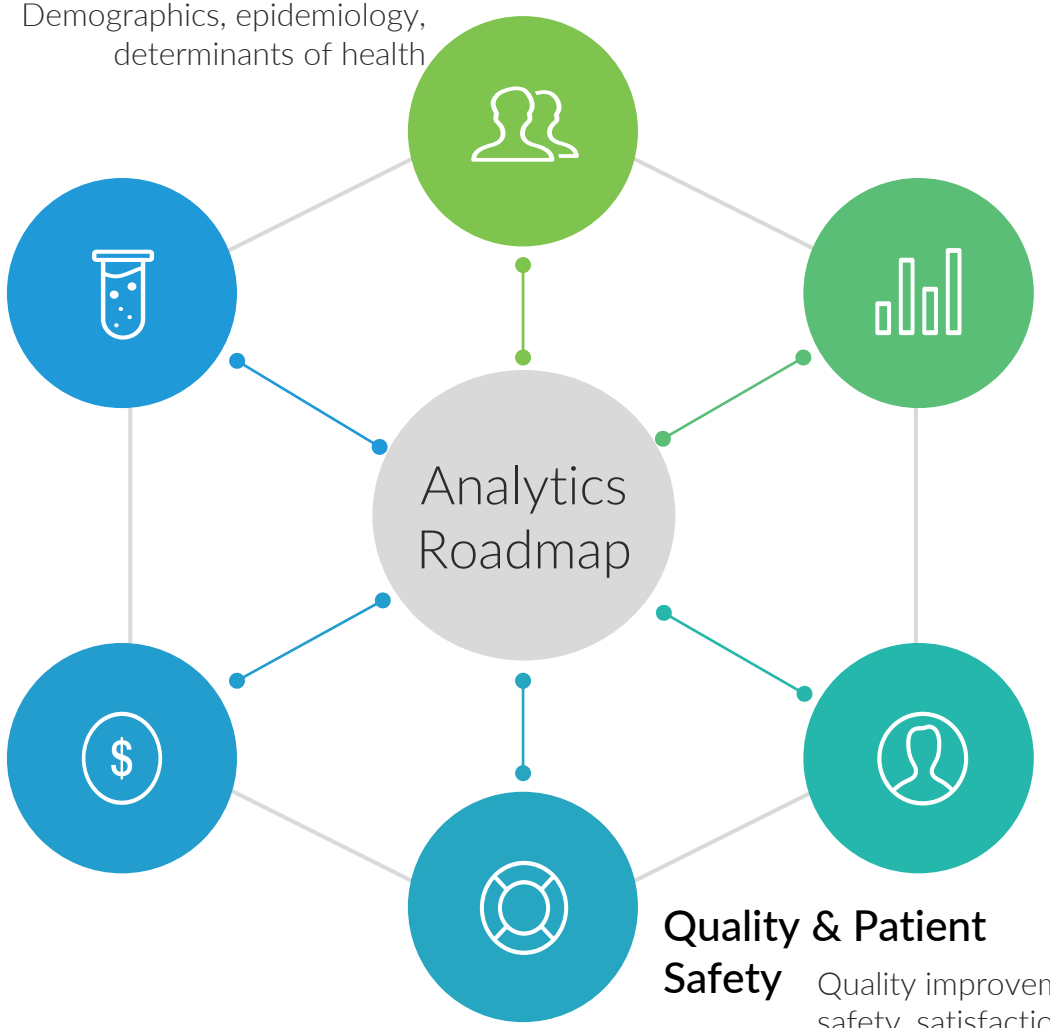
Data as a Utility

We have changed how we think about data

Utility vs. Luxury

We tend to treat data as a luxury, we lock it away so that only approved people can access it. NS Health is shifting to treat data like water. Life can't exist without it. We all need it. We wouldn't go anywhere without it. This is how we want our organization to think of data.

Integrated Analytics Strategy



Population Health
Demographics, epidemiology, determinants of health

Clinical/Research
Outcomes, diagnosis, investigations, clinical decision support

Workload/Utilization
Patients where, when, what, and how much

Financial
Cost and efficiency of services from the system to patient level

Workforce
Clinicians where, when, what and how much

Quality & Patient Safety
Quality improvement, patient safety, satisfaction, outcomes

Analytics Team

A team of 50+ analysts spread across the province, providing data to drive decision making throughout NS Health

"Supporting evidence and data based decision making"

The team is made up of a mix of roles with team members having varied backgrounds and skill sets to support a wide range of analytical services and projects.

- Analytic Leads
- Clinical Performance Consultants
- Senior Decision Support Analysts
- Data Analysts
- Decision Support Analysts
- Research and Statistics Officers
- Health Records Analysts
- MIS Statistical Coordinators

Analytics Leadership

Chief Data Officer and Director of Analytics

"Organizations may build their services on data, but they don't necessarily manage it well."

- Dedicated leadership to focus on the data and analytics (D+A) strategy of the organization: Analytics Roadmap
- Optimization and valuation of organizational data assets
- Work with partners within and beyond NS Health to meet D+A needs across the entire health system

Our Services

Focused on Data Extraction, Staging, Linkage and the Analytics Continuum

Data Extraction and Staging

Data extraction, aggregation and data mining methods organize the data and make it possible to identify patterns and relationships in it that would not otherwise be visible

Diagnostic Analytics

Examines data to answer the question “Why did it happen?”, using techniques such as drill-down, data discovery, data mining and correlations.

Data Linkage

Allows related information from one data source to be linked to information from another data source. Using the linked data makes it possible to gain a more comprehensive understanding.

Predictive Analytics

Extracting information from existing data sets in order to determine patterns and forecasts what might happen in the future with an acceptable level of reliability.

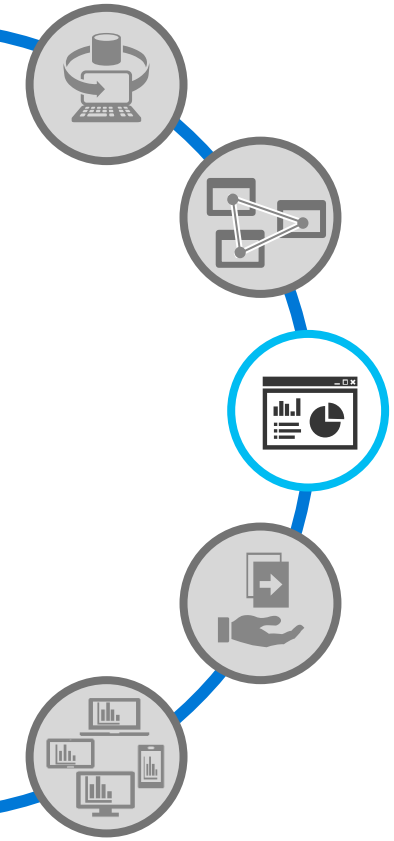
Descriptive Analytics

Summary of historical data to yield useful information and possibly prepare the data for further analysis. Reporting and data visualization may be applied to yield more insight.

Applied Analytics

Utilizing advanced statistical methods and innovative tools to create iterative, scalable and operational solutions, applying theory to the practice of health system planning and management.

Visualize: Develop visual and interactive reports

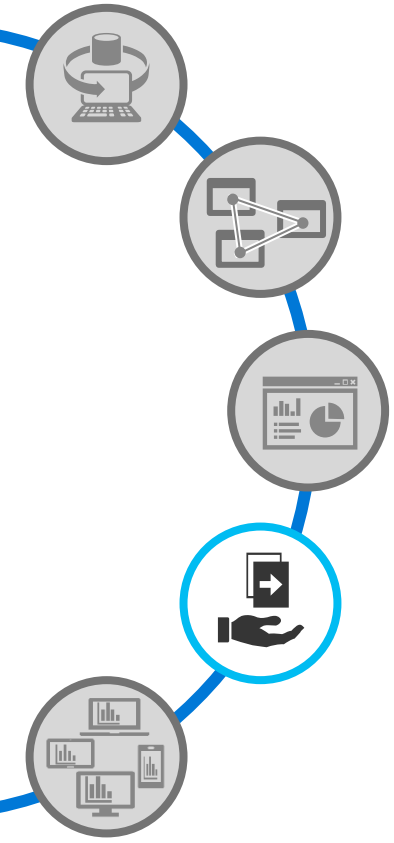


Visualize the data, by creating visually appealing and intuitive reports and dashboards

Explore data across multiple interactive visualizations

Provide insights in the context of your program

Publish: Share insights via NS Health Visualization Platform (Tableau)

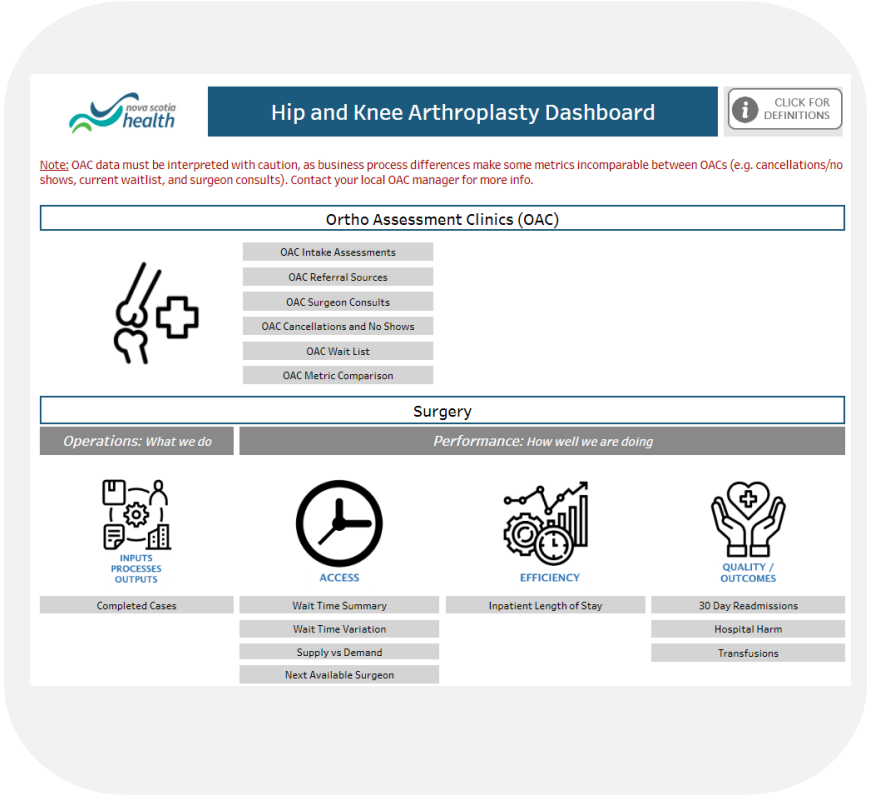


Customize dashboards for reporting purposes

Publish reports to the visualization platform

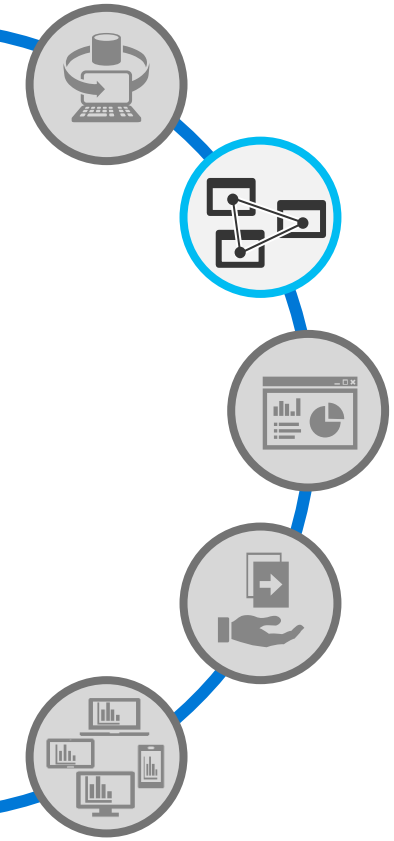
Set regular automatic or manual data refreshes

Review performance with relevant organizational body



Analysis: Data discovery and in-depth analysis

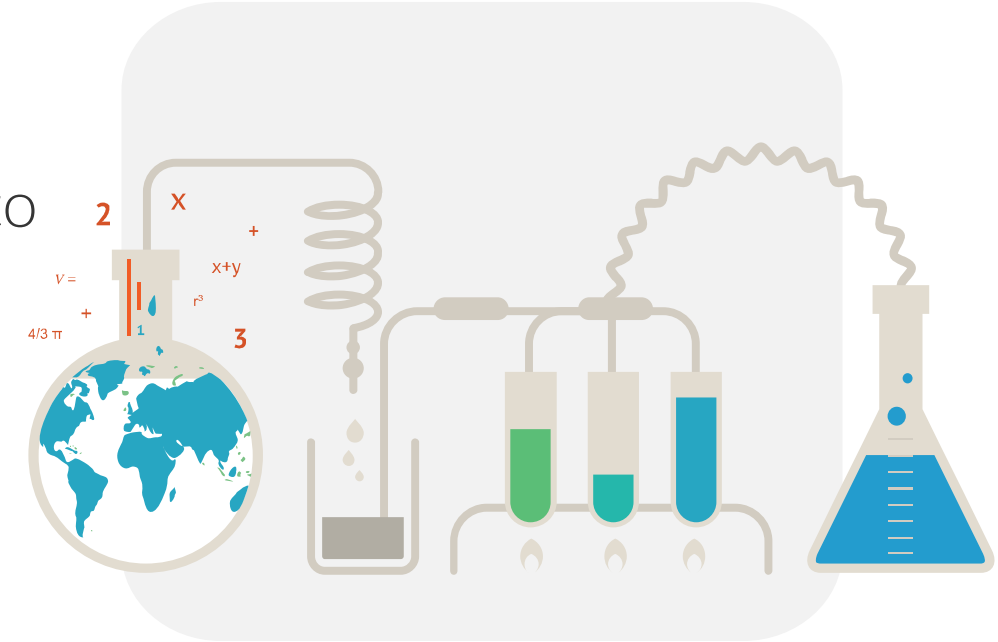
Shift focused from Data Extraction, Staging, Linkage to analysis and story telling



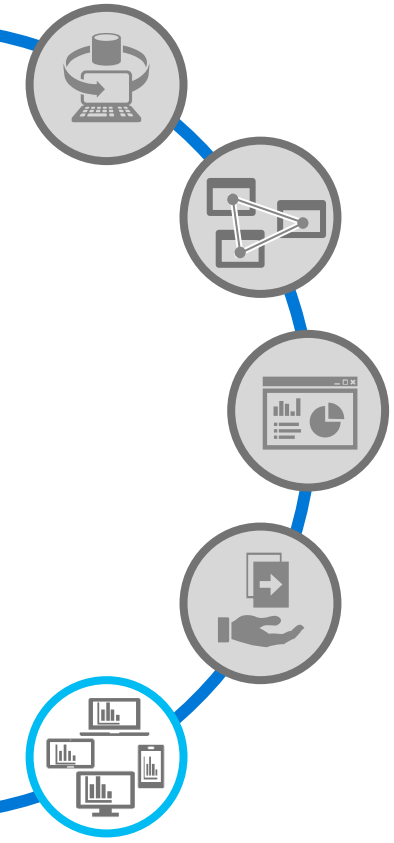
Utilize pre-existing and ad/hoc data models to link data

Apply statistical analysis techniques to gain insight

Produce descriptive, diagnostic and predictive analysis



Collaborate: Empower our organization



Provide access to reports and dashboards anywhere on any device
(mobile access for Tableau coming soon)

Enable users to ask questions and discover insights from the data through self-serve analytics or interaction with our team

Deliver insights through new medium

Performance Indicators and Reports

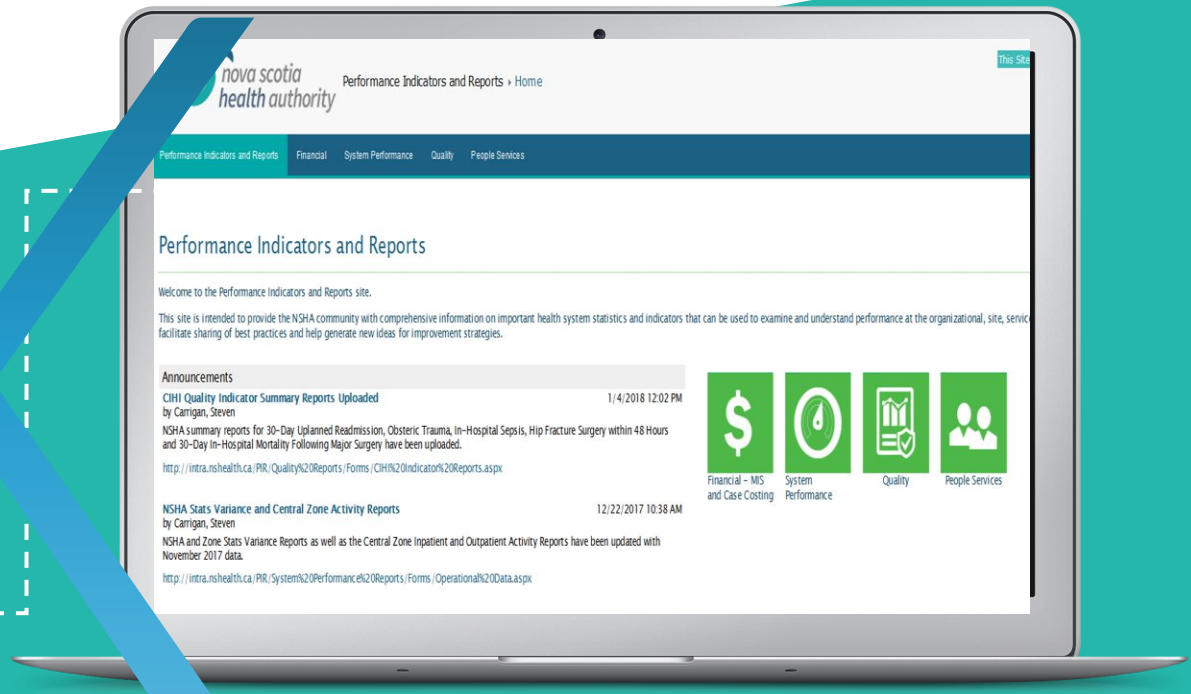
NSHA Intranet Site http://intra.nshealth.ca/PIR

Purpose

- Based on historical report repositories across the NSHA
- This site is intended to provide the NSHA community with comprehensive information on important health system statistics and indicators that can be used to examine and understand performance at the organizational, site, service, and unit levels.

Important Info

- The reports uploaded to the site work best when accessed through Internet Explorer
- Must use Internet Explorer when going to the PIR site

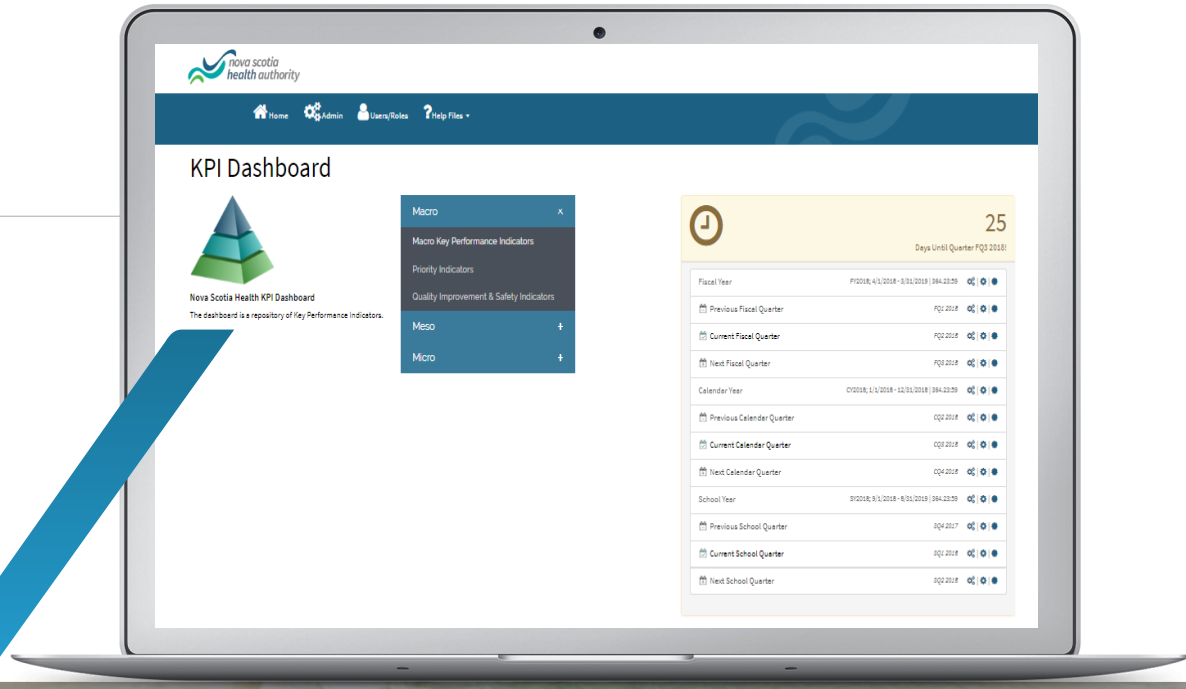


The dashboard is a repository of Key Performance Indicators.

NSHA KPI Dashboard

- KPI Dashboard (http://kpidashboard.nshealth.ca/)
- This site reports key indicators in alignment with the Performance & Accountability Framework NSHA wide and by Program or location to understand performance in the organization.

Click here for:
KPI DASHBOARD



Macro

NSHA

Meso

Zone or Progra

Micro

Site

Provincial Patient Flow Dashboard - Zone Snapshot

Zone: Central | Site Type: All | 2021/12/08 6:00 PM

Acute Unit Occupancy

QEII - Halifax Infirmary Site	96.9%
QEII - Victoria General (VG) Site	96.5%
Dartmouth General Hospital	103.8%
Eastern Shore Memorial Hospital	100.0%
Hants Community Hospital	87.5%
Musquodoboit Valley Memorial H..	66.7%
Twin Oaks Memorial Hospital	86.7%

Total Occupancy

QEII - Halifax In..	95.8%
QEII - Victoria ..	96.7%
Nova Scotia Ho..	89.4%
Dartmouth Gen..	103.8%
Eastern Shore ..	100.0%
Hants Commun..	95.7%
Musquodoboit ..	66.7%
Twin Oaks Me..	86.7%
Nova Scotia Re..	93.9%
East Coast For..	73.9%

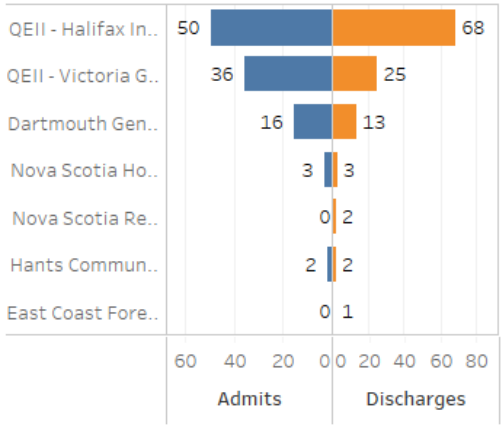
LTC Impact

QEII - Halifa..	4.4%
QEII - Victor..	11.4%
Nova Scotia..	1.9%
Dartmouth ..	10.2%
Eastern Sh..	40.0%
Hants Com..	26.3%
Musquodob..	66.7%
Twin Oaks ..	33.3%

ICU Occupancy

QEII - Halifax Infirmary Site	51	84.6%
	52	110.0%
	64	100.0%
QEII - Victoria General ..	3A	66.7%
Dartmouth General Hospi..	D21	62.5%

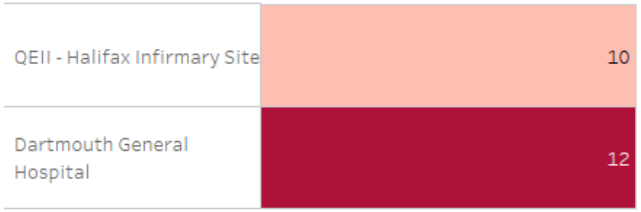
Inpatient Admissions and Discharges



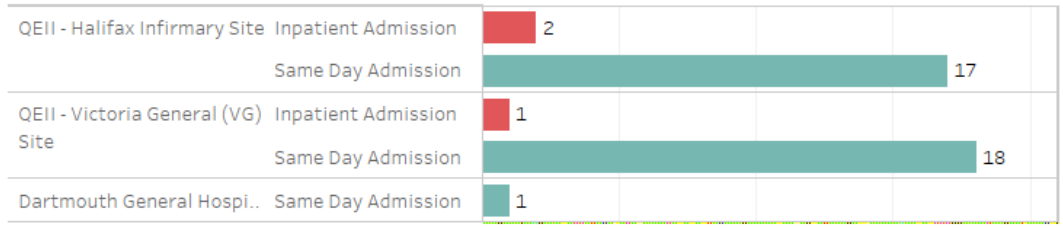
Current Occupancy (Census/Active Beds) (Zone)

Site Type	Site	Unit Category	Unit	Dec-08
Tertiary Hospital	QEII - Halifax Infirmary Site	Medical/Surgical	3IM	75.0% (9/12)
			42T	50.0% (3/6)
			61	25.0% (1/4)
			61I	100.0% (18/18)
		Emergency	QEI	(10/0)
		Intensive Care Unit	51	84.6% (11/13)
			52	110.0% (11/10)
			64	100.0% (10/10)
		Acute Psych	6LN	94.4% (17/18)
			7LN	96.0% (24/25)
			SSU	60.0% (3/5)
		Medical	9LN	100.0% (27/27)
			62	100.0% (37/37)
			74	103.4% (30/29)
			74E	100.0% (4/4)
			82	102.7% (38/37)
			84	97.2% (35/36)
		Pandemic Respons..	83C	40.0% (2/5)

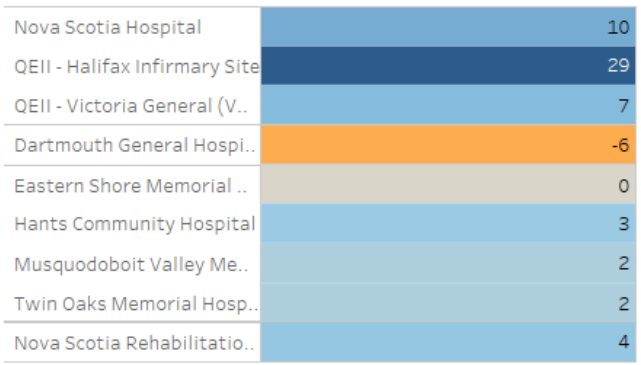
Admitted Patients in ED



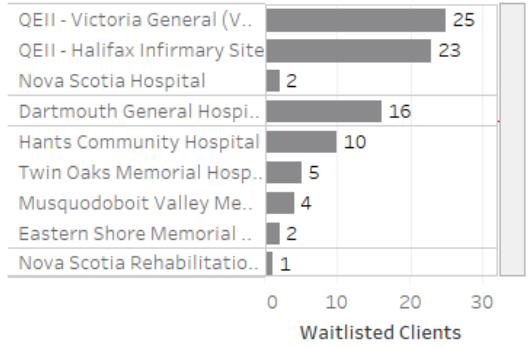
Scheduled Surgical Inpatient Cases (excluding endo) - December 8, 2021



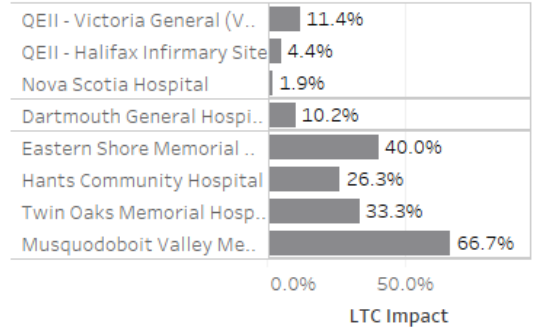
Available Beds



LTC Wait List by Hospital - December 7, 2021

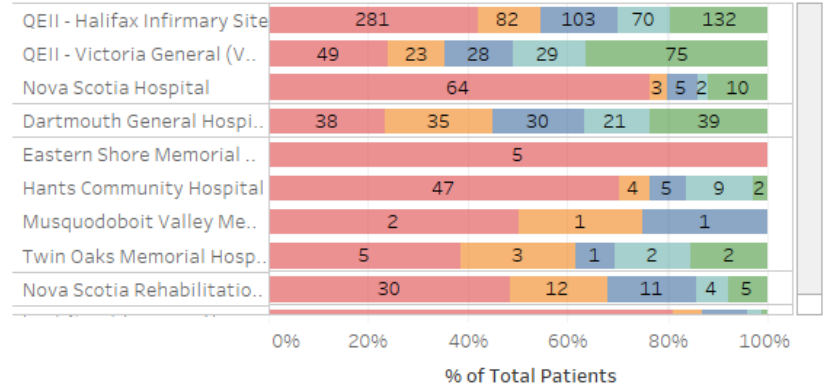


LTC Impact by Hospital



Patient Census by LOS Group

The daily patient census broken out by length of stay group.



Data source(s): Meditech, STAR

Prepared by: NSH Performance and Analytics

Priorities for NS Health Analytics

- Analytics enablement for system priorties
- Data Management / Data Governance
- AI for Analytics
- Supporting Digital Health Strategy

Data Management Framework

Next Steps

Category	Description
Roles & Responsibilities	• Clarify roles, responsibilities, and opportunities for collaboration
Data Governance	• Identify and implement a 'best-practice' data governance model(s) across NS Health, implement tools, engage stakeholders, establish structures and processes
Enterprise Data Warehouse	• Design and implement an agile, scalable enterprise Data Warehouse (eDW)
Data Integration	• Acquire a data integration and modeling tool to support the process of extracting data from the different sources, cleaning the data, and linking the data ✓ • Increase capacity of BI team
Data Warehouse Documentation	• Build a web-based, user-friendly site that houses data catalogues, data dictionaries, data quality assessments, and other key meta-data documentation ✓ • Increase human resource capacity
Enterprise Analytics	• Procure tools to enable organizational approach and standardized toolkit for reporting and advanced analytics✓ • Train staff as required

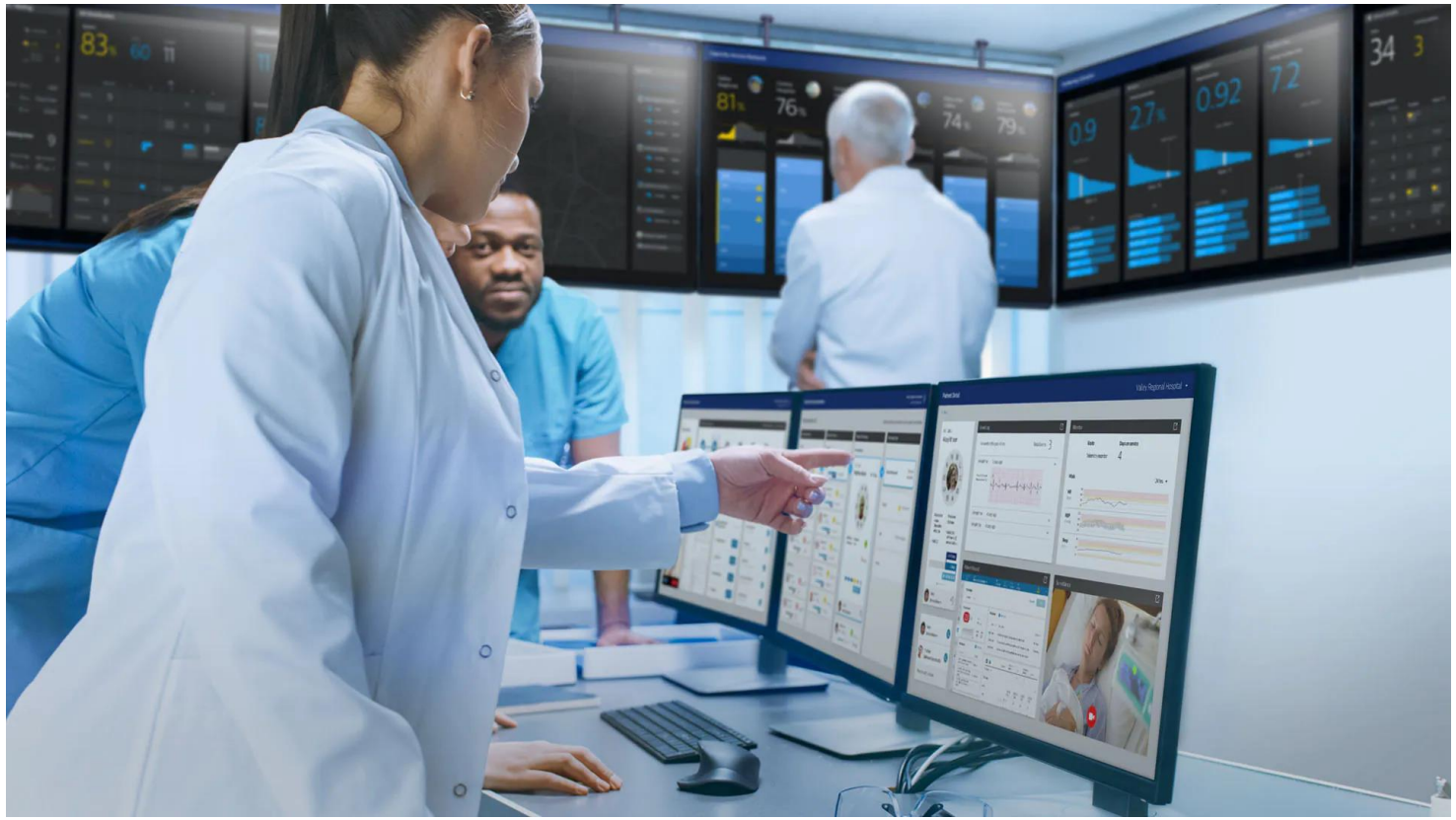
Data Governance

Key priority for next two years

- Define and agree to overarching principles
- Create flexible approach to match unique use cases
- Identify core infrastructure investment
- Align in support of Digital Health Strategy

AI and Analytics

Our goal is to help find the answers to the central questions that affect NS Health's performance



Primary care

- How many providers, what mix, what medium?

Access and Flow

- What are the drivers of flow?
- What are the drivers of wait times?

Capacity

- How many beds do we need?

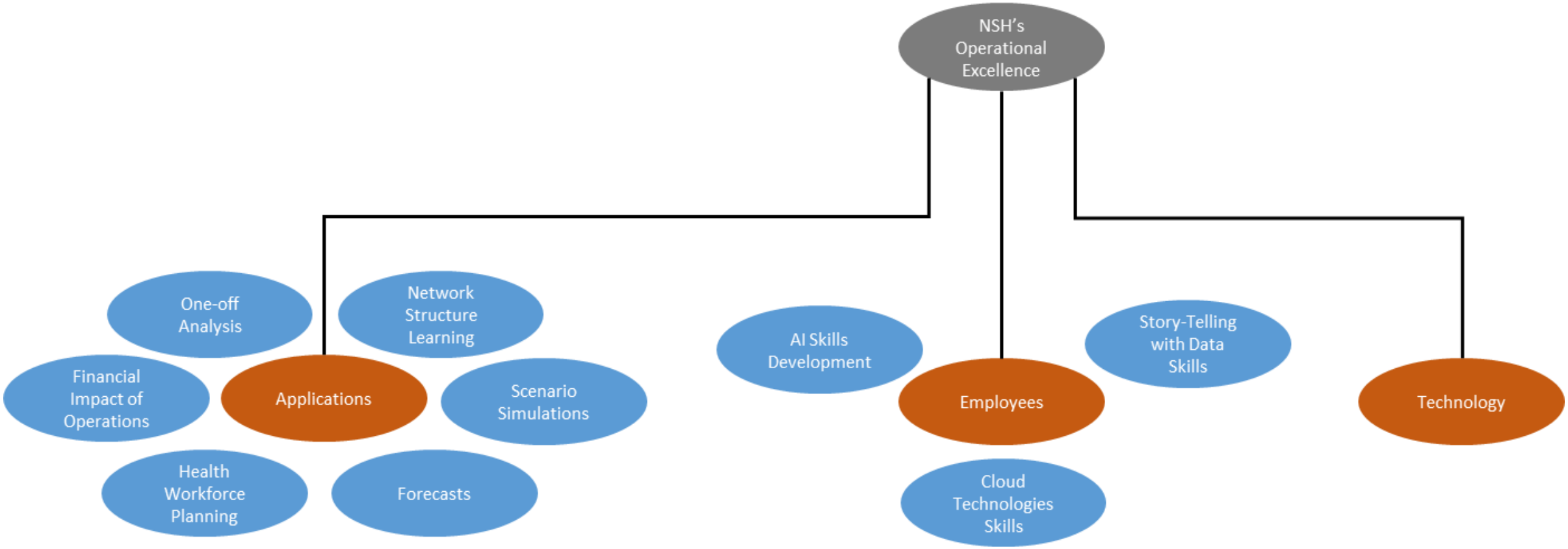
Workforce

- How many healthcare professionals do we need?

Management of chronic diseases

- Determine diseases where in-home treatment model for patients with chronic illnesses makes sense.

Drivers of the Analytics AI Strategy



NS Health Digital Health Strategy

Major focus on NS Health

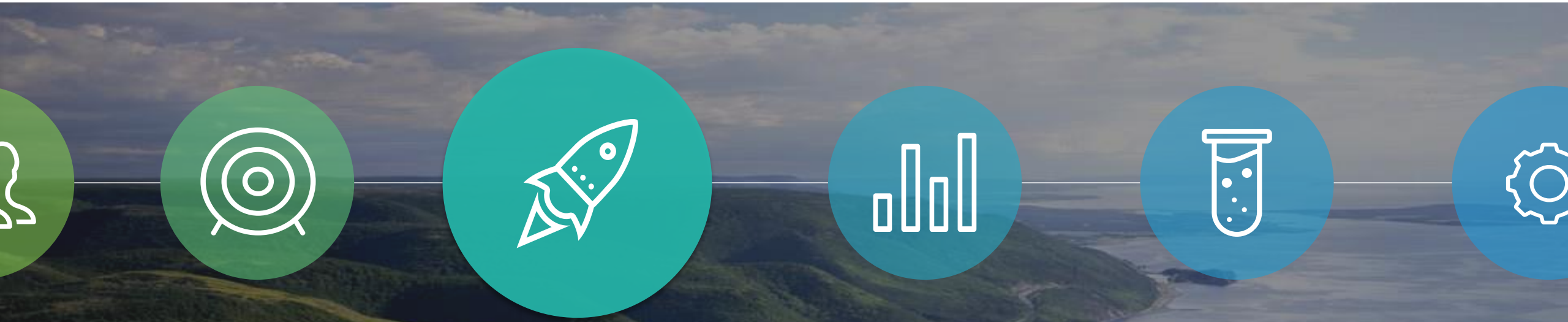
- Driver of corporate priorities
- Enabled by multiple portfolios within NS Health and partners beyond (i.e., NSDS)
- Analytics has key role in in:
  - Cloud
  - AI
  - Data virtualization/Data fabric
  - Synthetic data
  - Analytic support for virtual care

Applied Analytics Case Study

Applying theory to the practice of health system management

Applied Analytics Team

Applying theory to the practice of health system management



Team

- Data Scientist / Analysts
- Data Engineer / System Analysts

- Multi-disciplinary agile team to take on the pain points of health system management.
- Utilizing advanced statistical methods and innovative tools
- Develop agile, scalable and operational solutions

Applied Analytics Process | Transform Patient Data into Intelligent Action

Business Problem
Typically, hospitals have a 5-10% discrepancy between Budgeted versus Actual patient volumes and financials

Solution
Patient volume and financial forecasting

Business Value
Enhanced forecasts leading to operational savings and improved patient experiences

Data

- Data Sources
- Apps and Web
- Sensors and Devices

Applied Analytics

Data Analysis
- Information Exploration
- Data Analysis

Modelling and Validation
- Econometric Models
- Time-Series Analysis
- Machine Learning

Action

- People
- Reporting
- Automated Systems

Data Requirement

Patient Volume History
e.g., emergency department visits, surgical cases, outpatient visits, midnight stays history

Modeling

Use multiple models to produce forecasts

- Decomposition- no external variables
- Decomposition- with external variable
- Ensemble forecasts
- Autoregressive–moving-average (ARMA) models- no external variables
- ARIMA model- with external variables

Improved Forecasting

Potential Short-Term Forecasting
- Scheduling surgeries
- Weekly cycles
- Daily actuals

Potential Long Term Forecasting
- Demographics
- Industry trends
- Payor trends

Different Tools for Different Purposes

We have developed several tools to produce forecasts that fulfill the needs of different applications and temporal horizons.

ED Overcrowding & Surge Levels

ED workload forecasts for the

next 7 days, by hour

Utilization-Based Forecasts

ED, inpatient and LTC forecasts for the

next 6 months, by day

Population-Based Forecasts

ED, inpatient, surgery demand and systemic oncology demand forecasts for the

next 20 years, by year

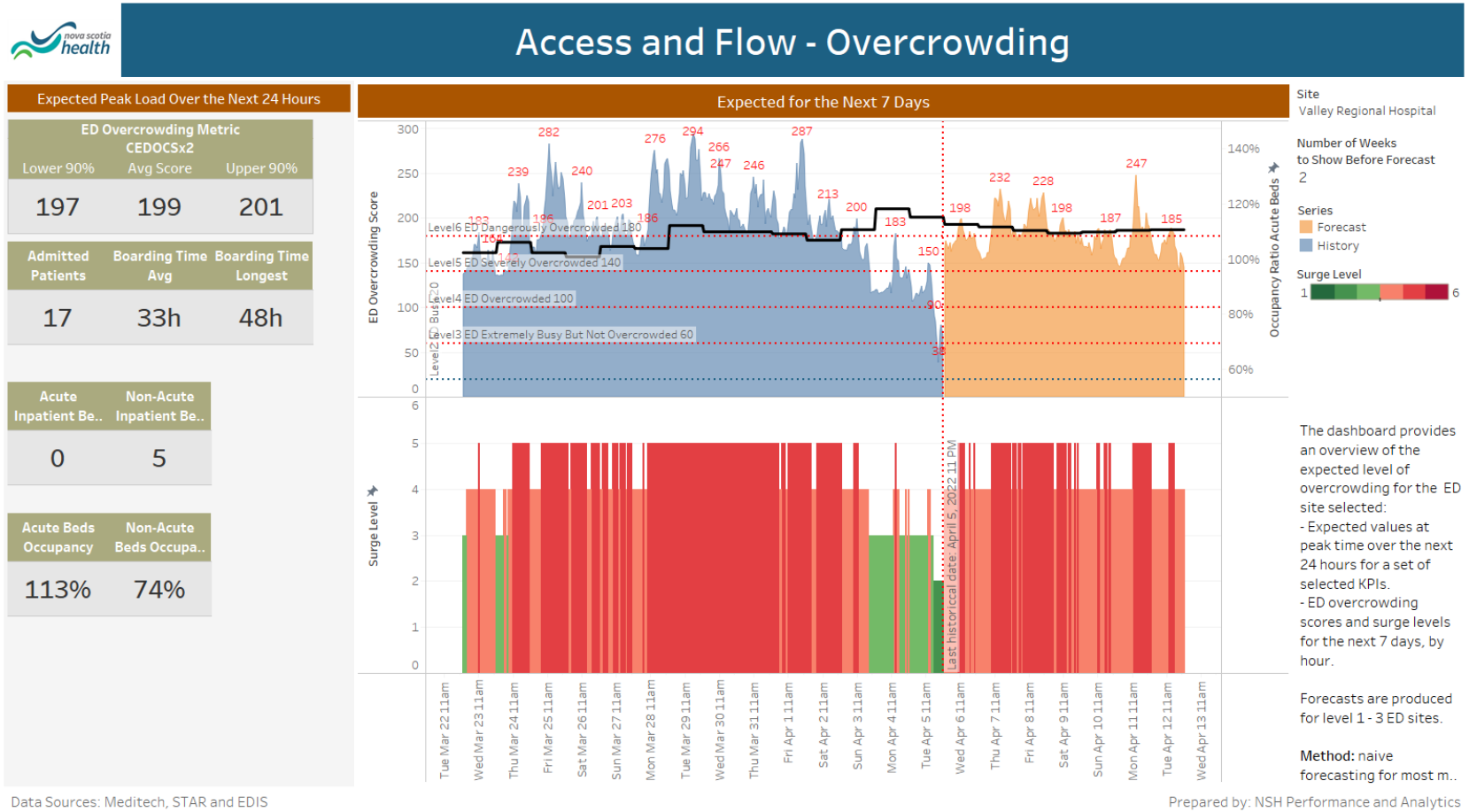
36

ED Overcrowding and Surge Levels

Short-term fluctuations are used to estimate the future level of activity of our ED's, incl. number of total, waiting and admitted patients, boarding times and site occupancy

The combination of ED and site predictions allows us to estimate upcoming surge levels

The temporal horizon is 7 days

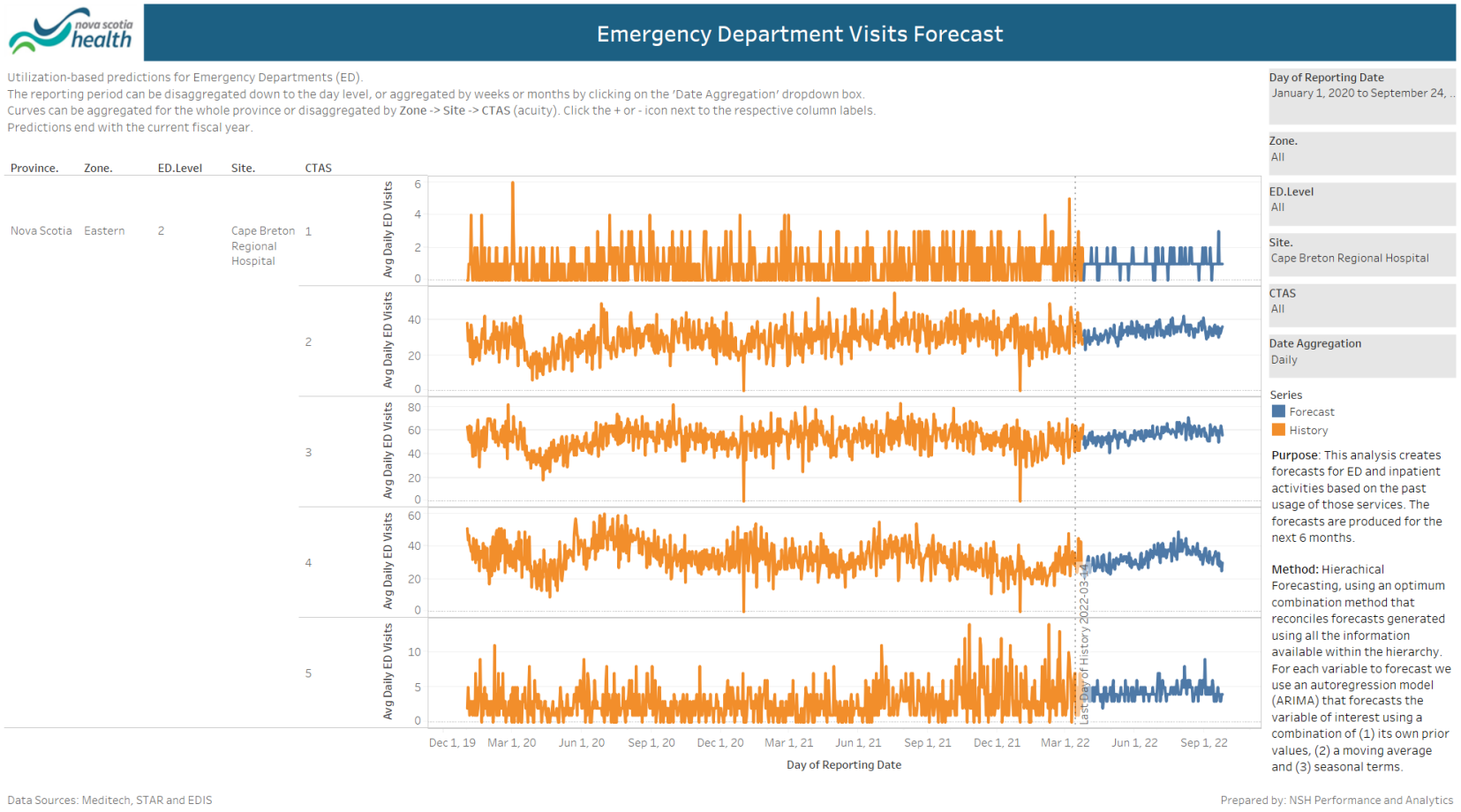


Utilization-Based Forecasts

Underlying trends, seasonality and hierarchical organization are used to estimate the future demand of ED and inpatient services, as well as some LTC metrics

The results can also be disaggregated by zone, site, CTAS or service

The temporal horizon is 6 months

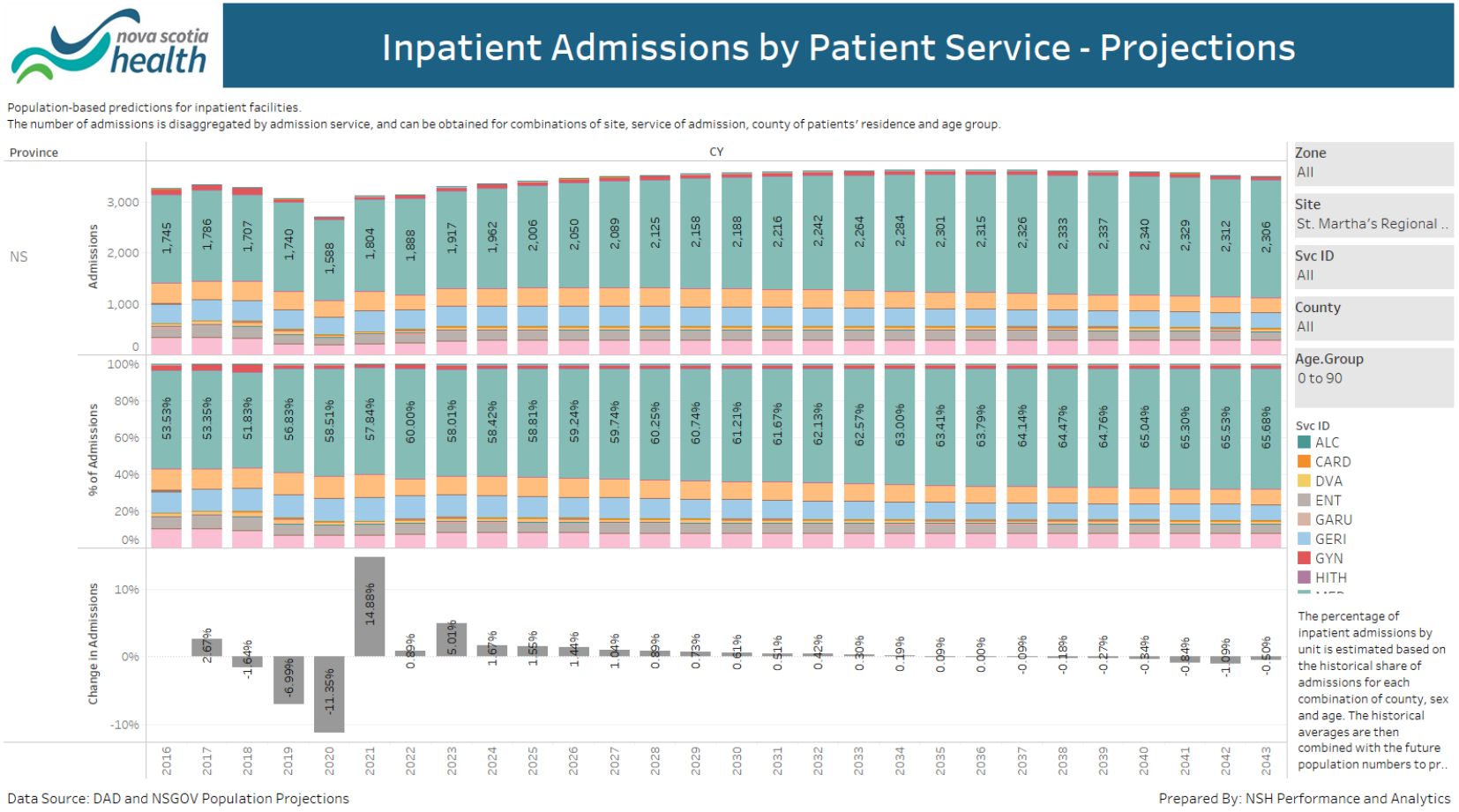


Population-Based Forecasts

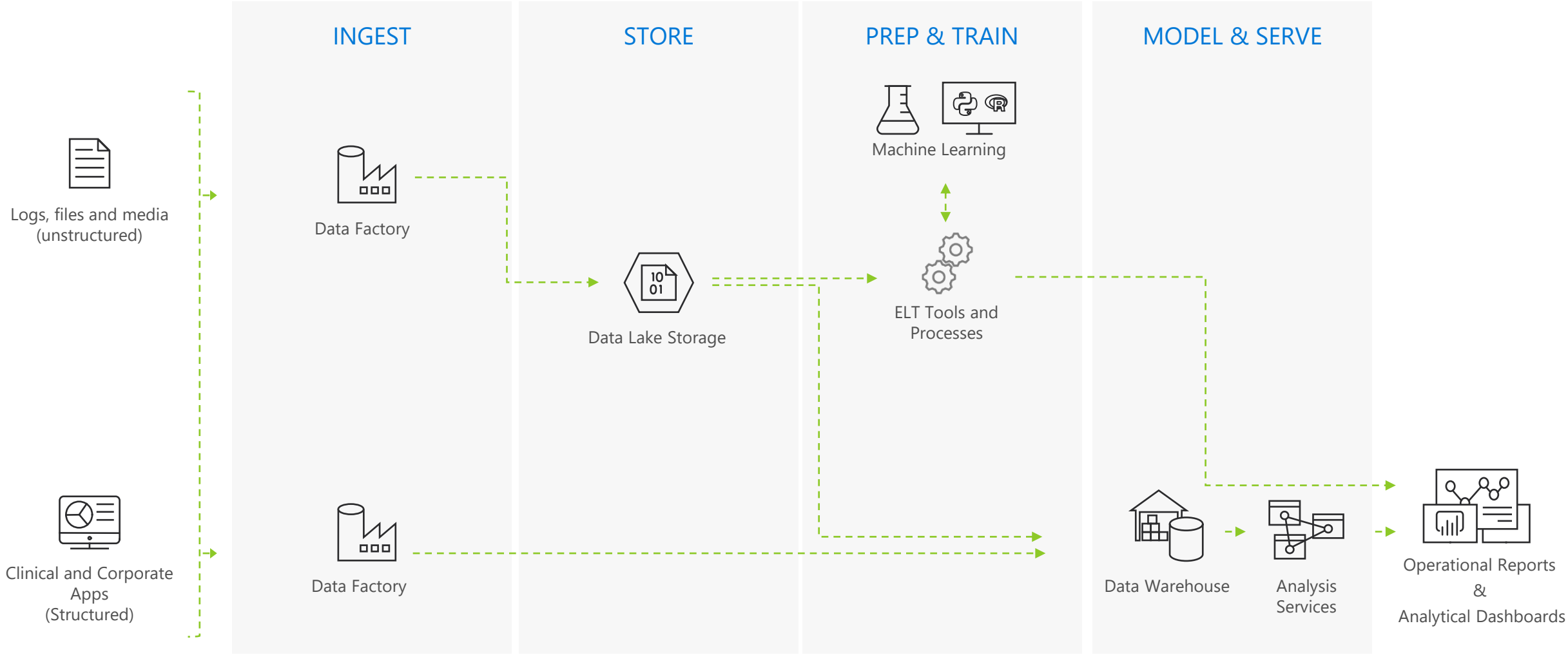
Population projections by **geography, sex and age** are used as drivers of the future demand of ED, inpatient, surgery and systemic oncology services

The results can also be disaggregated by zone, site, unit or patient service

The temporal horizon is **20 years**

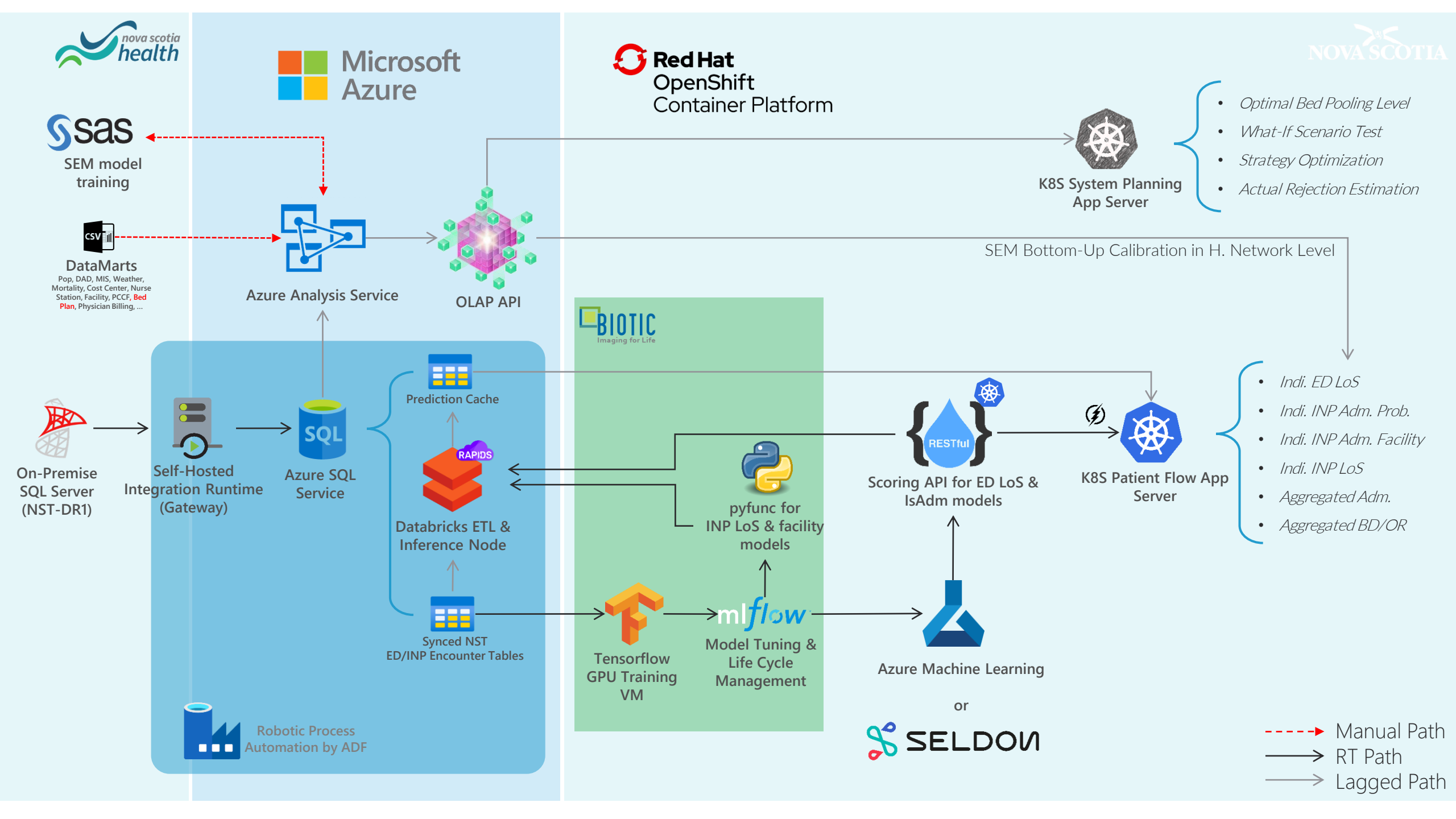


Applied Analytics / Cloud Data Management



THANK YOU

Question ?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Microsoft Azure
Red Hat OpenShift Container Platform
NOVA SCOTIA
SEM model training
DataMarts
Pop, DAD, MIS, Weather, Mortality, Cost Center, Nurse Station, Facility, PCCF, Bed Plan, Physician Billing, ...
Azure Analysis Service
OLAP API
K8S System Planning App Server
Optimal Bed Pooling Level
What-If Scenario Test
Strategy Optimization
Actual Rejection Estimation
SEM Bottom-Up Calibration in H. Network Level
BIOTIC
Imaging for Life
On-Premise SQL Server (NST-DR1)
Self-Hosted Integration Runtime (Gateway)
Azure SQL Service
Prediction Cache
RAPIDS
Databricks ETL & Inference Node
Synced NST ED/INP Encounter Tables
Robotic Process Automation by ADF
pyfunc for INP LoS & facility models
Tensorflow GPU Training VM
mlflow
Model Tuning & Life Cycle Management
RESTful
Scoring API for ED LoS & IsAdm models
Azure Machine Learning
or
SELDON
K8S Patient Flow App Server
Indi. ED LoS
Indi. INP Adm. Prob.
Indi. INP Adm. Facility
Indi. INP LoS
Aggregated Adm.
Aggregated BD/OR
Manual Path
RT Path
Lagged Path