NUS National University of Singapore

Industrial Systems Engineering and Management

National Dental Centre Chair Performance Reporting and Optimisation

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SingHealth

Project Description

Long waiting time to appointments coupled with the existence of sub-optimal dental chair utilisation indicates a mismatch between treatment supply and patient demand in the National Dental Centre of Singapore (NDCS). This mismatch cannot be effectively addressed due to the lack of consistent data reporting and visibility of dental chair performance. This project aims to help SingHealth develop a Business Intelligence (BI) tool that gives a better awareness of dental chair performance to senior management. It can also facilitate them to make informed decisions to optimise performance, ultimately leading to shorter waiting time and better patient satisfaction.
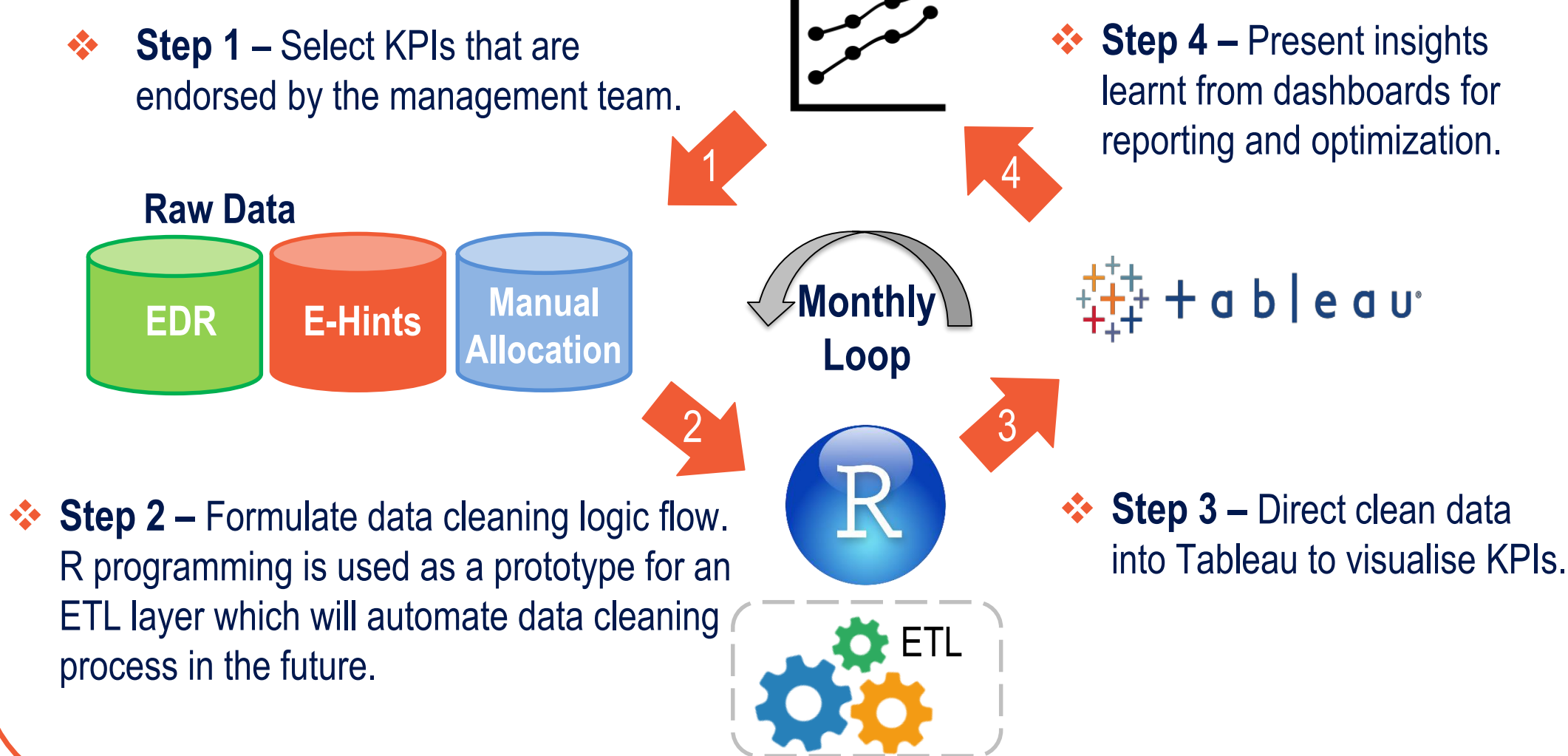
Objectives

DEVISE KPIs to empower stakeholders in everyday operations

ANALYSE Current system performance to maintain and improve quality

OPTIMISE Propose strategies to augment current performance
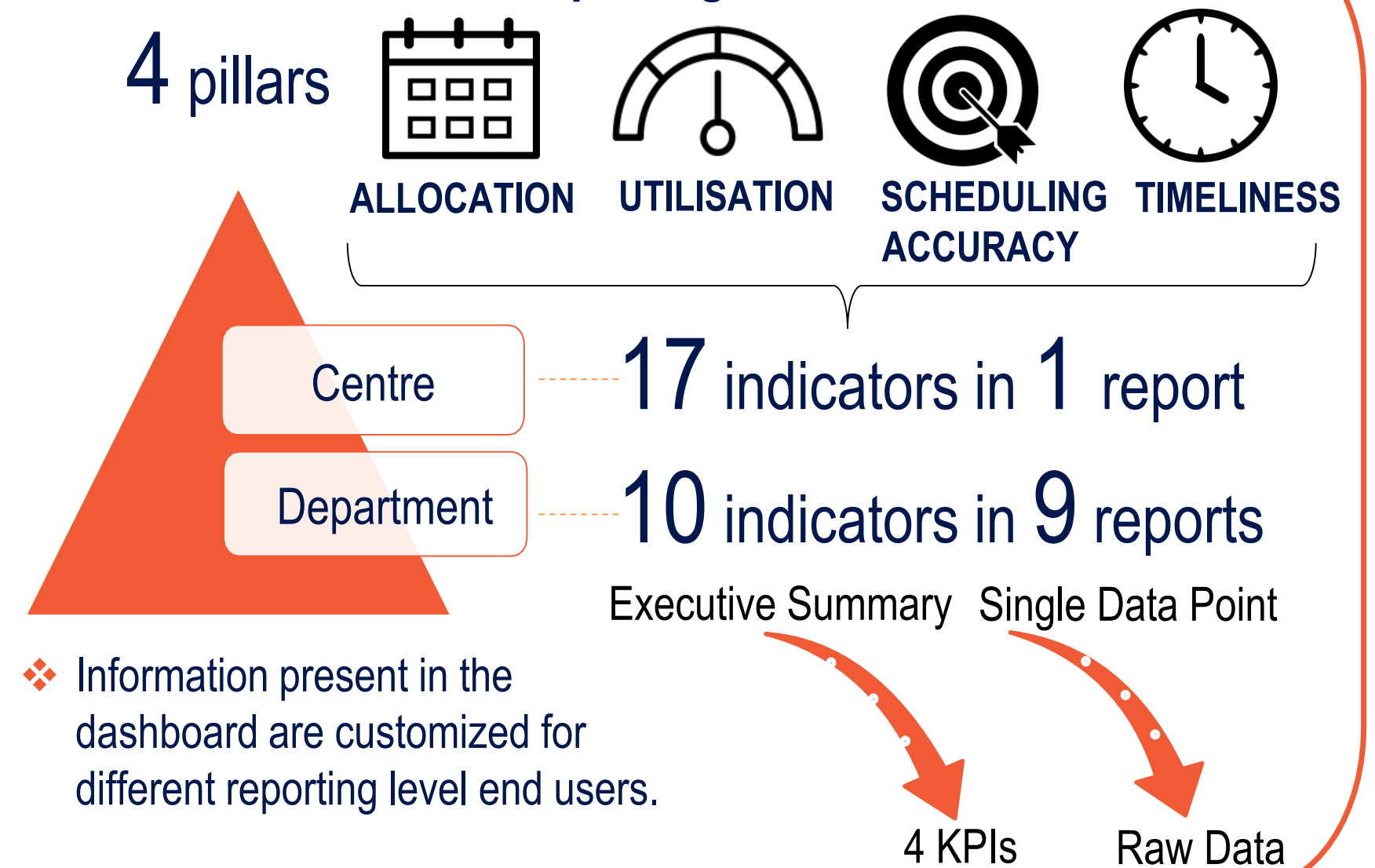
Methodology

DEFINE · MEASURE · ANALYSE · IMPROVE · CONTROL

BsC BALANCED SCORECARD

PROJECT MANAGEMENT

BUSINESS PROCESS REENGINEERING

Technical Implementation - Dashboards

Dashboard Design Flow

Step 1 – Select KPIs that are endorsed by the management team.

Raw Data: EDR, E-Hints, Manual Allocation

Monthly Loop

tableau

R **ETL**

Step 2 – Formulate data cleaning logic flow. R programming is used as a prototype for an ETL layer which will automate data cleaning process in the future.

Step 3 – Direct clean data into Tableau to visualise KPIs.

Step 4 – Present insights learnt from dashboards for reporting and optimization.

Dashboard KPIs and Reporting Levels

4 pillars

ALLOCATION · UTILISATION · SCHEDULING ACCURACY · TIMELINESS

| Centre | **17** indicators in **1** report |
| Department | **10** indicators in **9** reports |

Executive Summary → 4 KPIs
Single Data Point → Raw Data
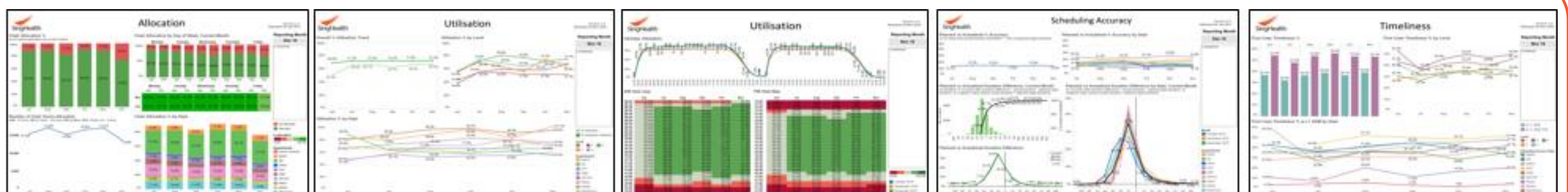
❖ Information present in the dashboard are customized for different reporting level end users.

Product and Impacts

* Data presented on this poster are fabricated for demonstration purpose only

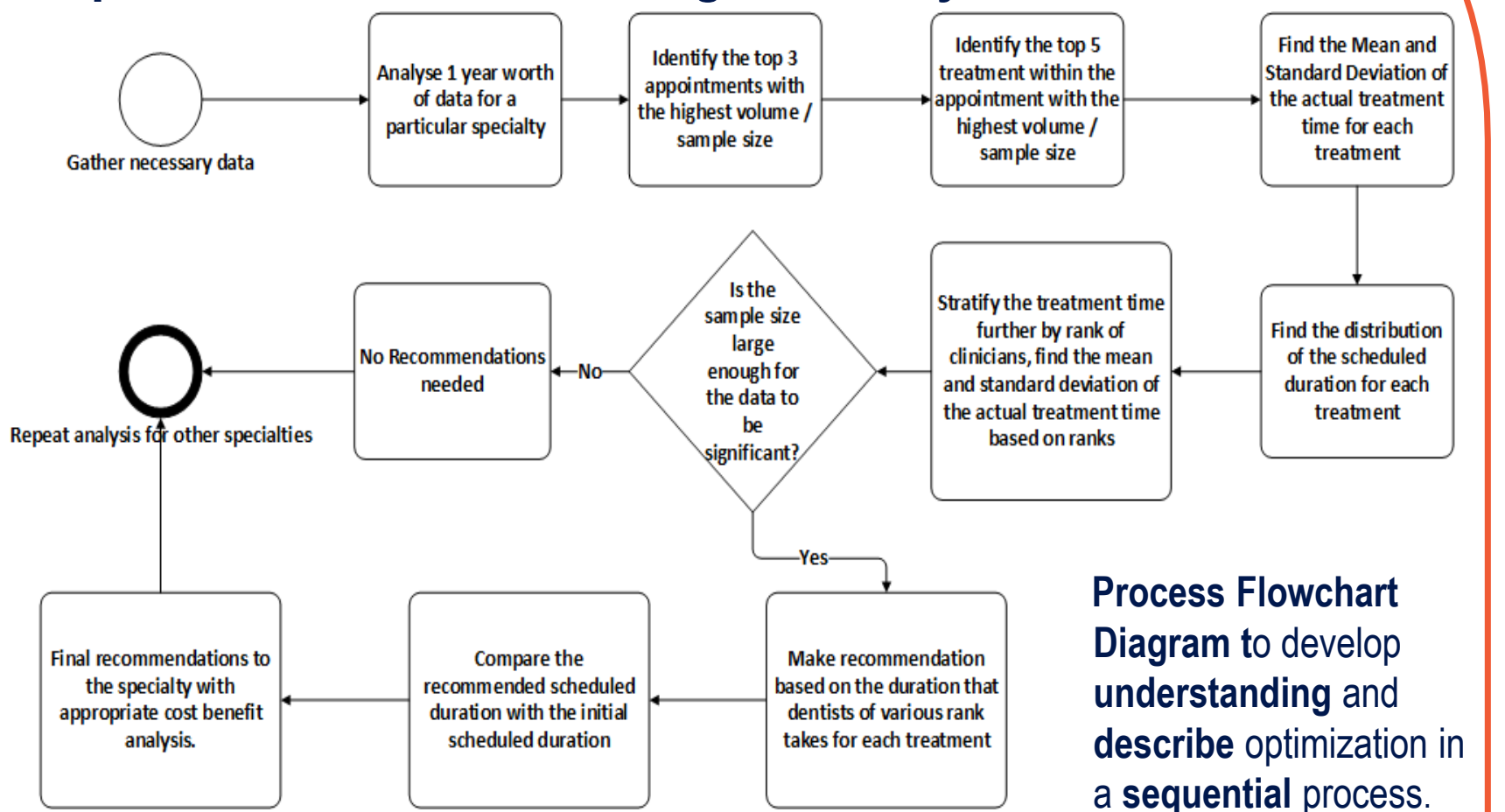Allocation · Utilisation · Utilisation · Scheduling Accuracy · Timeliness

❖ **Monthly performance reports disseminated to Sr. Mgmt. & HODs**   ❖ **Provide accurate contextual and knowledge-driven data for informed decision making**

Technical Implementation - Optimisation

Improvements to Dental Chair Allocation

Fishbone diagram to identify problems – People, Facility, Allocation Process and External Factors

People:
- National Service Commitments
- Expected absence of doctors
- Trainings, Orientation and Meetings
- Post-call (A&E)
- Last minute decision of doctors to be present/absent
- Leave / MC
- Change in doctor list
- Varying Work Days
- Part-Time Specialist
- Rank of Doctors

Facilities:
- Number of Chairs
- Dental Chairs for special needs
- Out-of-order chairs

Allocation Process:
- Urgent referrals from NHC and NCC (L1)
- No live information on chair allocation across levels
- Appointment prior to radiation therapy (L1)
- Patient prior to surgeries or transplant (L1)
- Age of Patient (L1)
- Patient Health Status (L1, L6)
- Long term follow up of dental treatment (L1)
- At most 1 chair can be allocated to a doc

External Factors:
- Holiday Seasonal Trend
- Mismatch in supply of doctors and chairs
- Demand and Supply varies across week

Dental Chair Allocation

① **Facility** Purchase Portable Dental Chairs to serve additional patients in rooms reserved for wheelchair bound patients

② **People and Allocation Process** Use portable walkie-talkie to enable real-time communication to ensure efficient communication

③ **People and External Factors** Additional 31 dentists on duty per session and de-conflict dentists' leave schedule to solve mismatch in supply of dentists and chairs

④ **Allocation Process** Reduce each allocation session duration from 4 hrs to 1 hr as doctors may not use the entire allocated session

Potential Improvements
From ③ :
❖ **+ 10.6%** chair allocation to 95%
From ③ & ④ :
❖ **+ 2790 hrs/mth** of chair use
❖ **+ 15.8%/mth** chair utilisation
❖ **+ ~93 patients** served extra a day

Improvements to Scheduling Accuracy

- Gather necessary data
- Analyse 1 year worth of data for a particular specialty
- Identify the top 3 appointments with the highest volume / sample size
- Identify the top 5 treatment within the appointment with the highest volume / sample size
- Find the Mean and Standard Deviation of the actual treatment time for each treatment
- Find the distribution of the scheduled duration for each treatment
- Stratify the treatment time further by rank of clinicians, find the mean and standard deviation of the actual treatment time based on ranks
- Is the sample size large enough for the data to be significant?
- No → No Recommendations needed → Repeat analysis for other specialties
- Yes → Make recommendation based on the duration that dentists of various rank takes for each treatment
- Compare the recommended scheduled duration with the initial scheduled duration
- Final recommendations to the specialty with appropriate cost benefit analysis

Process Flowchart Diagram to develop **understanding** and **describe** optimization in a **sequential** process.

Key Findings: Scheduled treatment duration was optimised and recommendations for various treatment duration was made for all 9 departments in the dental centre

Potential Improvements
❖ **+ 55.5 hrs/mth** of chair use
❖ **+ 0.31%/mth** chair utilisation
❖ **+ ~2 patients** served extra a day

Limitations: Analysis assumes dental treatment to be done is known at the point of scheduling appointments.

By applying methodologies to real world systems and issues, we successfully provided the visibility and enhanced use of dental chairs. With continuous monitoring and improvements by NDCS in the future, this initiative can ultimately contribute to a reduction of inefficient use of healthcare resources for the benefit of the community.