

Reducing Surgical Wait Times

A Collaborative Approach with Community Hospitals

Suting Yang

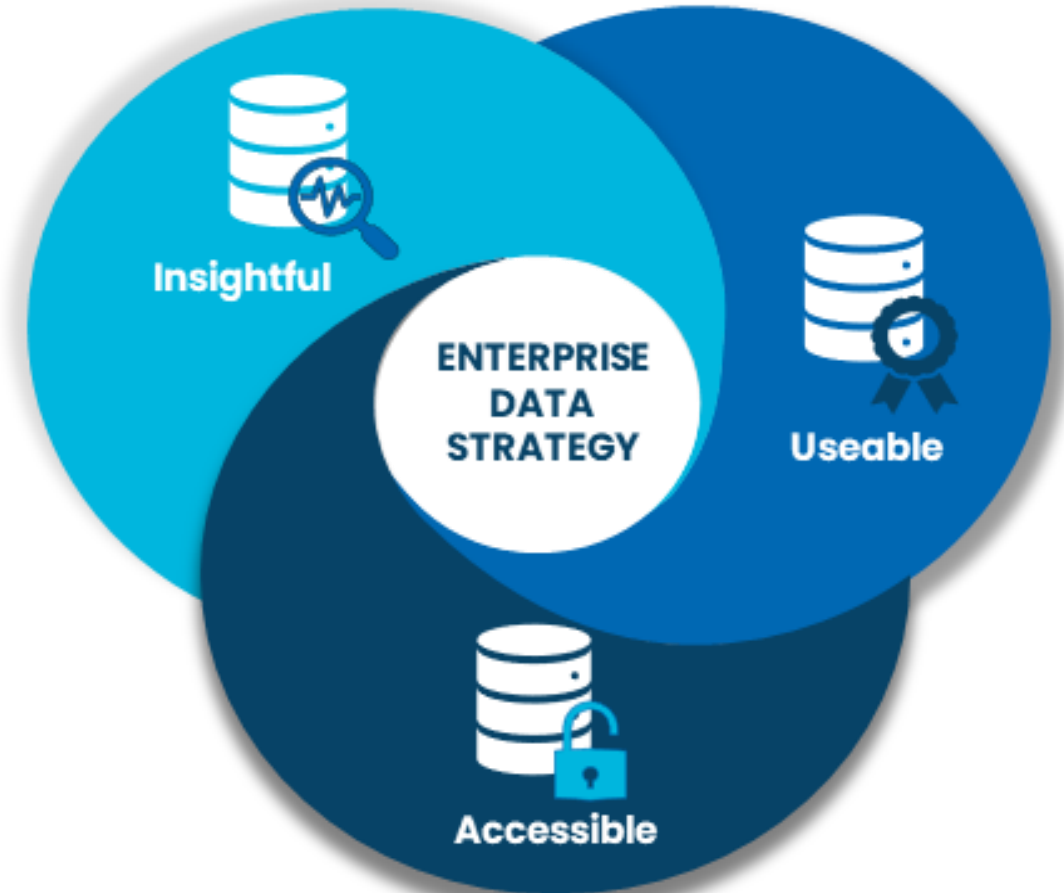
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The Hospital for Sick Children

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Enterprise Data Strategy: Use Data to Make a Difference

- Data is the Backbone at SickKids – it is used everyday by clinicians, researchers, and staff at all levels.
- The Enterprise Data & Analytics Office, in collaboration with various parts of the hospital, are committed to **transform, streamline, and improve** the way we **collect, use, access, manage, and work** with data across the organization and with external partners.
- To enable our vision of becoming a data-led organization, **where data makes the difference**, our team works to ensure our data is **usable, accessible and insightful**.



The Analytics Hub: Helping your data tell a story

The Analytics Hub is a team of seasoned biostatisticians, methodologists, and data scientists supporting the organization **with reliable and sophisticated analytic solutions**. Together, we leverage the wealth of SickKids data, cutting edge technologies, and our broad range of expertise and talent to generate meaningful stories, insights and answers to your questions from data.

Key Functions



Increase confidence in analyses and deliver results you can trust



Compliment analyses with an objective knowledgeable voice



Apply advanced and/or appropriate analyses to answer your questions



Offer methodological and advisory support for analytic needs



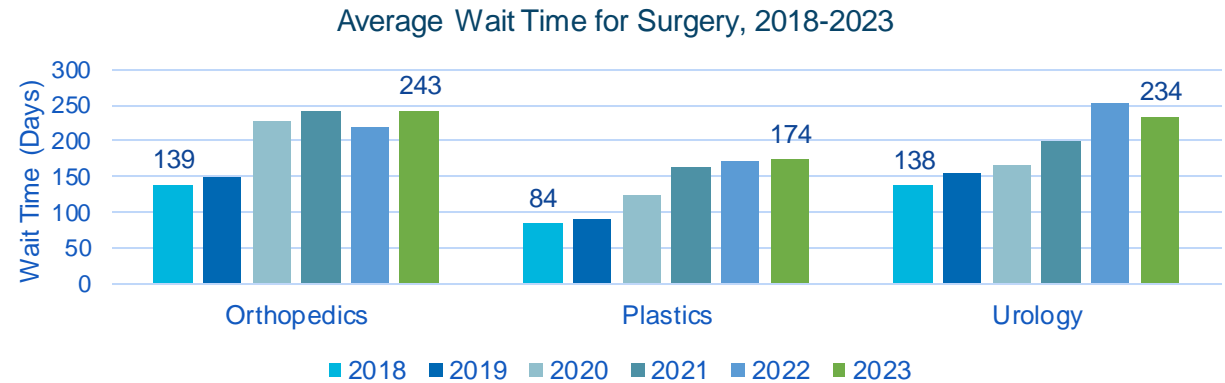
Support user understanding and interpretation of data and results

Background & Objective

Understanding the Problem



- The prolonged wait time for elective surgeries has gotten worse since the start of pandemic.
- The Hospital for Sick Children (SickKids) aims to collaborate with community hospital networks to **build sub-hubs** so that specific services could be provided locally.
- The objective is to find **the optimal hospital(s) per service** to build partnership with.



Surgical Service	Waitlist Size	Over 1 year on Waitlist
Orthopedics	868	297 (34%)
Plastics	1,051	291 (28%)
Urology	2,342	1,373 (58%)

Waitlist for Orthopedics, Plastics, Urology, as of Aug 2023

In-Scope Surgical Services:
 Orthopedics, Dentistry, Ophthalmology, Plastic Surgery, Otolaryngology, General Surgery, Urology

Analysis Workflow

Data Collection & Engineering

- Use **SickKids data** and **external data from Public Health Ontario** to retrieve the information containing
 - Surgical referral history
 - Wait history
 - Current waitlist
 - Social determinant factors

Social Determinants Analysis

- **Social determinants analysis** via Generalized Estimating Equation (GEE) Logistic Regression to explore how social factors relate to surgical wait times in Greater Toronto Area (GTA)
- **Equity analysis** to compare patient group distribution in completed surgeries vs. waitlist to find out any over- or under-representation

Multi-criteria Decision Analysis

- **Spatial Analysis:** multi-criteria decision analysis to evaluate the utility score for each dissemination area (DA) in GTA
- **Hospital Analysis:** aggregate DA-level analysis to hospital-level utility based on surrounding neighborhoods; rank hospitals based on utility scores for different services

Surgical Data from SickKids

Attribute	Description	Time
# Accepted Referrals	Total accepted referrals	2018 - 2023
% Declined Referrals	% Declined referrals	2018 - 2023
Wait Time 1	Average wait time between referral and consultation	2018 - 2023
Wait Time 2	Average wait time between waitlisted and surgery	2018 - 2023
Time on Waitlist	Average wait time in days of the waitlisted patients	As of Aug 14, 2023

- Data on referrals and completed surgeries are compiled from historical medical visits at SickKids and aggregated according to the dissemination area (DA) where patients live
- Waitlist information, as of Aug 2023, is compiled and organized by DA where patients live

Social Determinants Data from Public Health Ontario

Attribute	Description	Time
Household Marg Index	Measure relates to family and neighborhood stability	2021
Material Marg Index	Measure relates to poverty and inability to access and attain basic material	2021
Age and Labor Marg Index	Measure relates to the impact of disability and dependence	2021
Racialized and Newcomer Marg Index	Measure relates to proportions of recent immigrants and/or 'visible minority' group	2021

Ontario Marginalization Dimensions

- Four dimensions are linear combinations of the 18 input variables that independently explain the greatest possible variance in data
- Each dimension is a separate index with a standardized factor score
- Each dimension is also available in quintiles, with Q1 presenting least marginalized and Q5 the most marginalized

Social Determinants Analysis

Social Determinants Analysis on Wait Time

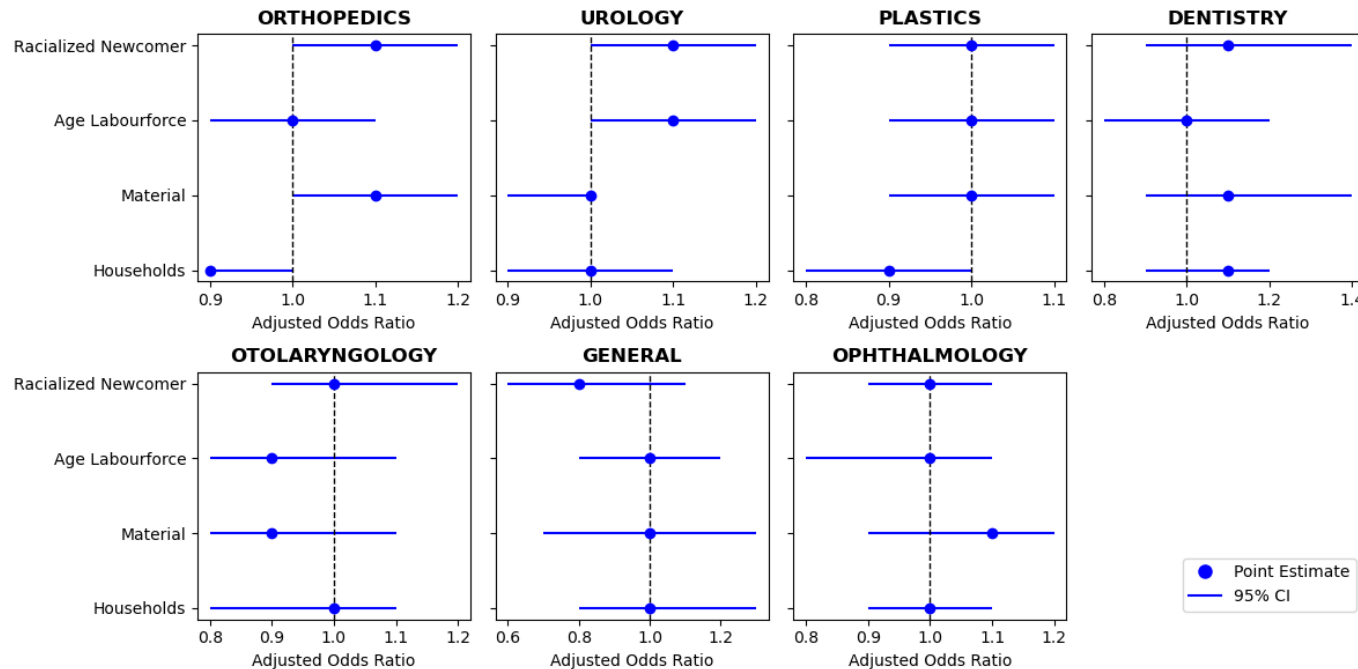
Multivariable GEE Logistic Regression

- Objective: determine whether the social determinants are associated with the odds that patients waited more than a year on the wait list until surgical procedures
- Data: patient-level completed surgeries, 2018-2023
- Outcome and Exposures:
 - **Primary outcome:** wait time exceeding a year for elective surgeries
 - **Dependent variable:** binary variable on whether the wait time was greater than a year
 - **Exposures of interest:** 4 dimensions of marginalization as measured by 2021 Ontario Marginalization Index in terms of quintiles: 1 (least marginalized) – 5 (most marginalized)
- Covariates:
 - **Age:** 0-4 (reference), 5-12, 13-17, 18+
 - **Sex:** Female (reference), Male
- Model: fit GEE logistic models clustering surgeries by spatial (DA) and temporal (year) features, and estimate the adjusted Odds Ratios (aORs*) by including all covariates

Model Interpretation for Exposures

Adjusted Odds Ratios on Marg Quintiles – Completed Surgeries (2018-2023)

Forest Plots on Marg Quintiles – Completed Surgeries (2018-2023)

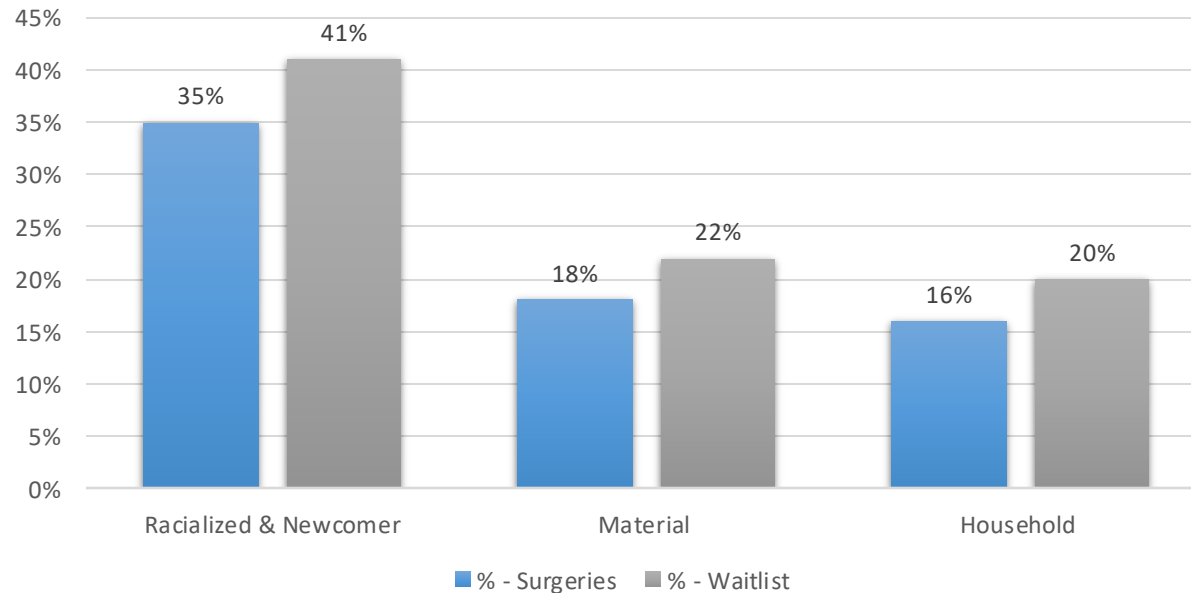


- **Odds Ratio:** how one unit increase in Marg quintile could impact the probability of WT2 exceeding a year
- Overall, **no significant disparity in odds ratios** among various groups based on marginalization dimensions
- For those that are statistically significant, the odds ratios are very close to 1

	Odds Ratio	95% CI	p-value
Orthopedic			
Households	0.9	[0.9,1.0]	0.04*
Material	1.1	[1.0,1.2]	0.1
Age Labourforce	1	[0.9,1.1]	0.94
Racialized Newcomer	1.1	[1.0,1.2]	0.09
Urology			
Households	1	[0.9,1.1]	0.93
Material	1	[0.9,1.0]	0.42
Age Labourforce	1.1	[1.0,1.2]	0.03*
Racialized Newcomer	1.1	[1.0,1.2]	0.01*
Plastics			
Households	0.9	[0.8,1.0]	0.06
Material	1	[0.9,1.1]	0.39
Age Labourforce	1	[0.9,1.1]	0.63
Racialized Newcomer	1	[0.9,1.1]	0.97
Dentistry			
Households	1.1	[0.9,1.2]	0.55
Material	1.1	[0.9,1.4]	0.16
Age Labourforce	1	[0.8,1.2]	0.91
Racialized Newcomer	1.1	[0.9,1.4]	0.24
Otolaryngology			
Households	1	[0.8,1.1]	0.66
Material	0.9	[0.8,1.1]	0.27
Age Labourforce	0.9	[0.8,1.1]	0.26
Racialized Newcomer	1	[0.9,1.2]	0.82
General Surgery			
Households	1	[0.8,1.3]	0.75
Material	1	[0.7,1.3]	0.96
Age Labourforce	1	[0.8,1.2]	0.96
Racialized Newcomer	0.8	[0.6,1.1]	0.12
Ophthalmology			
Households	1	[0.9,1.1]	0.58
Material	1.1	[0.9,1.2]	0.37
Age Labourforce	1	[0.8,1.1]	0.45
Racialized Newcomer	1	[0.9,1.1]	0.85

Surgery-to-Waitlist ratio suggests under-representation for most marginalized group

% of most marginalized group in completed vs. waitlisted cases, Orthopedic



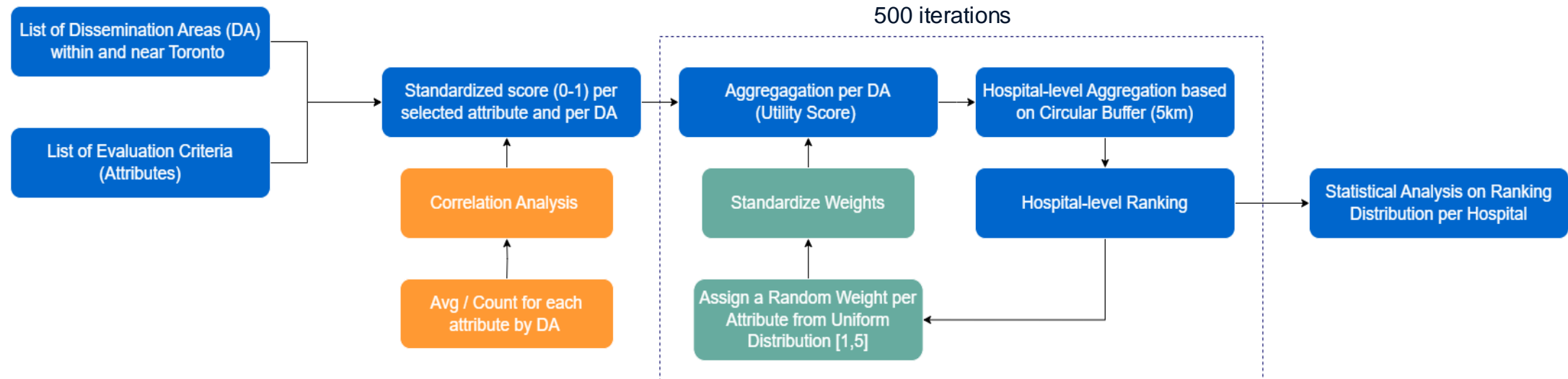
Surgery-to-Waitlist ratio for most marginalized group, Orthopedic

	Ratio
Racialized	0.85
Material	0.82
Household	0.80

- For (1) racialized and newcomer, (2) material resources, (3) households and dwellings, patients residing in most marginalized regions tend to be **under-represented by ~15% in completed surgeries**
- Purely looking at the completed surgeries may be biased; this approach might overlook Quintile 5 patients who have been waiting for an extended period and are still on the waitlist

Spatial Multi-Criteria Decision Analysis

Spatial Multi-criteria Decision Analysis (MCDA) Framework

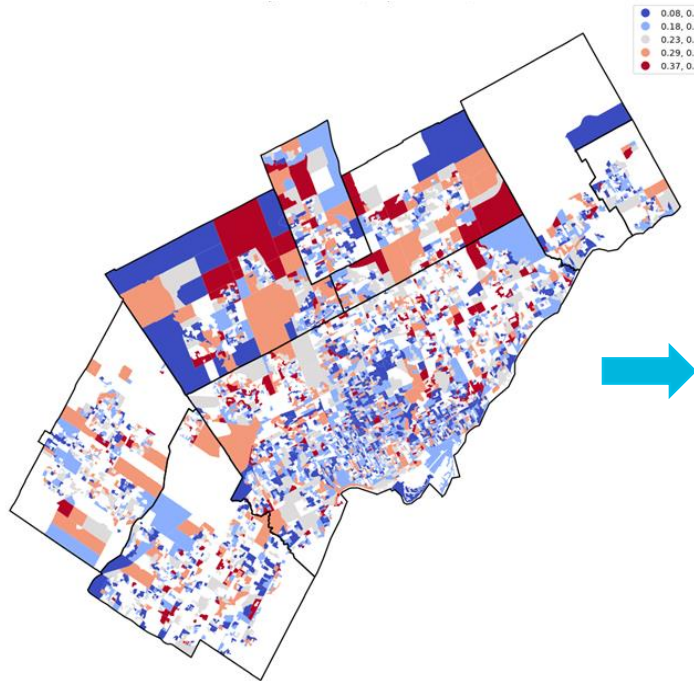


Attributes for evaluation

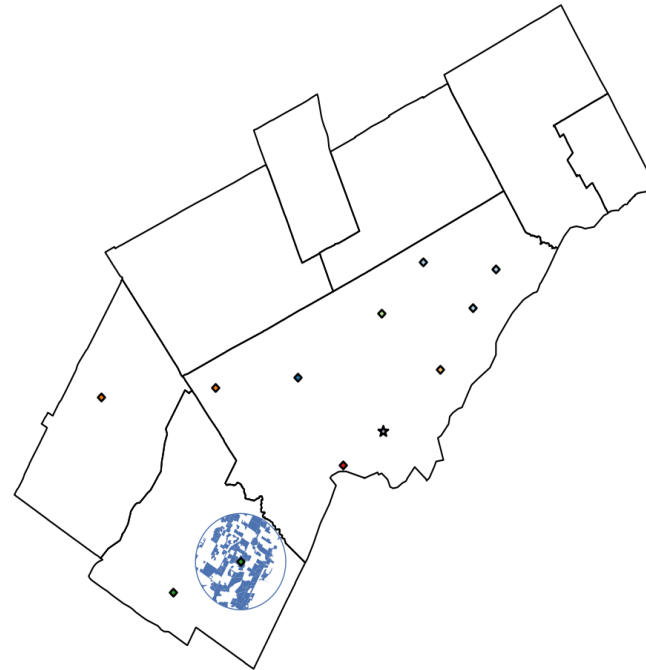
- Historical referrals
- Historical wait times
- Snapshot of waitlist (as of Aug 2023)
- Social determinants (household, material, age and labor, racialized and newcomer)

DA- to Hospital-level Analysis with Circular Buffer (within 5 km)

DA-level utility score



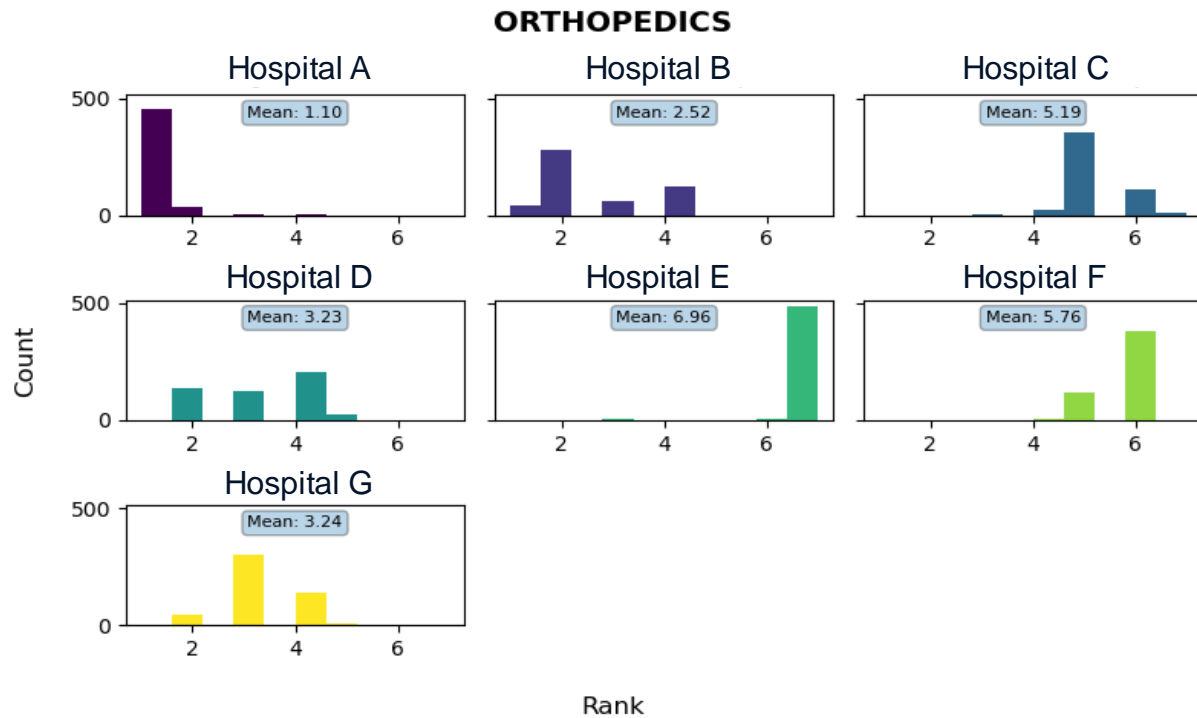
DAs within 5km circular buffer



Converting to Hospital-level score

- Create a circular buffer (within 5 km) for each hospital
- Retrieve all the DAs within the circular buffer
- Calculate the average utility scores among the DAs
- Rank the hospitals based on the average score

Probabilistic Analysis for Hospital Rankings



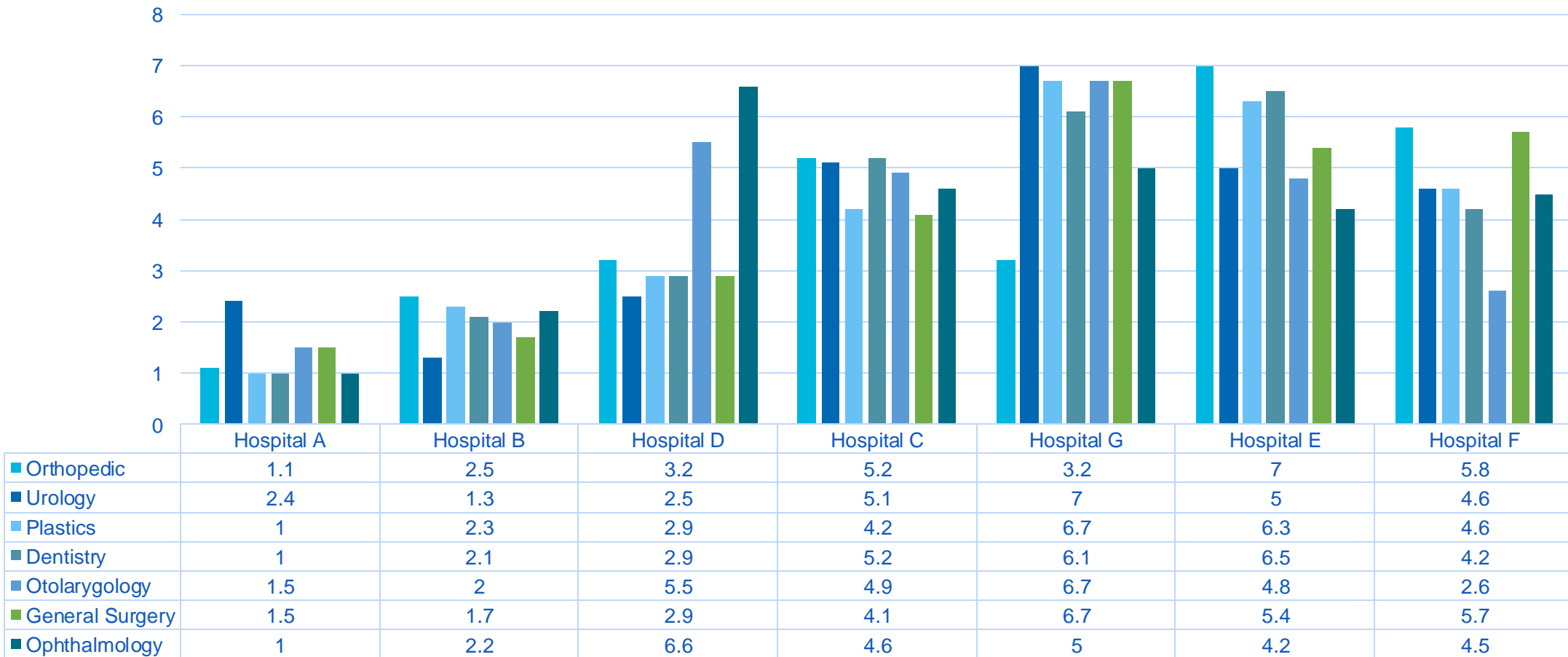
Orthopedic – Hospital Rank Distributions

Hospital	Mean (Variation)
Hospital A	1.1 (0.4)
Hospital B	2.5 (0.4)
Hospital C	5.2 (0.1)
Hospital D	3.2 (0.2)
Hospital E	7 (0.1)
Hospital F	5.8 (0.1)
Hospital G	3.2 (0.3)

Orthopedic – Hospital Rank Descriptive Stats

Hospital A tends to have consistently higher rankings across all surgical services

Average Hospital Rankings for Surgical Services



Recommendations

Our Recommendations & Associated Impact

Recommendation

Impact



The final assessment could be skewed if it relies only on the surgeries performed. Hence, it's crucial to **factor in data on surgeries completed, patients on the waiting list, and social determinants** when determining a location.

- Enhance equity in access to care when considering completed surgeries, waitlist information, and social determinant factors into the decision-making model

Hospital A has consistently higher ranking regardless of weights. Therefore, **Hospital A would be the first hospital network** to build partnership with.

- Shorten the waitlist at SickKids for elective surgeries
- Reduce the surgical wait time

On-site **bed capacity and healthcare human resource (HHR)** should also be considered when building partnerships.

- Make sure sufficient resources could be offered in partner hospitals

When choosing the second hospital, the **impact of first partnership** should be considered.

- Ensure a broader range of service while reducing overlaps
- Efficient use of hospital resources

Questions?

Thank you