

Hospital Census and Emergency Visits Prediction

Scarborough Health Network

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Problem Overview

Why are we here today?

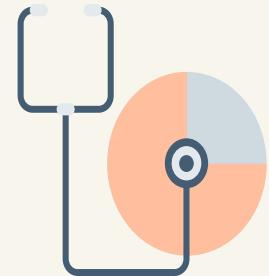
Hospital occupancy has risen sharply, **ED wait times** are higher than ever, affecting patient flow and care quality.

The team needs to understand what volumes will look like next to make informed operational decisions.

Why is this important?

Accurate forecasts help with **capacity planning, resource allocation, and reducing overcrowding risks**.

Leadership requires short-term (Sep 2025 – Mar 2026) and long-term (5-year) projections to guide planning.



Dataset Summary

Inpatient Census (Jan 2022 – Mar 2025)

- 14,040 daily snapshots
- 3 sites: SHG Avg. Census 607, SHB Avg. Census 571, SHC Avg. Census 406
- 2 service lines: Medicine & Surgery
- Census varies by day, service, and campus
- 11 AM: Total Avg. 3,613 patients (peak); 11 PM: Total Avg. 2,726 patients (23% drop)
- Hour 11 for inpatient census forecasts → reflects true operational pressure
- Hour 7 appears once → likely anomaly

Emergency Department Volumes (Apr 2016 – Dec 2025)

- 9,840 daily records
- 3 sites avg. visits/day: General 935, Centenary 937, Birchmount 878
- SHC appears once → likely anomaly

Data Challenges and Cleaning



Outliers

Removed a few extremely high Census and ED Volume data points.



Invalid Data

CensusData: Removed the data point recorded at hour 7 as all other rows were reporting Census at hour 11 or hour 23.

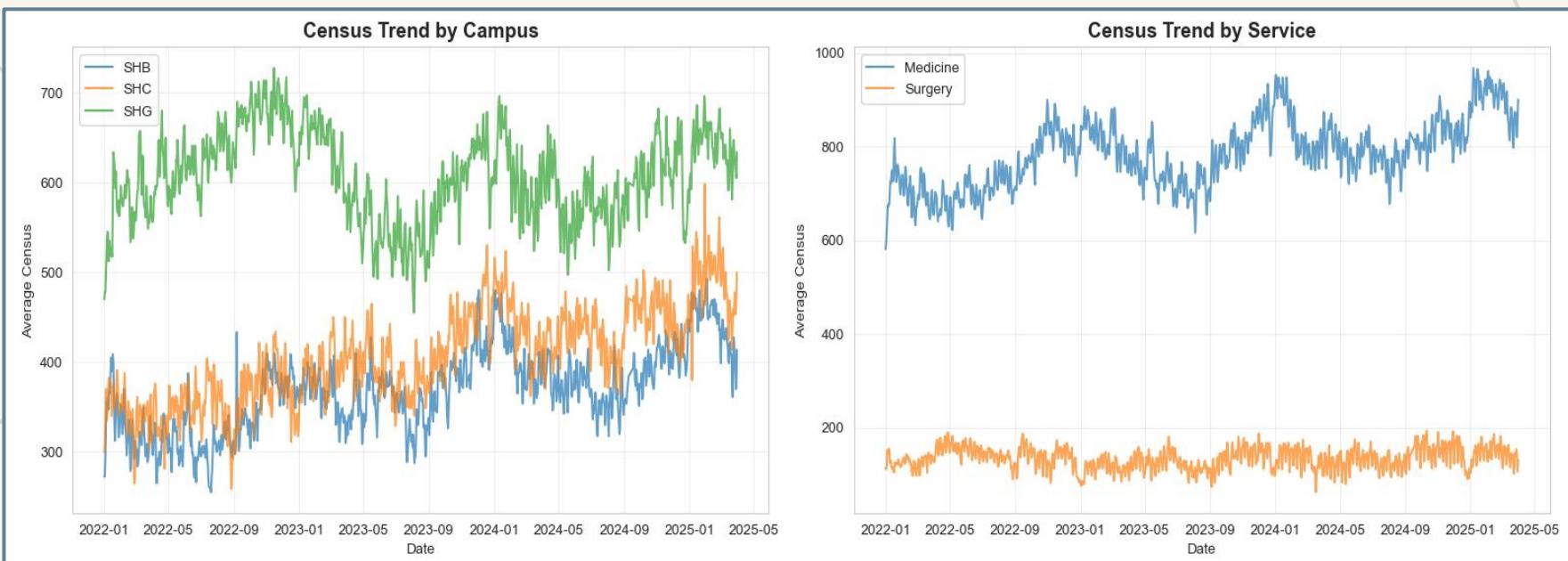
EDData: Renamed the SHC site to Centenary to maintain consistency in site column.



Future Data

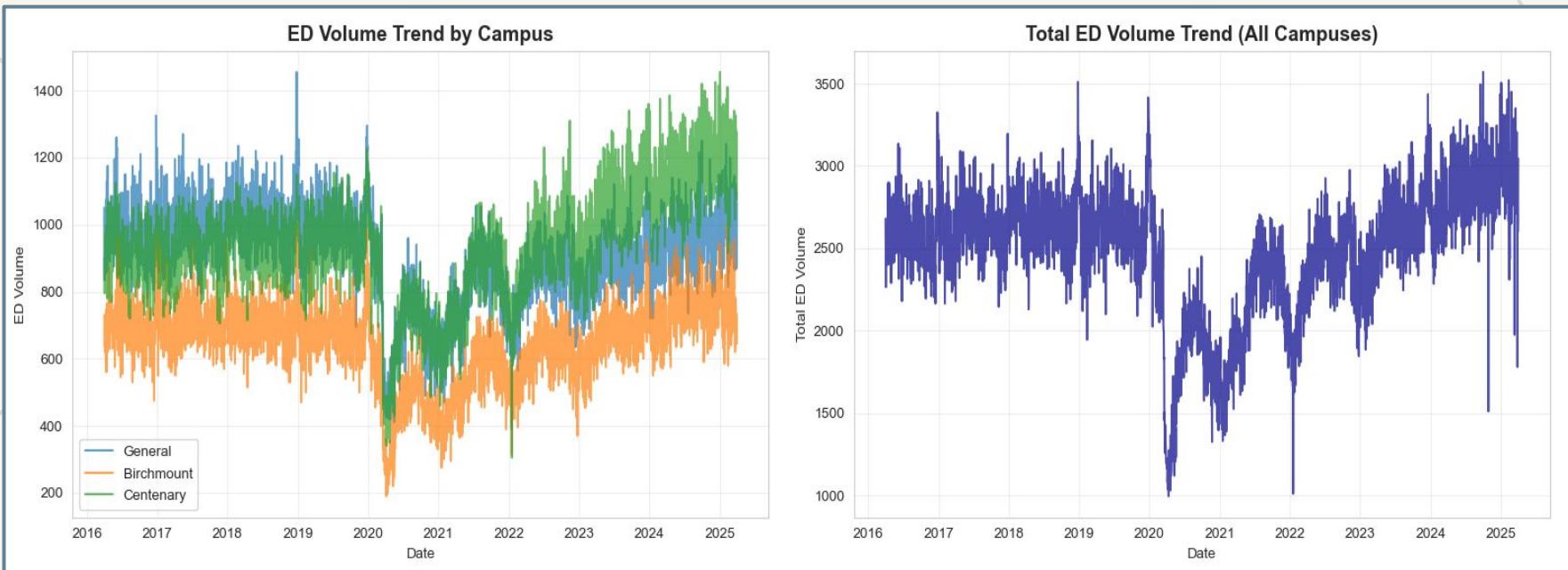
Removed all data points reported for future, as the dataset should strictly contain past data points.

Exploratory Data Analysis



Hospital Census is significantly **higher for SHG site**. **Medicine** admits significantly higher number of patients than **Surgery**.

Exploratory Data Analysis



Hospital ED Volume is **slightly lower for Birchmount** campus. ED Volumes show a **steep rise from 2020 to 2025**, as compared to a constant average before 2020.

Forecasting Approach

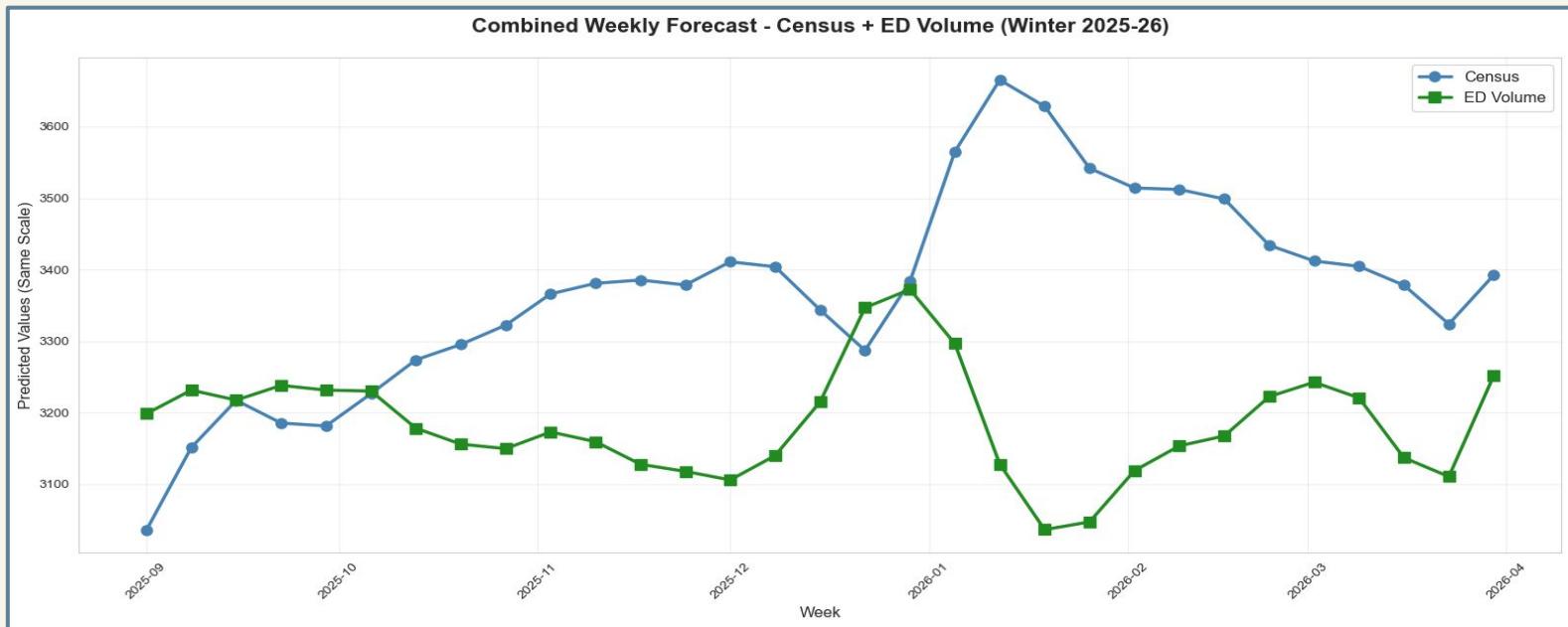
Feature Engineering: Calendar variables (day/month/season), trend, COVID adjustments, winter indicators

Model Comparison: SARIMA vs Prophet tested separately for each campus and service line

Validation: 80/20 train-test split with grid search; selected best model per group based on MAPE (percentage error)

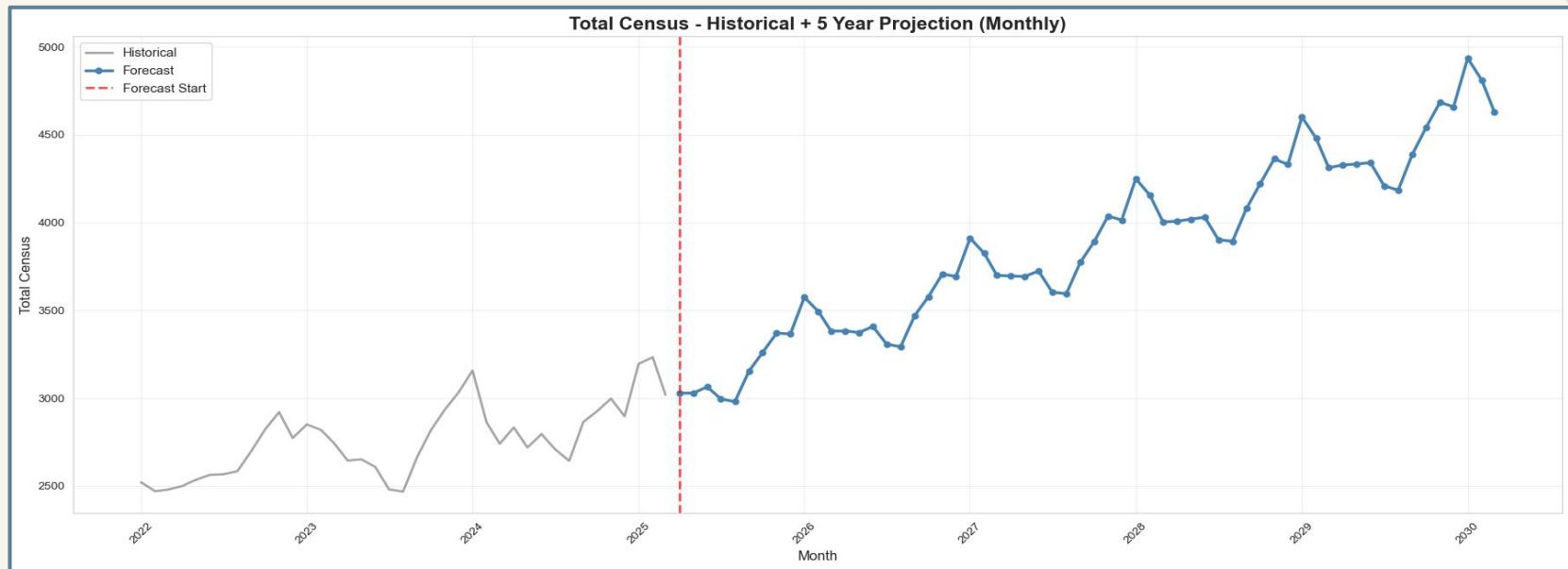


Predictions: Winter 2025 - 2026



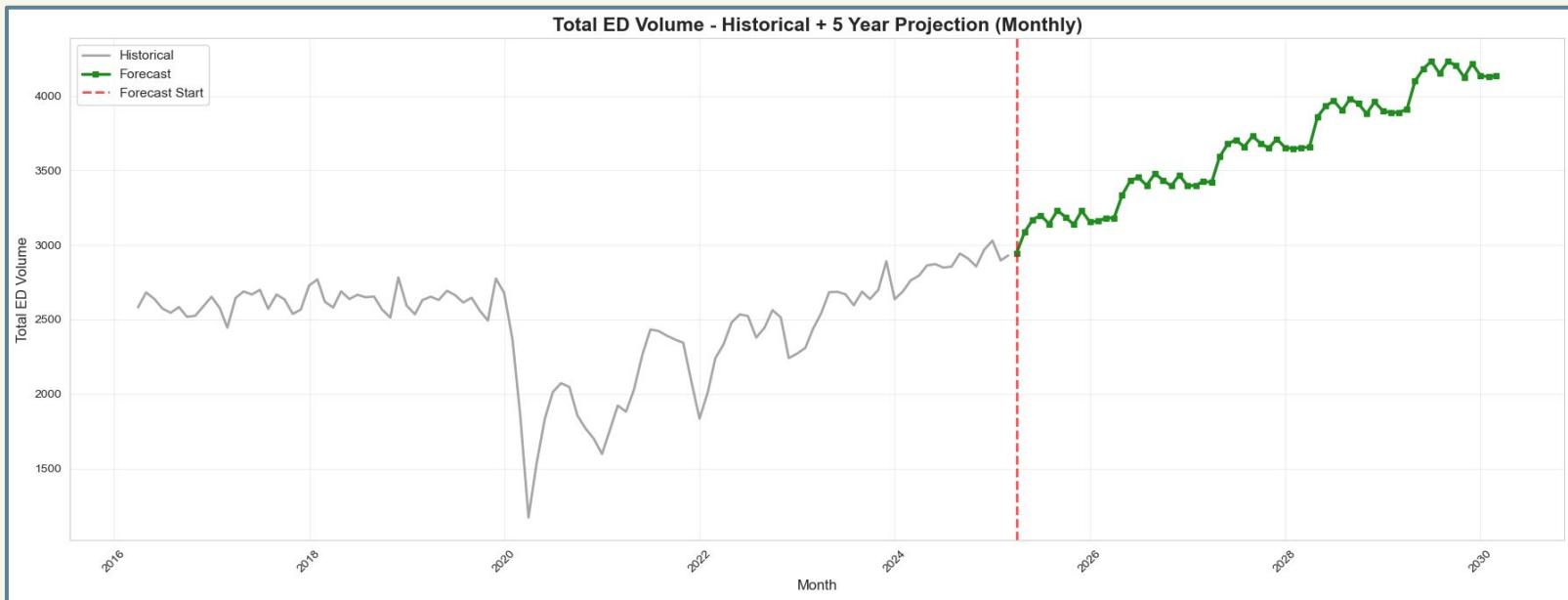
Both metrics **peak in January 2026**, showing synchronized winter surge across emergency and inpatient services. **ED shows more volatility** while census maintains sustained elevation through winter

Predictions: Next 5 years



Hospital Census are **cyclically increasing** from 2026 to 2030, **peaking in January** every year

Predictions: Next 5 years



Hospital ED visits are **cyclically increasing** from 2026 to 2030, **peaking several months** in every year

Key Insights



Winter 2025-26 Will Be Most Severe

Forecasted peak census (~3,650 patients, Week 19/Jan 2026) exceeds all historical winters by 10-15%



Earlier Surge Onset

Volume elevation begins September 2025 (Week 0) at 3,050 census vs. historical ~2,700



Extended Surge Duration

Sustained high volumes persist through March 2026 (~3,400 census) vs. typical spring decline



Predicted Seasonality

All winters exhibit Jan-Feb peak with Dec pre-holiday dips

Actionable Recommendations

ED Capacity Expansion

Add 150-200 temporary surge beds by September 2025 (gap between forecasted 3,650 peak and typical 3,400 capacity)

Quarterly Re-Forecasting

Adjust capacity plans based on real-time trends

ED Flow Optimization

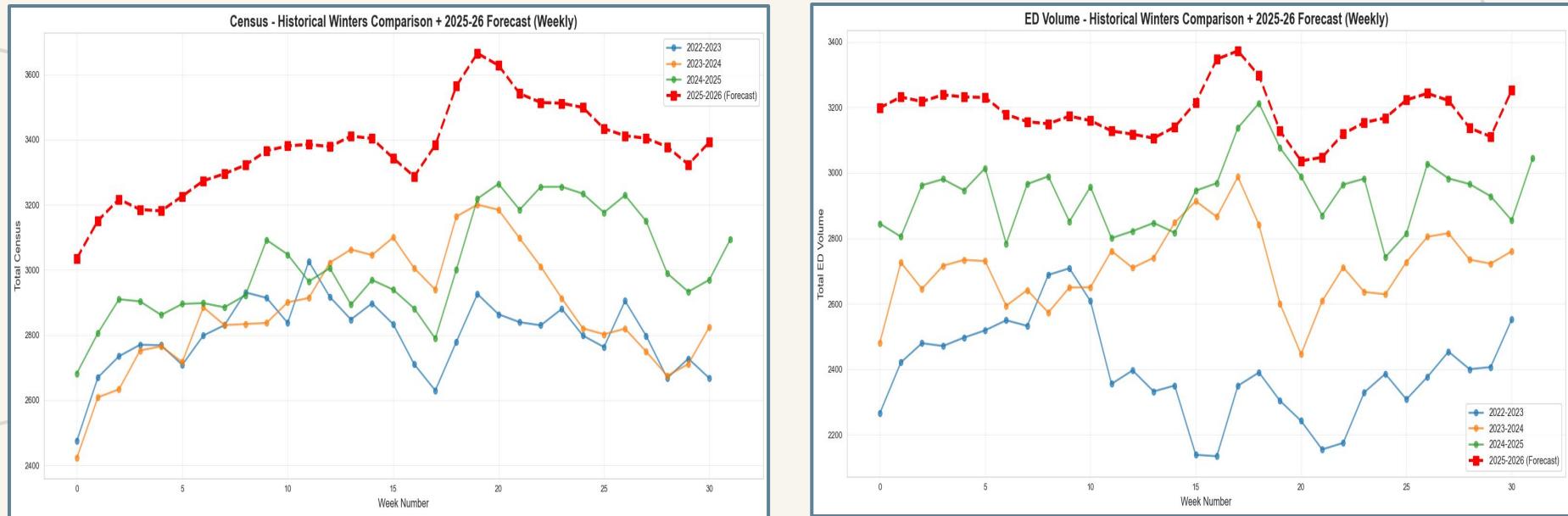
Establish direct admission pathways to bypass ED for elective admissions

Long-Term Planning

Infrastructure investment, ambulatory Care Shift



Bonus Insights



Weekly Hospital Census and ED visits for 2025-2026 are **significantly higher** than the historical averages from 2022- 2025



Thank You!

Questions?

