Nova Scotia Health Long Term Care Inter-Facility Transfer Tool

Department of Industrial Engineering
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1. Problem Definition

Thousands of long-term care patients across Nova Scotia are unhappy in their current facility. These patients put themselves on an inter-facility transfer waitlist hoping to be moved to a facility of their choice.

- **First Available Bed Policy:** Patients in need of long-term care in Nova Scotia are assigned the first available bed that meets their care needs and is within 100km of their community.
- **Reasons for Transfer Requests**:
  - •Desire to be closer to family
  - •Desire to be closer to their culture/home community
  - •Reuniting with a partner in a different facility
- **Wait Times for Transfers:** Transferring to a preferred facility can take several years, as inter-facility transfers are not prioritized.

2. Project Scope & Objectives

- Create a tool to identify potential transfer chains
  - Increase the number of transfers per vacancy
  - Increase patient satisfaction by placing them in their preferred homes

3. Integer Linear Programs (ILPs) & Algorithms

Every bed/patient on the waitlist was treated as a node in a network, and every potential transfer is an edge. From there, 2 ILPs were created to identify transfer chains. The objective is to maximize the total score of every transfer in the chain. Transfers/edges are only considered if the new facility meets a patients needs and is within their list of preferred homes.

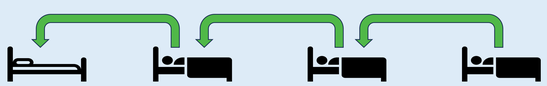
Objective function: Maximize $\sum_{i=1}^{n}\sum_{j=1}^{n} C_{ij} * x_{ij}$

Longest Path Problem

Starts with an **empty bed** and produces one chain from there.

Constraints: **vacancy must be filled**, flow must be conserved (if someone leaves a bed, someone else must fill it).

Solved with **Dynamic Programming**/Greedy Algorithm

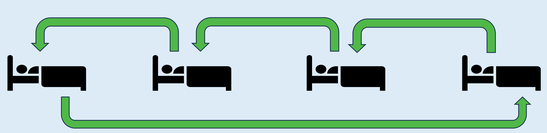


Assignment Problem

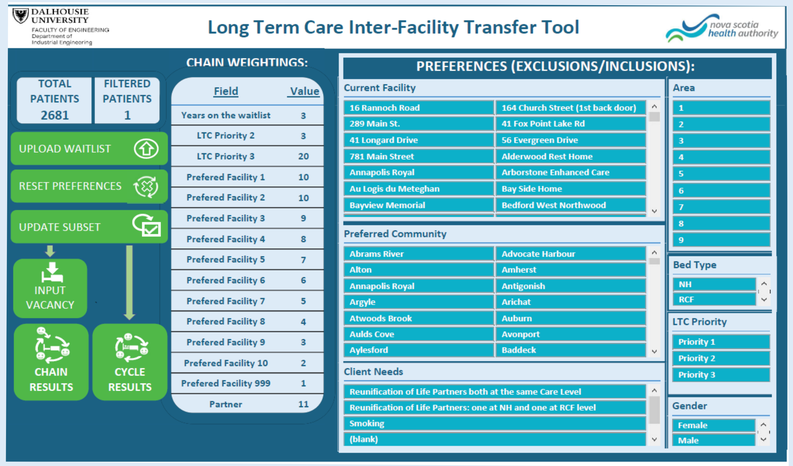
Finds all potential bed swaps and cycles (**no vacancy required**).

Constraints: **every patient must be assigned a bed** (can be their own bed if no transfers are possible).

Solved with the **Hungarian Algorithm**



4. Inter-Facility Transfer Tool Interface



Goal: Input customized data, find longest chains/cycles of transfers.

Prioritizing: Priority level, years on the waitlist, and facility rankings can be weighted to increase/decrease their chance of being selected in the solution.

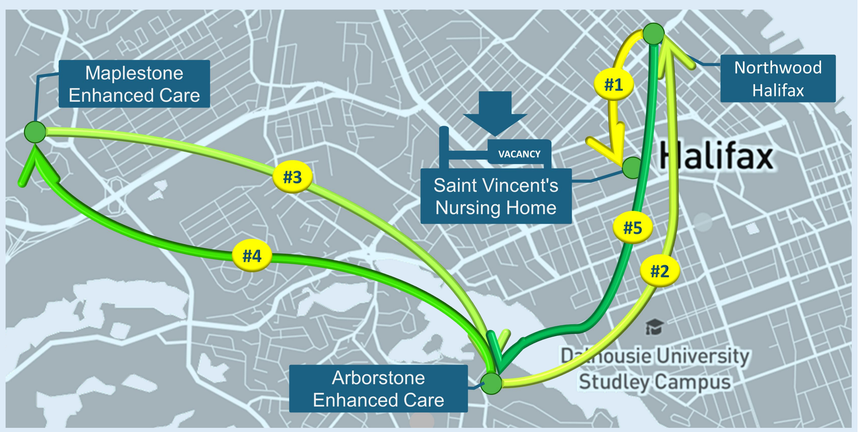
Data Filtering: The user can filter the entire provincial dataset to look at certain areas and patient attributes.

Scenario Planning: The user can test out different scenarios by inputting vacancies, adjusting the filters, and getting transfer chains all within the tool.

5. Case Study

A vacancy at Northwood Care facility for a female/non-smoking patient using the tool, and the data was filtered only for facilities on the Halifax peninsula. The diagram below shows a piece of the chain produced.

1. A patient from Northwood can be transferred into Saint Vincent's
2. A patient from Arborstone Enhanced Care can be transferred into Northwood
3. A patient from Maplestone Enhanced Care can be transferred into Arborstone
4. A second patient from Arborstone can be transferred into Maplestone
5. A patient from Northwood can be transferred into Arborstone

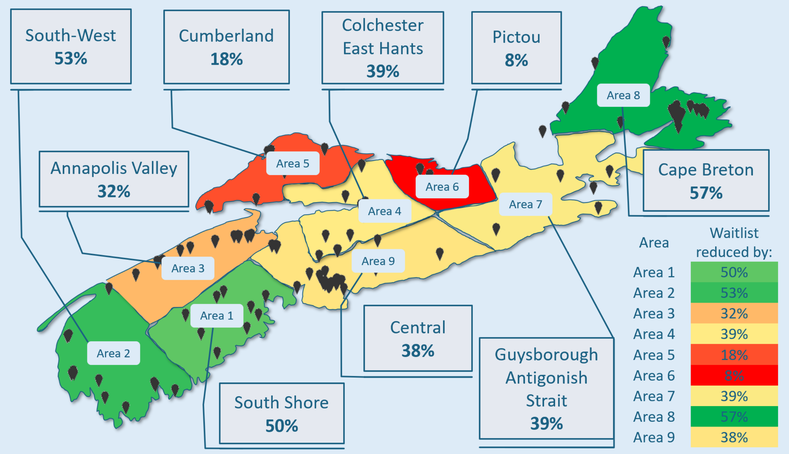


•This chain continues and contains **95 transfers** in total. This is a potential waitlist **reduction of 20%** for that dataset. The chain also includes a patient being reunited with their life partner. Dynamic Programming was used to generate this chain.

• The facilities within this chain are on average **6.5km apart**. This is approximately a 9-minute drive, assuming 40km/h and city traffic.

6. Potential Impact

By filtering the data by area and running each subset through the Assignment Problem ILP, a maximum waitlist reduction of **40%** was discovered.



- Transfer chains can be found **within minutes**.
- The scenario planning aspect of the tool provides **flexibility**: if a patient does not want to transfer, then they can be removed from the dataset and another chain can be generated.
- The tool provides **data insights** into the current state of the waitlist: the user can query the data to identify areas that need more attention, allowing for data-driven decision making.

7. Tool Status

The tool is **currently being used by the NSH Long Term Care team**, and their feedback is being implemented into the final design.