Using Business Intelligence for Efficient Inter-Facility Patient Transfer

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Overview

- Healthcare Infrastructure in Northern BC
- Patient Transfer
- Proposed System
- Key Features
- Future Work
Background

• Collaborative effort between University of Northern British Columbia (UNBC) and the Northern Health Authority (NH)
Patient Transfer

• Inter-facility transfers have been identified as being a suboptimal process
• Communication delays and ineffective documentation lead to slower patient transfers
• In practice today, transfers are often made based on proximity and habit, rather than hospital performance and capability
• Need for data-driven approach
Patient Transfer: Challenges

- Requires knowledge of services and transport options
- Commonly stored in legacy formats
- Data integrity/quality
- Inter-facility communication
Patient Transfer: The process

1. Identify transferable patients
2. Identify a destination
3. Call the Patient Transfer Network
4. Accomplish the transfer

The focus of the proposed system is optimization of step 2
Proposed System

• Built using data collected by Northern Health (NH) from 26 candidate facilities
Data Warehousing

• Data extraction and cleansing
• Transformation
• Loading
Conventional BI

- Reporting Services (KPIs)
- Analysis Services (Data cube, Data mining)
- Data Warehousing (Data Integration, ETL/ELT)
Design Summary

Legacy Data (Spreadsheets) -> ETL Process (SSIS) -> Data Warehouse (SQL Server) -> OLAP Cube (SSAS) -> Reports (SSRS) -> Report Web Interface (ASP.NET)

Linked Dimensions (SSAS) 

Data-Entry Webform (ASP.NET)
OLAP Cube

• Dimensional Data Model (Kimball Approach)
• 7 fact tables used
• reports render in under 7 seconds
• 4 dimensions and 4 linked-dimensions
• Hierarchies such as Northern Health > HSDA > LHA > Community allow facts to be aggregated when data rolled-up
Analysis Cube Design

- **Distance**: Distance PK, Community FK, From Community FK, Distance, Time
- **DimAirport**: Airport PK, Airport Name, Airport Type, Landing Type, Carrier Name, Runway Type, Airport Comment
- **Question**: Question PK, Question Description, Question Sub Category, Question Category, Question Type, Suggested Display
- **FactAnswers**: Answer PK, Question FK, Community FK, Facility FK, Note FK, Answer Value, Answer Time Stamp
- **Ambulances**: Ambulance PK, Community FK, Station FK, Crew FK, Crew Type, Crew Count, Facility FK
- **FactAirport**: Airport FK, Runway FK, Community FK, Facility FK, Runway Length, Runway Count
- **Transfer**: Destination FK, From Facility FK, Community FK
- **DimNotes**: Note PK, Answer Comment, Subcategory Comment
- **Destination**: Destination PK, Destination Name, Transfer Reason
- **Ambulance Crew**: Crew PK, Crew Description
- **Ambulance Station**: Station PK, Station Name

The diagram illustrates the relationships and data structures involved in an analysis cube design, focusing on various tables and their attributes.
Platform

• MS SQL Server
  – SSIS used for integration
  – SSAS used for analysis and query processing
  – SSRS enhanced with maps and custom embedded objects
• ASP.NET wrappers
• Web Forms for remote data entry
• User-triggered cube processing
• Changes pushed to reports instantly
### Data Entry Web Form

#### Patient Transfer Data Entry

<table>
<thead>
<tr>
<th>Airport</th>
<th>Ambulance</th>
<th>Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airports</td>
<td>Ambulances</td>
<td>Destinations</td>
</tr>
<tr>
<td>Carriers per Airport</td>
<td>Ambulance Crews</td>
<td></td>
</tr>
<tr>
<td>Carriers List</td>
<td>Ambulance Stations</td>
<td></td>
</tr>
</tbody>
</table>

#### Ability to care for high acuity patients

- Stabilize and hold greater than 5 days
- Yes [ ] No [ ]

#### Aboriginal Liaison

- Aboriginal Liaison [ ] Yes [ ] No [ ]
- Community Health Representative...

#### Blood Services

- Blood Services [ ] Yes [ ] No [ ]

#### Critical Care Services

- Critical Care Services [ ] Yes [ ] No [ ]
  - Beds in Formal ICU: 0

#### Diabetic Nurse Educator

- Diabetic Nurse Educator [ ] Yes [ ] No [ ]

#### Dialysis Unit

[UNBC University of Northern British Columbia]

Northern Health

The northern way of caring
Access Control

• Designated account access
• Account management is handled using Windows Active Directory
• Web access is controlled using ASP.NET Windows authentication
Reporting Features

- Interactive web-based interface that delivers available services and infrastructure to transfer operators
- An interactive map for navigation
- Detailed summary reports of important facility information
- Facility comparison tool
- Facility mapping tool
- Transportation options
University Hospital of Northern British Columbia

**Facility Classification**: Urban

**Located in**: Prince George

- Inpatient Beds: 200
- Beds (Outside Community): 53
- Beds in Formal ICU: 10
- Hospice / Palliative Care Beds: 0
- Monitored Stretchers: 20
- Operating Rooms: 7
- Total ED Stretchers: 20
- Oncology Services Capacity: 11

### Lab/Imaging Access

<table>
<thead>
<tr>
<th>Service</th>
<th>24 hours</th>
<th>Limited hours</th>
<th>Onsite</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Lab</td>
<td>✔️</td>
<td>X</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>MRI</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Radiology</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Ultrasound</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>X-ray</td>
<td>X</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>
Facility Summary Reports

Patient Care Services

- Ability to care for high acuity patients
  - Stabilize and hold greater than 5 days ✓
- Aboriginal Liaison ✓
- Blood Services X
- Diabetic Nurse Educator ✓
- Dialysis Unit ✓
  - Outside Community ✓
- Dietician ✓
- Home and Community Care
  - Available in Home Community ✓
- Mental Health and Addiction
  - Community Services ✓
  - De-escalation Room X
  - Designated Observation Unit ✓
  - Inpatient Unit ✓
  - Residential Services X
  - Seclusion Room ✓
  - Occupational Therapist ✓
  - Perinatal Services ✓
  - Pharmacy X
  - Physiotherapist ✓
  - Recreational Therapist ✓
  - Respiratory Services ✓
  - Social Worker ✓
  - Speech and Language Therapist ✓
  - Telehealth ✓
  - Wound Care / Ostomy Clinician ✓

Staff

- General Practitioner 129
  - ER Physician 12
  - Family Practice 107
  - GP Anesthetics 10
- Oncology Staff 19
  - GP's in Oncology 3
  - Medical Oncologist 3
  - Nursing Staff 10
  - Radiation Oncologist 3
- Specialist 30
  - Anesthesiologist 10
  - Dermatology 0
  - Emergency 0
  - IM Diabetes 0
  - Intensivist 1
  - Internal Med 0
  - Internist 1
  - Nephrologist 2
  - Neurology 0
  - Nurse Practitioner 0
  - Obstetrician 4
  - Pain Management 1
  - Pathologist 0
  - Pediatrician 5
  - Perinatologist 0
  - Psychiatry 0
  - Radiologist 5

- Surgeon 28

Equipment and Rooms

- ER
- Hospice / Palliative Care
- Oncology Services
- Residential Care
## Facilities and Equipment

### University Hospital of Northern British Columbia
- **Facility**: Urban
- # of Beds (Community Hospital Site): 0
- # of Beds in Formal ICU: 10
- # of Hospice / Palliative Care Beds: 0
- # of Inpatient Beds: 200
- # of Residential Care Beds: 348

- Blood Services
- ER
- Hospice / Palliative Care
- Mental Health and Addiction
- Oncology Services
- Surgical Services

### G.R. Baker Hospital
- **Facility**: Rural
- # of Beds (Community Hospital Site): 0
- # of Beds in Formal ICU: 4
- # of Hospice / Palliative Care Beds: 3
- # of Inpatient Beds: 32
- # of Residential Care Beds: 117

- Blood Services
- ER
- Hospice / Palliative Care
- Mental Health and Addiction
- Oncology Services
- Surgical Services

### Prince Rupert Regional Hospital
- **Facility**: Rural
- # of Beds (Community Hospital Site): 0
- # of Beds in Formal ICU: 0
- # of Hospice / Palliative Care Beds: 0
- # of Inpatient Beds: 22
- # of Residential Care Beds: 61

- Blood Services
- ER
- Hospice / Palliative Care
- Mental Health and Addiction
- Oncology Services
- Surgical Services
## Facility Comparison Tool

### Patient Care Services

<table>
<thead>
<tr>
<th>Service</th>
<th>G.R. Baker Hospital</th>
<th>Prince Rupert Regional Hospital</th>
<th>University Hospital of Northern British Columbia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to care for high acuity patients</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Aboriginal Liaison</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Diabetic Nurse Educator</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dialysis Unit</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Dietician</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Home and Community Care</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Oncology Services</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Perinatal Services</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Occupational Therapist</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Physiotherapist</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Recreational Therapist</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Speech and Language Therapist</td>
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<td>✓</td>
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<tr>
<td>Residential Care</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Respiratory Services</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Social Worker</td>
<td>✓</td>
<td>✗</td>
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</tr>
<tr>
<td>Telehealth</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Wound Care/Ostomy Clinician</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Staff

- **University Hospital of Northern British Columbia**
- **G.R. Baker Hospital**
- **Prince Rupert Regional Hospital**

#### Graph

- Anesthesiologist
- Dermatologist
- Emergency
- Endocrinologist
- Intensive Care
- Internist
- Gastroenterologist
- General Practitioner
- Obstetrician
- Paediatrician
- Pathologist
- Oncologist
- Pediatrician
- Radiologist
- Neurologist
- Neurosurgeon
- Nurse Practitioner
- Palliative Medicine
- Paediatric Surgery
- Perioperative Medicine
- Physical Medicine
- Pulmonologist
- Psychiatrist
- Proctologist
- Radiation Oncologist
- Renal
- Renal Surgeon
- Rheumatologist
- Secretarial
- Social Worker
- Speech Language Therapist
- Telehealth
- Theatre Support
- Urologist
- Urologist Surgeon
- Vascular Surgeon
- Wound Care/Ostomy Clinician

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## Lab-Imaging Access

<table>
<thead>
<tr>
<th></th>
<th>University Hospital of Northern British Columbia</th>
<th>G.R. Baker Hospital</th>
<th>Prince Rupert Regional Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hours</td>
<td>Limited hours</td>
<td>Onsite</td>
</tr>
<tr>
<td>CT</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Lab</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>MRI</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Nuclear Medicine</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Radiology</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Xray</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Facility Mapping Tool

Selected Facility
- Prince Rupert Regional Hospital

Patient Care Services
- Critical Care Services
- Diabetic Nurse Educator
- Dietician
- Home and Community Care
- Hospice / Palliative Care
- Oncology Services
- Perinatal Services
- Rehabilitation Services
- Residential Care
- Respiratory Services
- Social Worker
- Surgical Services
- Telehealth
- Wound Care/ Ostomy Clinician

Imaging
- CT
- Lab
- MRI
- Nuclear Medicine
- Radiology
- Ultrasound
- X-ray

Staff
- General
- Surgeon
- Specialist
- Oncology

Utility
- Dialysis Unit
- ER
- Mental Health and Addiction

Facilities meeting Specified Criteria:

- Mills Memorial Hospital
  - Dialysis Unit
  - On-Site: ✓
- ER
  - Monitored Stretcher: 6
  - Stroke Protocol: ✓
  - Total ED Stretcher: 11
- Social Worker
  - On-Site: ✓
- Surgeon
  - General: 3
- Access Details
  - 24 hours: ✓
  - Limited hours: ✓
  - Onsite: ✓
- Lab
- University Hospital of Northern British Columbia
  - Dialysis Unit
  - On-Site: ✓
- ER
  - Monitored Stretcher: 20
  - Stroke Protocol: ✓
  - Total ED Stretcher: 20
- Social Worker
  - On-Site: ✓
- Surgeon
  - General: 1
- Access Details
  - 24 hours: ✓
  - Limited hours: X
  - Onsite: ✓
- Lab
- Fort St. John Hospital and Health Centre
  - 14 hrs 51 mins
## Facility Mapping Tool

### Selected Facility
- St. John Hospital

### Patient Care Services
- Critical Care Services
- Diabetic Nurse Educator
- Dietician
- Home and Community Care
- Hospice / Palliative Care
- Oncology Services
- Perinatal Services
- Rehabilitation Services
- Residential Care
- Respiratory Services
- Social Worker
- Surgical Services
- Telehealth
- Wound Care/ Ostomy Clinician

### Utility
- Dialysis Unit
- ER
- Mental Health and Addiction

### Facilities meeting Specified Criteria:

<table>
<thead>
<tr>
<th>Hospital</th>
<th>ER</th>
<th>Stroke Protocol</th>
<th>Total ED Stretcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. John Hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stuart Lake Hospital</td>
<td>48</td>
<td>0</td>
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</tr>
<tr>
<td>Fraser Lake Community Health Centre</td>
<td>53</td>
<td>0</td>
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<tr>
<td>University Hospital of Northern British Columbia</td>
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<td>0</td>
<td></td>
</tr>
<tr>
<td>Lakes District Hospital and Health Centre</td>
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<td></td>
</tr>
<tr>
<td>Houston Health Centre</td>
<td>2</td>
<td>0</td>
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</tr>
<tr>
<td>G.R. Baker Hospital</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bulkley Valley and District Hospital</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mackenzie and District Hospital and Health Centre</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>McBride and District Hospital</td>
<td>4</td>
<td>0</td>
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</table>
# Transportation Options

## Airport

<table>
<thead>
<tr>
<th>Airport Name</th>
<th>Airport Type</th>
<th>Runway Type</th>
<th>Carrier Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Helipad</td>
<td>Hospital Helipad</td>
<td>N/A</td>
<td>No Carrier</td>
</tr>
<tr>
<td>Prince Rupert Airport— Digby Island</td>
<td>Commercial Airport</td>
<td>1829 - Asphalt</td>
<td>Air Canada</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hawkair</td>
</tr>
<tr>
<td>Prince Rupert/Digby Island Water Aerodrome</td>
<td>Non-commercial Airport</td>
<td>N/A</td>
<td>No Carrier</td>
</tr>
<tr>
<td>Prince Rupert/Seal Cove Water Aerodrome</td>
<td>Commercial Airport</td>
<td>N/A</td>
<td>Inland Air Charters</td>
</tr>
<tr>
<td>Seal Cove Seaplane Base</td>
<td>Community Helipad</td>
<td>N/A</td>
<td>No Carrier</td>
</tr>
</tbody>
</table>

## Ambulance

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Crew Count</th>
<th>Crew Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#684</td>
<td>0</td>
<td>24/7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>On Call Only</td>
</tr>
</tbody>
</table>
Future Work

- Extend to the entire province of BC
- Coverage will include:
  - >5 Health Authority regions
  - >300 healthcare facilities
  - Service over 4 million BC residents
- Challenges:
  - Standardizing medical terms
  - Creating a unified set of data fields to store facility services information
Patient Transfer Dashboard Link

1. Click on the link and it will take you to the NH Service Inventory dashboard
2. In the upper Right hand corner click on the Patient Transfer link

http://servicesdashboard.northernhealth.ca/Services.aspx