# High Cost Users

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# Today's presentation

- **Defining High Cost Users**
  - *Original analysis*
    - What we found
      - costs by care type
      - by care type
      - age distribution of high cost users
      - distribution across LHINs
      - distribution across sub-LHINs
      - conditions in acute care that account for highest spending
  - *Updated analysis with Long-Term Care and OHIP data*
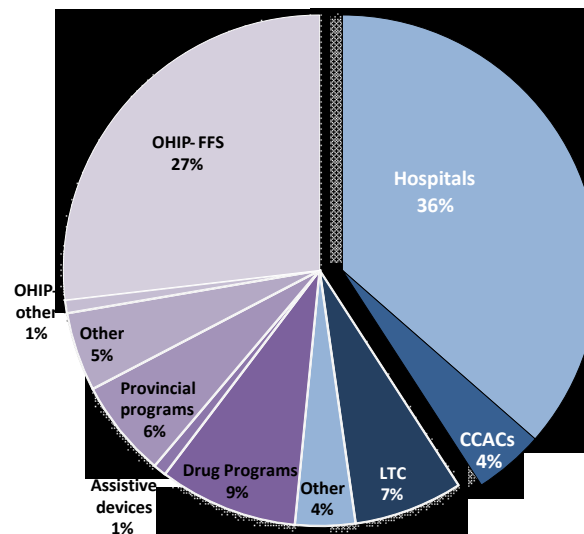- **Predictive Modelling**
- **Next Steps**

# Defining High Cost Users: *original analysis*

**2009/10**
- Acute inpatient care
- Day surgery
- Emergency rooms
- Inpatient rehabilitation
- Complex continuing care
- Inpatient mental health
- Home Care

Aligned with HBAM (included only those sectors that are included in HBAM.)

Expenses for these sectors account for approximately 80% of LHIN budgets, and
40% of the total MOHLTC operating expenses.



Pie chart: Hospitals 36%, CCACs 4%, LTC 7%, Other 4%, Drug Programs 9%, Assistive devices 1%, Provincial programs 6%, Other 5%, OHIP-other 1%, OHIP-FFS 27%

| | Population | Expenses (costs) in Millions $ | Average cost per patient $ | As a percentage of the population | As a percentage of costs |
|---|---|---|---|---|---|
| All population | 13,069,200 | | | | |
| **Used hospital/HC services** | **3,901,600** | **$ 14,214** | **$ 3,600** | **29.9%** | **--** |
| Top 10% of hospital/HC users | 390,200 | $ 10,623 | $ 27,200 | 3.0% | 75% |
| Top 5% of users | 195,100 | $ 8,641 | $ 44,300 | 1.5% | 61% |
| Top 1% of users | 39,000 | $ 4,440 | $ 113,800 | 0.3% | 31% |

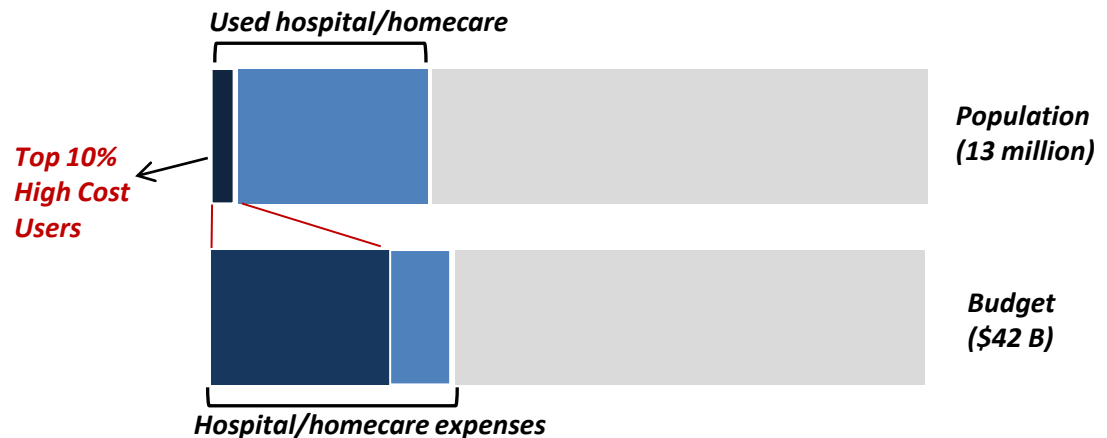The total population of Ontario is approximately 13.1 million
- in 2009/10 3.9 million of them (30%) of them used hospital or homecare services
- this use accounted for $14.2 billion in health care service costs

**We examined the total expenses for each patient in 2009/10 and ranked them to identify the top 10%, 5% and 1% among these patients.**

# Defining High Cost Users: *original analysis*

**2009/10**
- Acute inpatient care
- Day surgery
- Emergency rooms
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*Used hospital/homecare*

*Top 10% High Cost Users*

*Population (13 million)*

*Budget ($42 B)*

*Hospital/homecare expenses*

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*High* — Top 10% of hospital/HC users
*Very high* — Top 5% of users
*Super high* — Top 1% of users

**The top 10% of high cost users among the 3.9 million Ontario residents who had used hospital and homecare services in 2009/10 is 390,200 patients. This 'Top 10%'**
- accounts for approximately 3% of Ontario's population
- accounts for 75% of costs in the sectors we examined ($10.6 Billion)
- has an average cost per patient of $27,200

# What we analysed

- Described characteristics of Ontario high cost users (2009/10) of hospital & homecare (top 10%, 5% and 1%) with respect to:
  - Care type (sector)
  - Age
  - Sex
  - Disposition
  - ALC
- Repeated the analysis for each LHIN (looking at both LHIN of service, and LHIN of population)

  - Examined distribution of high cost users by subLHIN population

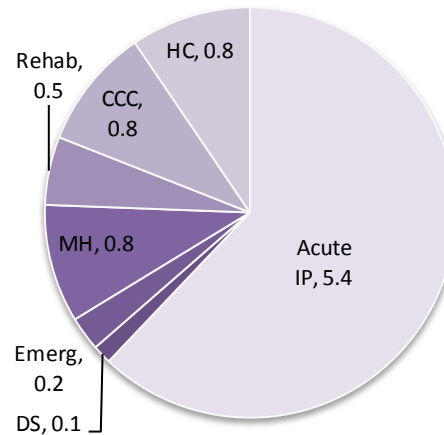- Repeated all analysis to look at high cost users within each sector

# What we found

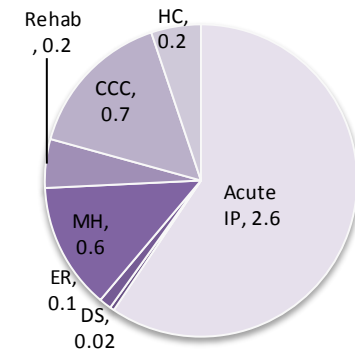## Health care patients and costs comparison across care types

**All users:**          3,901,600
**Cost in Billions $:**   $14.2
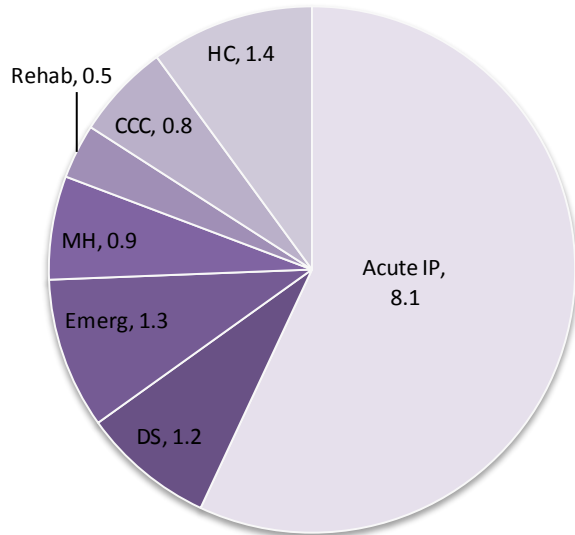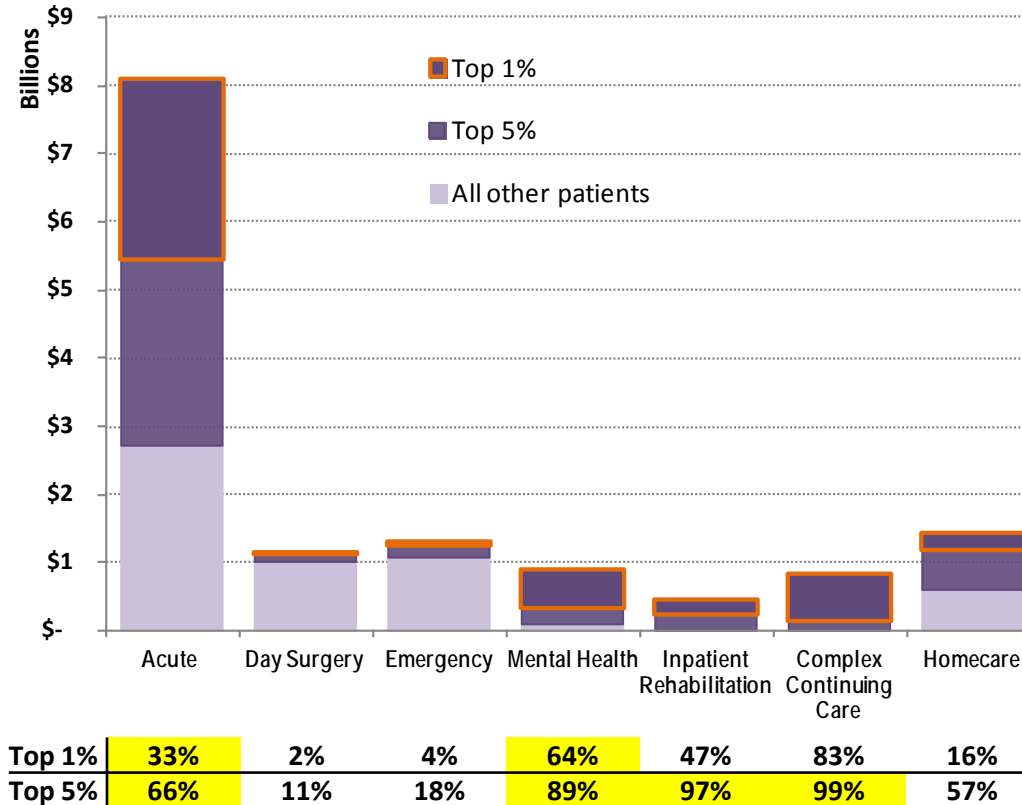
**Top 5% users:**        195,100
**Cost in Billions $:**   $8.6

**Top 1% users:**        39,000
**Cost in Billions $:**   $4.4



All users pie chart: Acute IP, 8.1; DS, 1.2; Emerg, 1.3; MH, 0.9; CCC, 0.8; Rehab, 0.5; HC, 1.4

Top 5% users pie chart: Acute IP, 5.4; DS, 0.1; Emerg, 0.2; MH, 0.8; CCC, 0.8; Rehab, 0.5; HC, 0.8

Top 1% users pie chart: Acute IP, 2.6; DS, 0.02; ER, 0.1; MH, 0.6; CCC, 0.7; Rehab, 0.2; HC, 0.2

1) Approximately 60% of costs are for Acute Inpatient care (regardless of whether we look at all health care uses, top 5% or top 1%).

2) Among the top 1%: almost 30% of costs are for Complex Continuing Care and Mental Health (compared to 12% of costs among all users).

**Acute**- Acute Inpatient
**DS**- Day Surgery
**Emerg**- Emergency Room
**MH**- Inpatient Mental Health
**Rehab**- Inpatient Rehabilitation
**CCC**- Complex Continuing Care
**HC**- Home Care

# What we found: *costs by care type*



| | Acute | Day Surgery | Emergency | Mental Health | Inpatient Rehabilitation | Complex Continuing Care | Homecare |
|---|---|---|---|---|---|---|---|
| **Top 1%** | **33%** | 2% | 4% | **64%** | 47% | 83% | 16% |
| **Top 5%** | **66%** | 11% | 18% | **89%** | **97%** | **99%** | 57% |

1) **Acute Inpatient Care:**
   - Top 5% high cost users accounted for two thirds of all acute inpatient costs.
   - Top 1% of high cost users accounted for one third of all acute care costs.

2) **Mental Health:**
   - Top 5% of high cost users accounted for 90% of inpatient Mental Health Costs, and
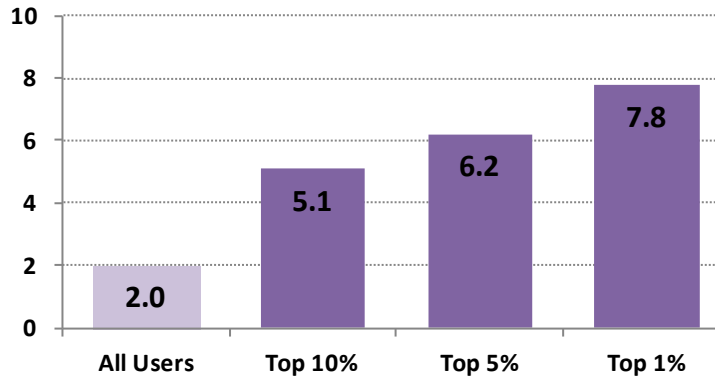   - Top 1% of high cost users accounted for two thirds of Mental Health costs.

3) **Inpatient Rehabilitation and CCC:**
   - Top 5% of high cost users accounted for majority of inpatient rehab and CCC costs.
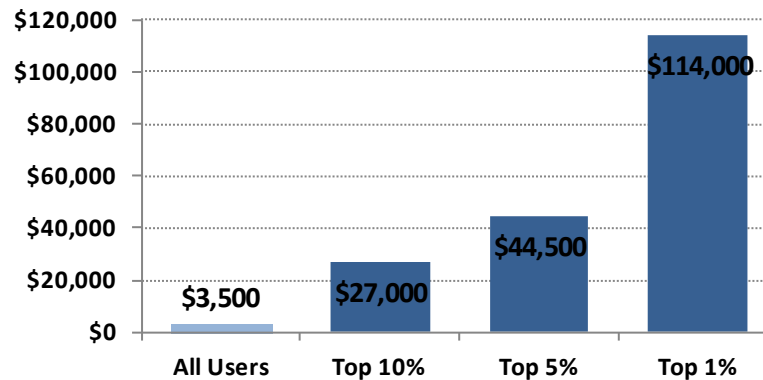
# What we found: *by care type*

**Percent of patients who used this care type**

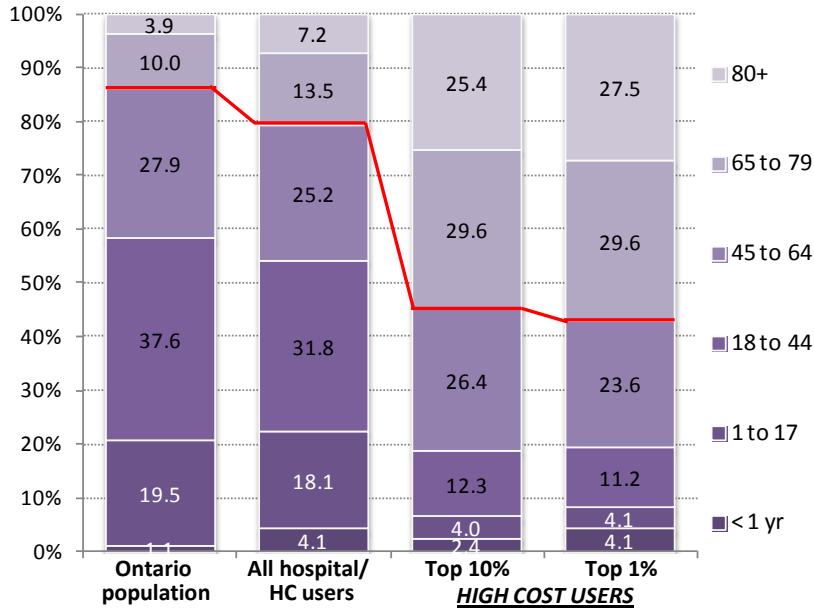| | All Users | Top 10% | Top 5% | Top 1% |
|---|---|---|---|---|
| **Acute IP** | 21.0 | 86.6 | 87.2 | 84.9 |
| **Day Surgery** | 24.8 | 29.2 | 28.1 | 21.9 |
| **Emergency** | 75.0 | 77.1 | 81.3 | 79.6 |
| **IP Mental Health** | 0.9 | 5.9 | 7.6 | 11.7 |
| **IP Rehabilitation** | 0.7 | 6.5 | 11.9 | 18.0 |
| **Complex Continuing Care** | 0.5 | 4.6 | 8.6 | 23.4 |
| **Homecare** | 11.0 | 51.1 | 58.6 | 57.6 |

**Average # of events per patient**



**Average cost per patient**



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# What we found: *age distribution of high cost users*



**% population by age group**

Chart categories (left to right): Ontario population, All hospital/HC users, Top 10%, Top 1% — under **HIGH COST USERS**

Legend: 80+, 65 to 79, 45 to 64, 18 to 44, 1 to 17, < 1 yr

| Age group | Ontario population | All hospital/HC users | Top 10% | Top 1% |
|---|---|---|---|---|
| 80+ | 3.9 | 7.2 | 25.4 | 27.5 |
| 65 to 79 | 10.0 | 13.5 | 29.6 | 29.6 |
| 45 to 64 | 27.9 | 25.2 | 29.6 | 29.6 |
| 18 to 44 | 37.6 | 31.8 | 26.4 | 23.6 |
| 1 to 17 | 19.5 | 18.1 | 12.3 | 11.2 |
| < 1 yr | 1.1 | 4.1 | 4.0 / 2.4 | 4.1 / 4.1 |

1) Although seniors account for 14% of the population, they account for 55% of Top 10% high cost users and almost 60% of the Top 1% high cost users.

2) Within the Top 1% high cost users, one in four are between the ages of 45-64 and one in five are below the age of 44.

3) Infants account for 1% of the population, but 4% of the super high cost users (Top 1%).

Billions — Total costs: Costs for Top 1% (~$14 to $10 billion region), Costs for remaining 99%

Pie chart (Top 1% costs by age):
- < 1 yr, 5%
- 1 to 17, 5%
- 18 to 44, 13%
- 45 to 64, 25%
- 65 to 79, 28%
- 80+, 24%
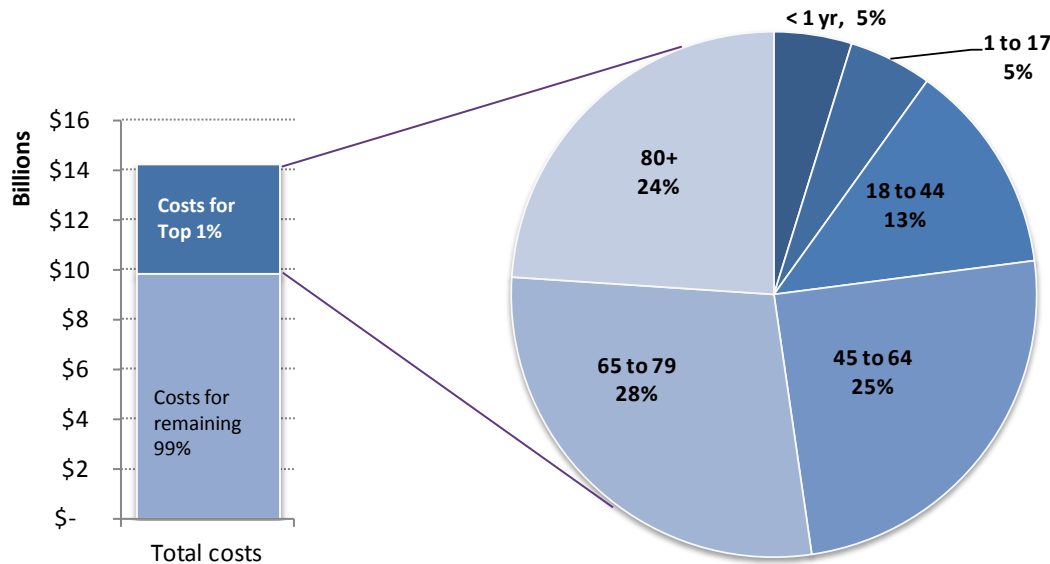
1) Over half the costs for Top 1% high cost users are for patients age 65 or over, and almost one fourth are for patients age 80 or more.

2) Within the Top 1% high cost users, one in four are between the ages of 45-64 and one in five are below the age of 44.

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# Distribution of top 5% high cost user patients and costs across LHINs

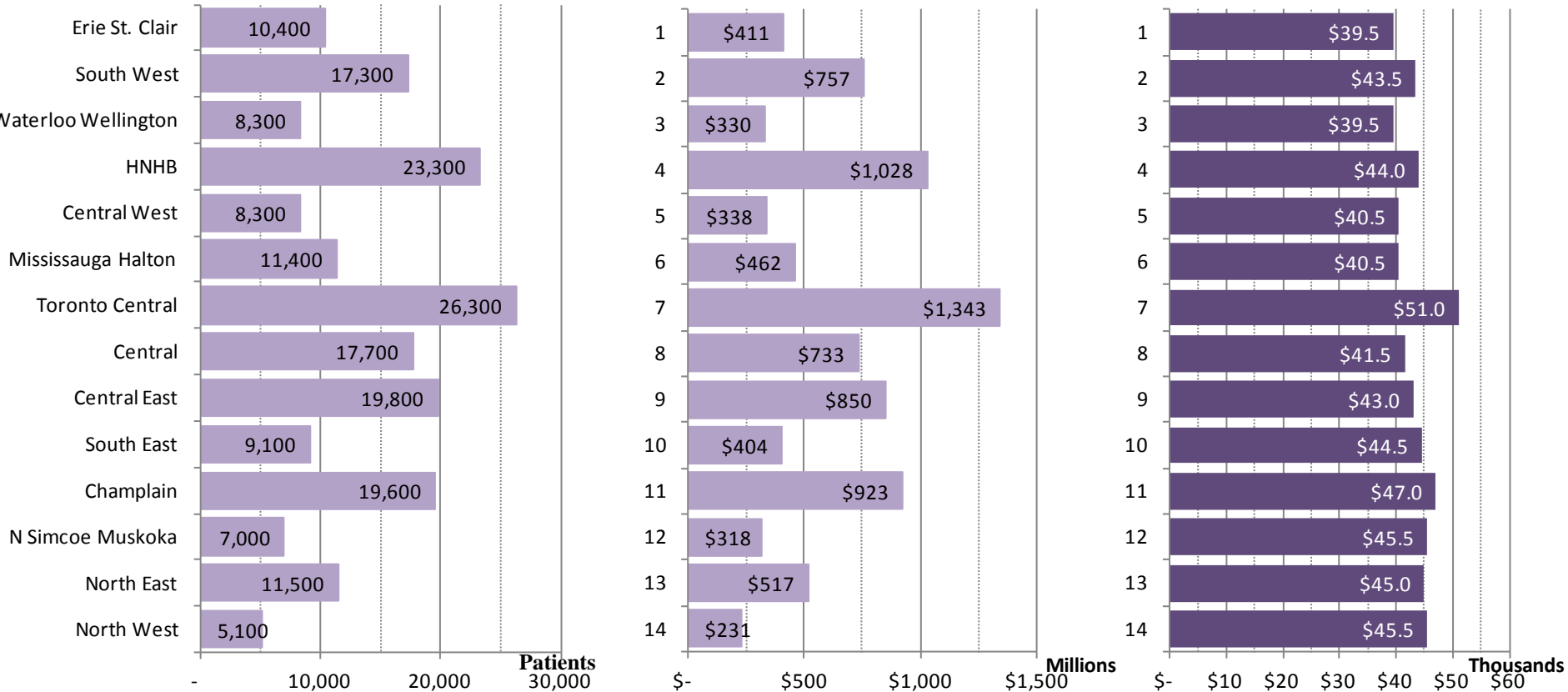**This group includes approximately 195,000 patients**
**These patients cost the system $8.6 Billion and accounted for 61% of total hospital & homecare costs.**
*Distribution of patients and costs is based on LHIN of service*
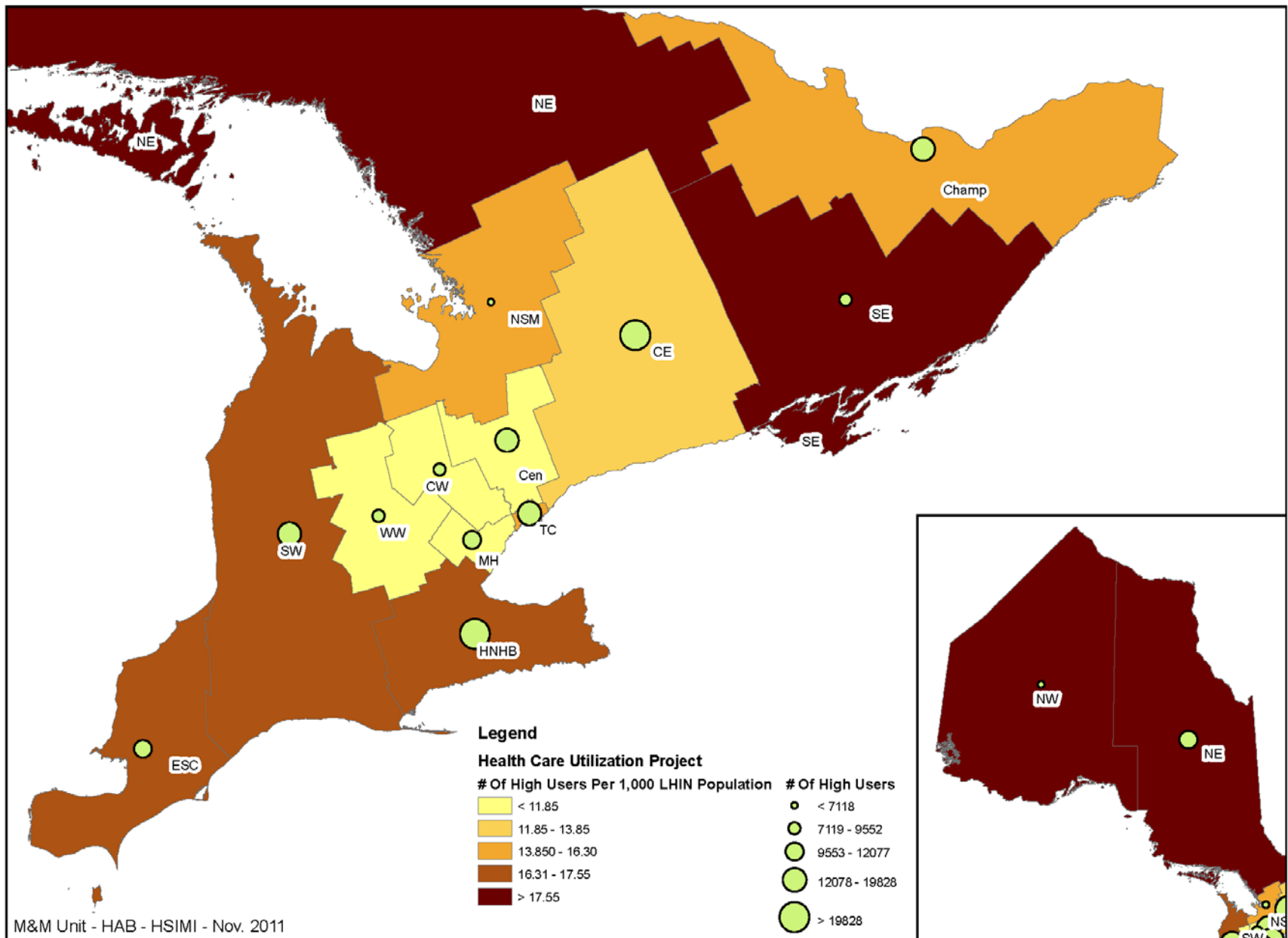
### Distribution of top 5% high cost user patients

| LHIN | Patients |
|---|---|
| Erie St. Clair | 10,400 |
| South West | 17,300 |
| Waterloo Wellington | 8,300 |
| HNHB | 23,300 |
| Central West | 8,300 |
| Mississauga Halton | 11,400 |
| Toronto Central | 26,300 |
| Central | 17,700 |
| Central East | 19,800 |
| South East | 9,100 |
| Champlain | 19,600 |
| N Simcoe Muskoka | 7,000 |
| North East | 11,500 |
| North West | 5,100 |

### Distribution of total costs for top 5% high cost user patients ($ in Millions)

| # | Cost |
|---|---|
| 1 | $411 |
| 2 | $757 |
| 3 | $330 |
| 4 | $1,028 |
| 5 | $338 |
| 6 | $462 |
| 7 | $1,343 |
| 8 | $733 |
| 9 | $850 |
| 10 | $404 |
| 11 | $923 |
| 12 | $318 |
| 13 | $517 |
| 14 | $231 |

### Average cost per top 5% high use patient ($ in Thousands)

| # | Cost |
|---|---|
| 1 | $39.5 |
| 2 | $43.5 |
| 3 | $39.5 |
| 4 | $44.0 |
| 5 | $40.5 |
| 6 | $40.5 |
| 7 | $51.0 |
| 8 | $41.5 |
| 9 | $43.0 |
| 10 | $44.5 |
| 11 | $47.0 |
| 12 | $45.5 |
| 13 | $45.0 |
| 14 | $45.5 |

**17,300 of the 195,000 'Top 5%' high cost users in Ontario were served by South West LHIN. These 17,300 patients cost South West LHIN $757M.**
**26,300 of the province's Top 5% health care users were served by the Toronto Central LHIN. The total expenses for these patients was over $1.34B.**
**On average, the cost of a Top 5% high cost user patient in South West LHIN was $43,500 compared to $51,000 in Toronto Central LHIN.**
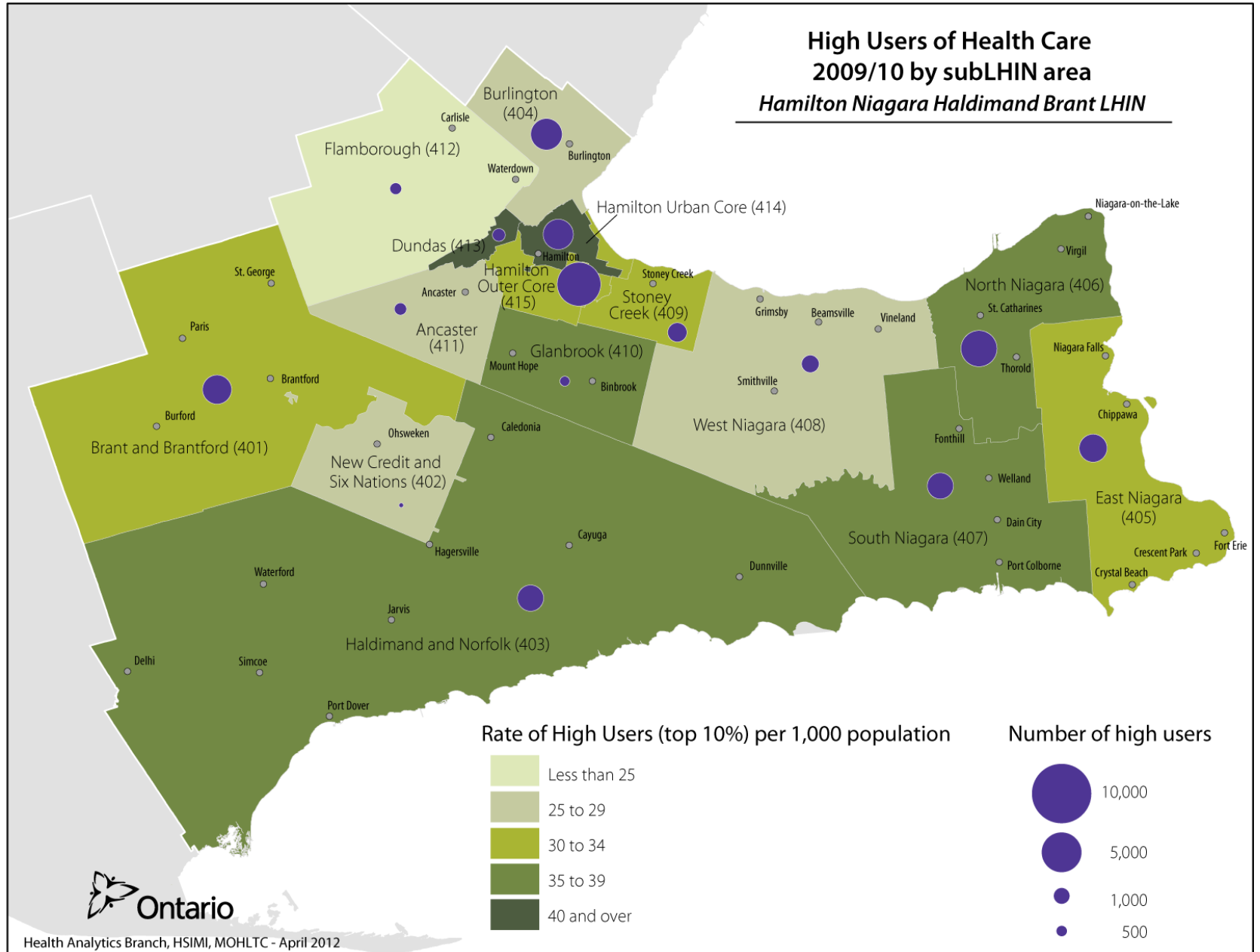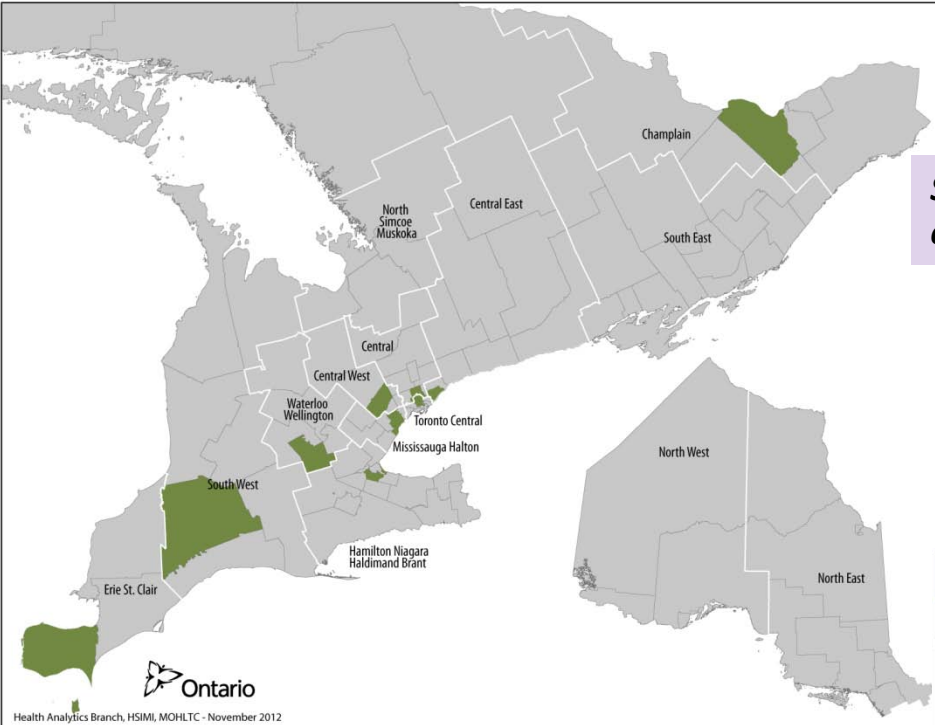
# What we found: *distribution across LHINs*



## Legend

### Health Care Utilization Project

#### # Of High Users Per 1,000 LHIN Population

| | |
|---|---|
| ▢ | < 11.85 |
| ▢ | 11.85 - 13.85 |
| ▢ | 13.850 - 16.30 |
| ▢ | 16.31 - 17.55 |
| ▢ | > 17.55 |

#### # Of High Users

| | |
|---|---|
| ∘ | < 7118 |
| ○ | 7119 - 9552 |
| ○ | 9553 - 12077 |
| ○ | 12078 - 19828 |
| ○ | > 19828 |

M&M Unit - HAB - HSIMI - Nov. 2011

# What we found: *distribution across subLHINs*



High Users of Health Care
2009/10 by subLHIN area
*Hamilton Niagara Haldimand Brant LHIN*

Burlington (404)
Carlisle
Flamborough (412)
Waterdown
Burlington
Hamilton Urban Core (414)
Niagara-on-the-Lake
Dundas (413)
Hamilton
Virgil
St. George
Hamilton Outer Core (415)
Ancaster
Stoney Creek
North Niagara (406)
St. Catharines
Paris
Ancaster (411)
Stoney Creek (409)
Grimsby
Beamsville
Vineland
Thorold
Niagara Falls
Brantford
Glanbrook (410)
Mount Hope
Binbrook
Smithville
Chippawa
Burford
West Niagara (408)
Fonthill
Brant and Brantford (401)
Ohsweken
Caledonia
Welland
East Niagara (405)
New Credit and Six Nations (402)
Cayuga
Dain City
Crescent Park
Fort Erie
Hagersville
South Niagara (407)
Port Colborne
Crystal Beach
Waterford
Dunnville
Jarvis
Haldimand and Norfolk (403)
Delhi
Simcoe
Port Dover

Rate of High Users (top 10%) per 1,000 population

- Less than 25
- 25 to 29
- 30 to 34
- 35 to 39
- 40 and over

Number of high users
- 10,000
- 5,000
- 1,000
- 500

Ontario

Health Analytics Branch, HSIMI, MOHLTC - April 2012

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# What we found: *distribution across subLHINs*



*SubLHIN areas with the largest NUMBER of Top 10% high cost users*
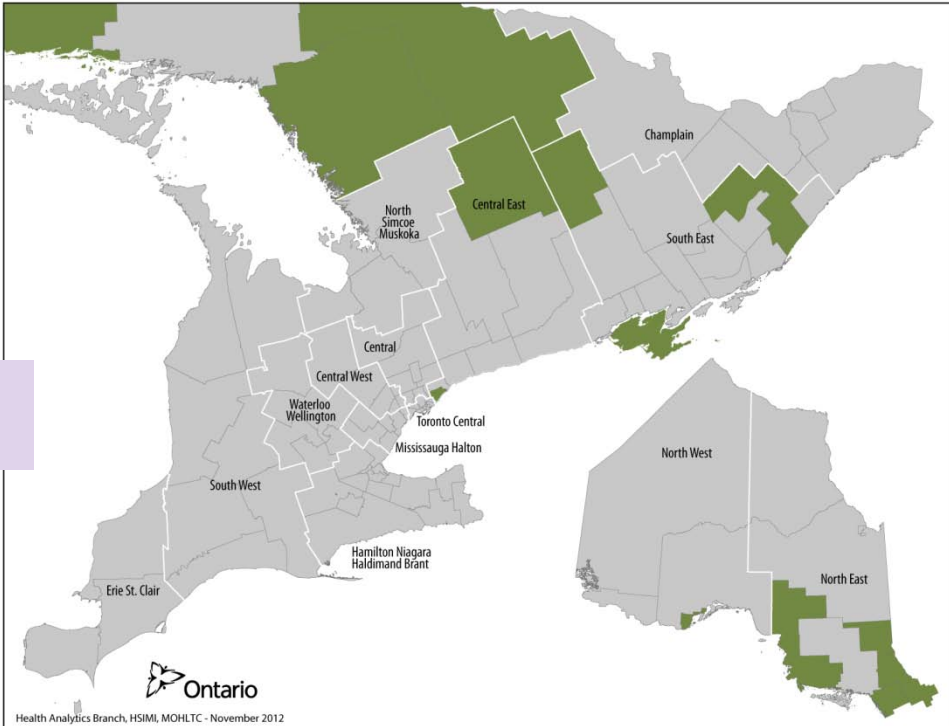
*SubLHIN areas with highest per population RATES of Top 10% high cost users*

# What we found: *conditions in acute care that account for highest spending*

**<1 year**

Neonates

**1-17 yrs**

Bone marrow, stem cell transplants
Cancer treatment

**18-44 yrs**

Extensive burns
Colostomy, enterostomy
Spinal trauma
Brain injuries
Cardiac valve replacement
Other trauma & injuries
Multisystemic/Unspecified site infection

**45-64 yrs**

Multisystemic/Unspecified site infection
Respiratory failure
Colostomy, enterostomy
Septicemia
Cardiac valve replacement
Liver/Pancreas/Duodenum Transplant
Lung disease

**65-79 yrs**

Multisystemic/Unspecified site infection
Cardiac valve replacement
Colostomy, enterostomy
Respiratory failure
Septicemia
Stroke
Heart failure

**80+ yrs**

Respiratory failure
Dementia
Stroke
Cardiac valve replacement
Multisystemic/Unspecified site infection
Heart failure
Colostomy, enterostomy
Hip replacement
Pneumonia

# Defining high cost users: *updated analysis*
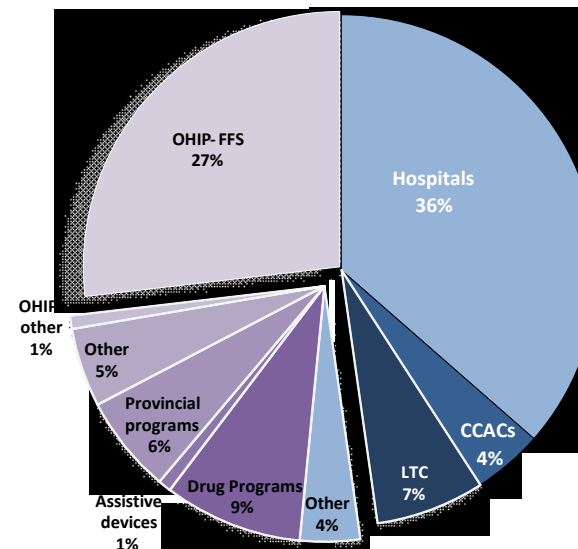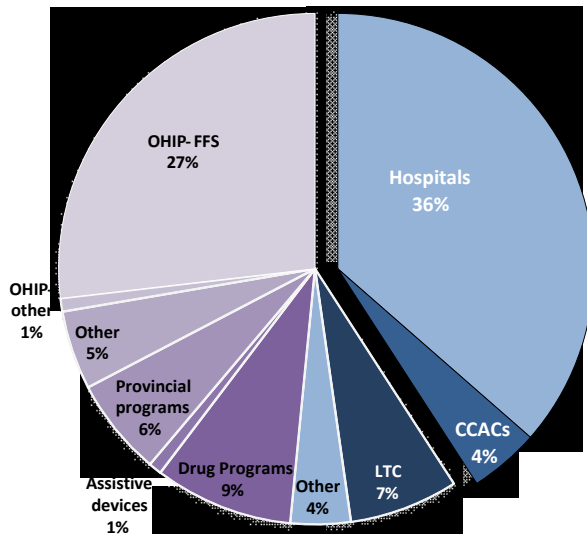
**2009/10**
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- Complex continuing care
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- Home Care

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- Day surgery
- Emergency rooms
- Inpatient rehabilitation
- Complex continuing care
- Inpatient mental health
- Home Care

- Long term care
- OHIP claims

**2010/11**
- Acute inpatient care
- Day surgery
- Emergency rooms
- Inpatient rehabilitation
- Complex continuing care
- Inpatient mental health
- Home Care

- Long term care
- OHIP claims



Pie chart (2009/10): OHIP-FFS 27%, Hospitals 36%, CCACs 4%, LTC 7%, Other 4%, Drug Programs 9%, Assistive devices 1%, Provincial programs 6%, Other 5%, OHIP other 1%



Pie chart (2010/11): OHIP-FFS 27%, Hospitals 36%, CCACs 4%, LTC 7%, Other 4%, Drug Programs 9%, Assistive devices 1%, Provincial programs 6%, Other 5%, OHIP other 1%

# Defining high cost users: *updated analysis*

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| | | | | | |
| **Used hospital/HC/LTC/OHIP** | **11,094,464** | **$ 24,178** | **$ 2,179** | **84.9%** | **--** |
| Top 10% | 1,109,447 | $ 18,610 | $ 16,774 | 8.5% | 77% |
| Top 5% | 554,724 | $ 15,759 | $ 28,409 | 4.2% | 65% |
| Top 1% | 110,945 | $ 8,011 | $ 72,204 | 0.8% | 33% |

# What we found: *updated analysis*

All users: 3,901,600
Cost in Billions $: $14.2

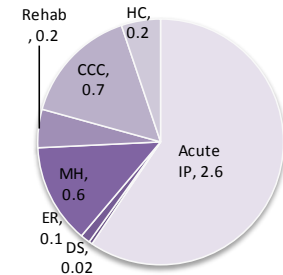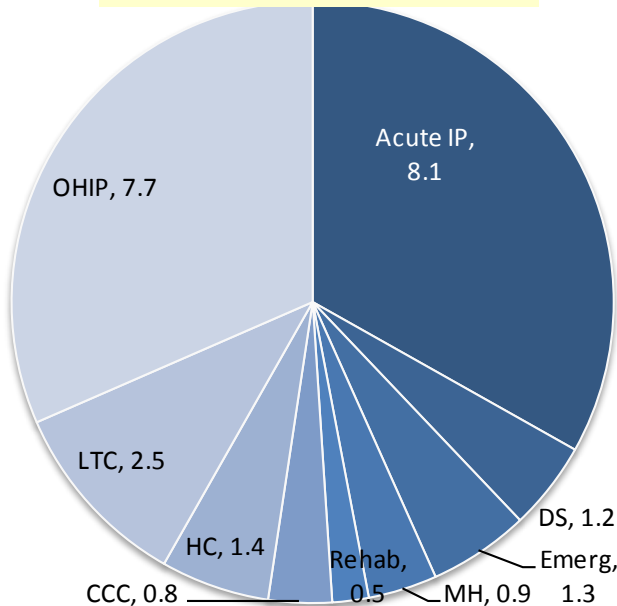Top 1% users: 39,000
Cost in Billions $: $4.4
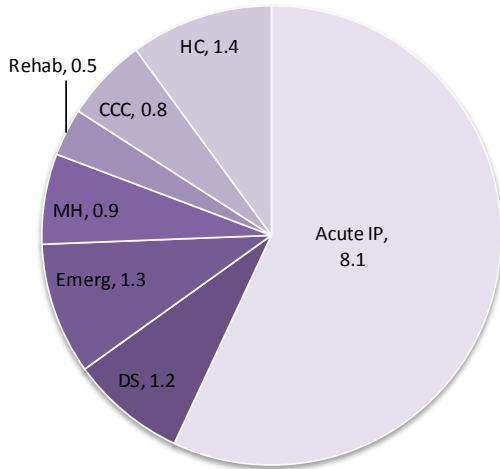


Original analysis:

1) Approximately 60% of costs are for Acute Inpatient care (regardless of whether we look at all health care uses, top 5% or top 1%).

All users: 11,094,500
Cost in Billions $: $24.2

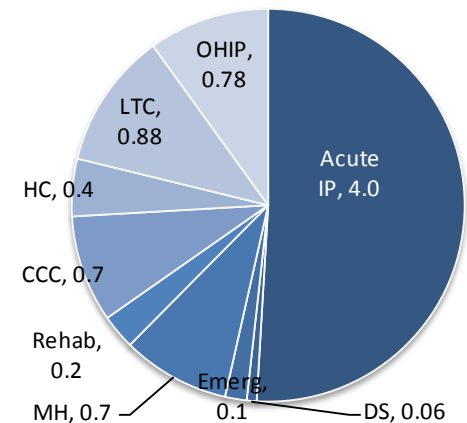Top 1% users: 110,945
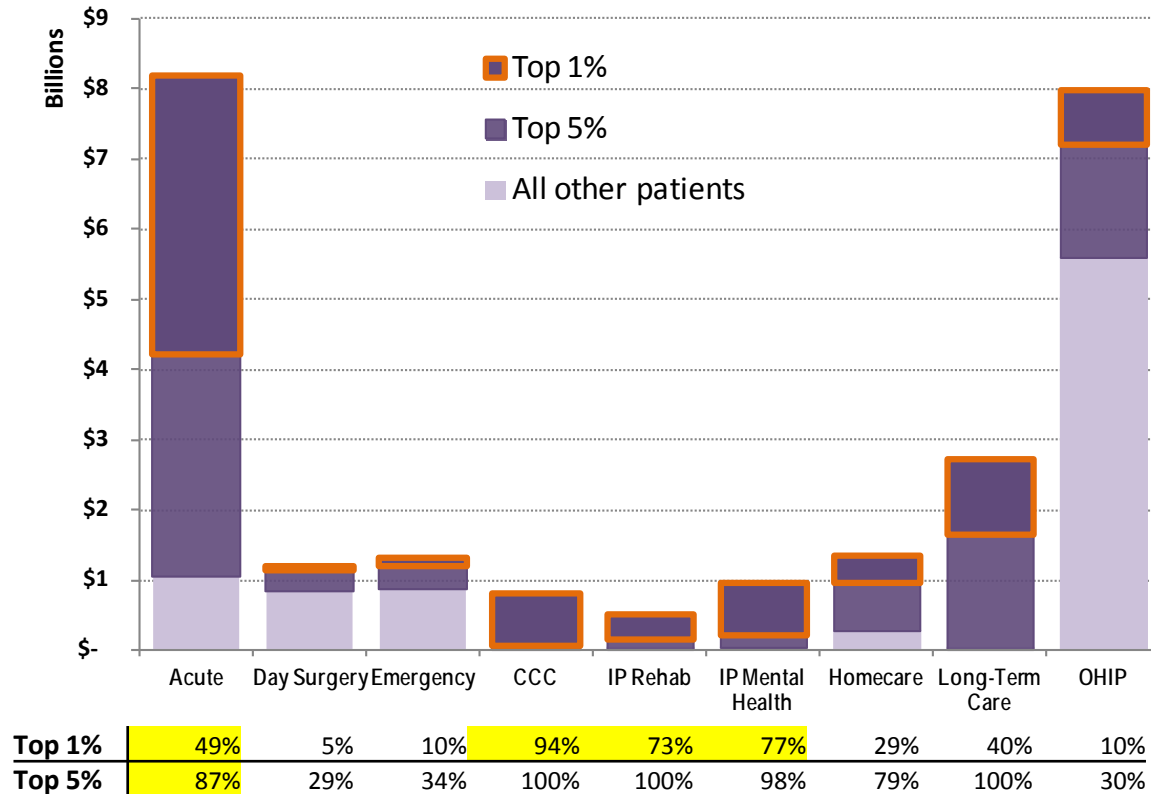Cost in Billions $: $8.0

Updated to include LTC and OHIP-FFS

1) **Among all health care users, approximately one third of costs are for Acute Inpatient care, one third are for OHIP and 10% are for LTC.**

2) **Among the Top 1% high cost users, approximately half of all costs are for Acute Inpatient care, 10% for OHIP and 11% for LTC.**

3) **CCC, Mental Health and Inpatient Rehab account for 9% of costs among all healthcare users, but 22% of costs among the Top 1%.**

# What we found: *updated analysis (2010/11)*



| | Acute | Day Surgery | Emergency | CCC | IP Rehab | IP Mental Health | Homecare | Long-Term Care | OHIP |
|---|---|---|---|---|---|---|---|---|---|
| **Top 1%** | 49% | 5% | 10% | 94% | 73% | 77% | 29% | 40% | 10% |
| **Top 5%** | 87% | 29% | 34% | 100% | 100% | 98% | 79% | 100% | 30% |

1) **Acute Inpatient Care**
   - Top 5% high cost users of health care accounted for 87% of all acute inpatient costs.
   - Top 1% of high cost users accounted for half of all acute care costs.

2) **Long-term Care**
   - Almost all LTC residents end up among the Top 5% and Top 1% of high cost users of health care.

3) **Inpatient Rehabilitation, CCC and Inpatient Mental Health**
   - Top 5% of high cost users accounted for majority of inpatient rehab and CCC costs.
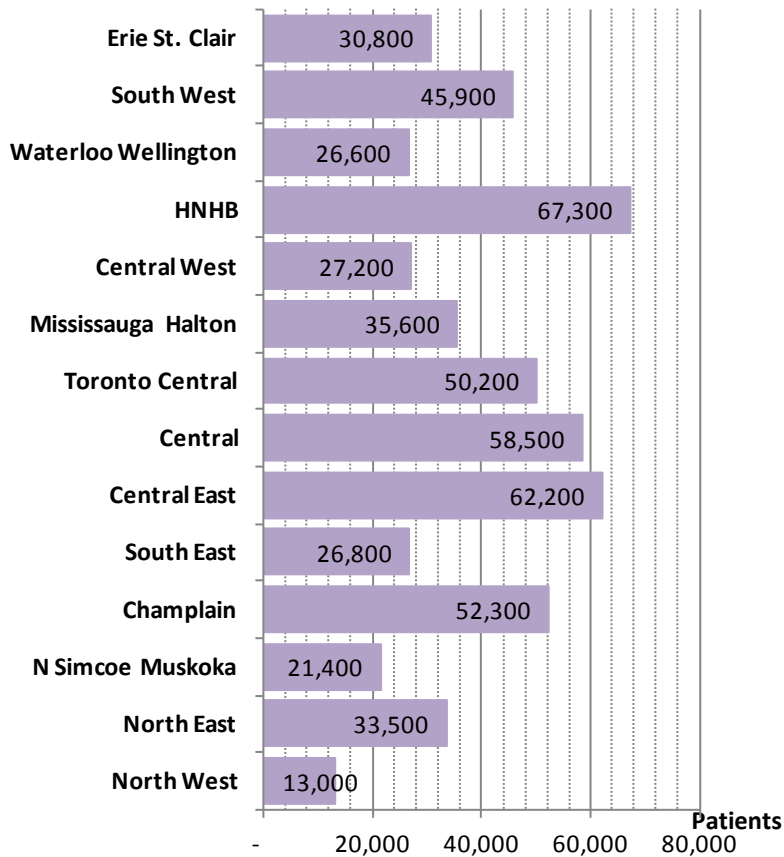
# Distribution of top 5% high cost user patients and costs across LHINs

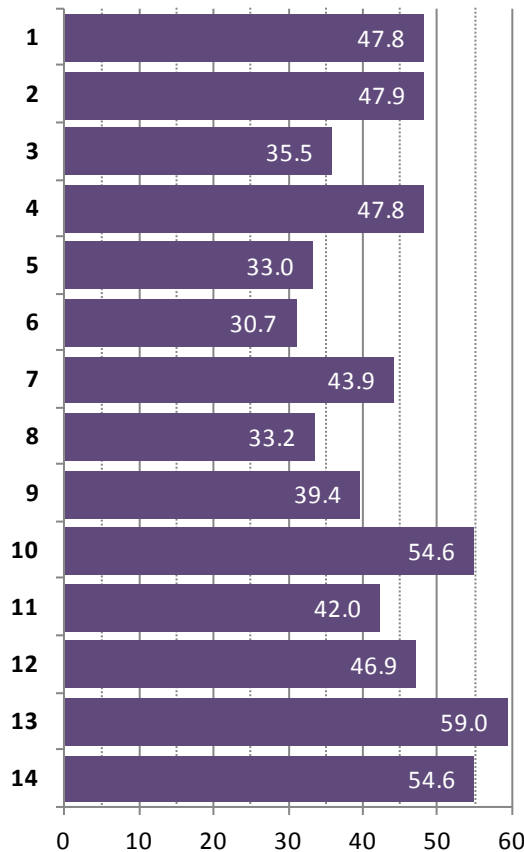**This group includes approximately 554,700 patients**
**These patients cost the system $15.8 Billion and accounted for 65% of hospital, homecare, LTC and OHIP costs**
*Distribution of patients and costs is based on LHIN of patient*

**Distribution of top 5% high cost user patients by LHIN of Patient**

| LHIN | Patients |
|---|---|
| Erie St. Clair | 30,800 |
| South West | 45,900 |
| Waterloo Wellington | 26,600 |
| HNHB | 67,300 |
| Central West | 27,200 |
| Mississauga Halton | 35,600 |
| Toronto Central | 50,200 |
| Central | 58,500 |
| Central East | 62,200 |
| South East | 26,800 |
| Champlain | 52,300 |
| N Simcoe Muskoka | 21,400 |
| North East | 33,500 |
| North West | 13,000 |

**Rate of high cost user patients per 1,000 population**

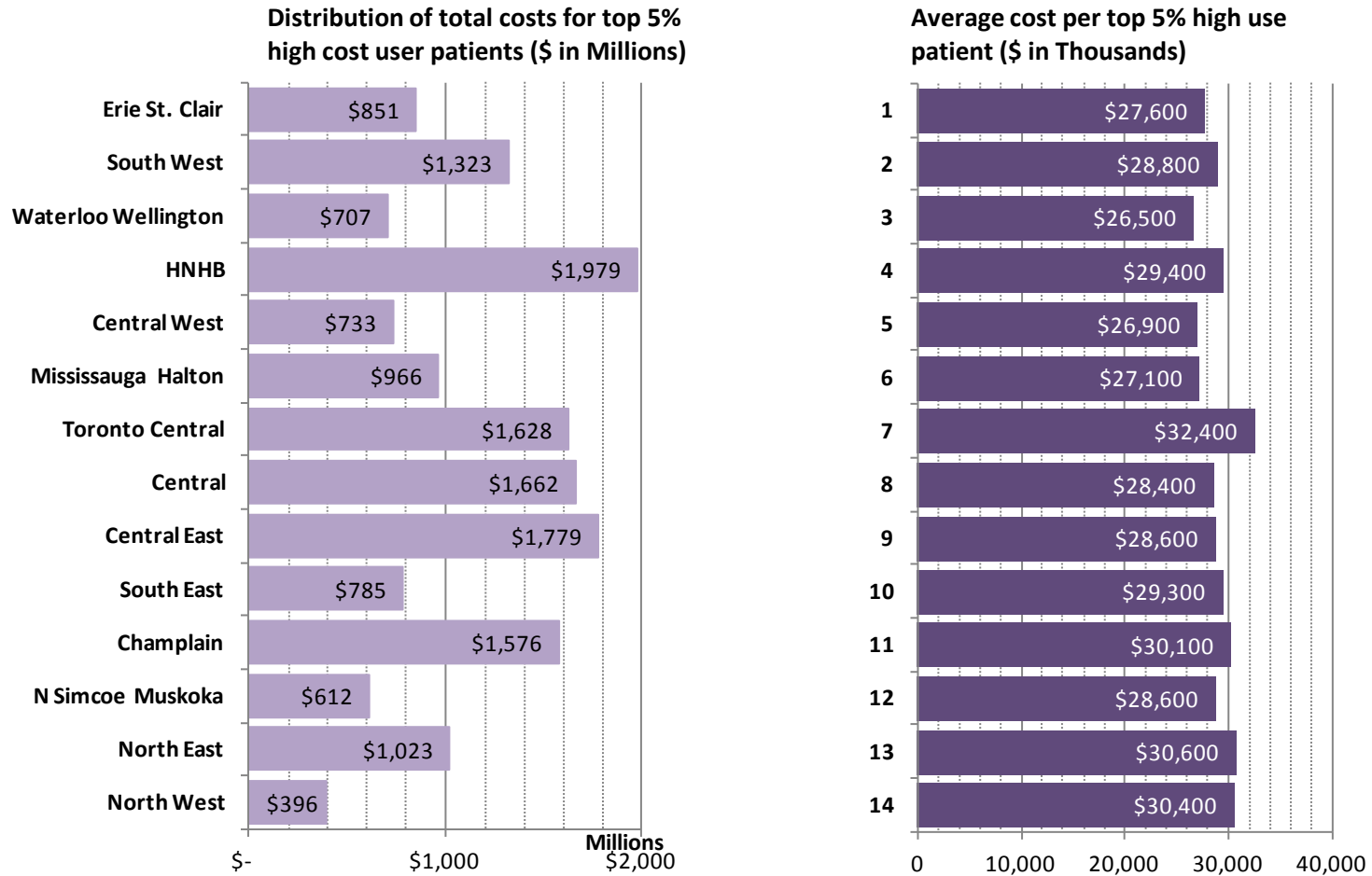| LHIN | Rate |
|---|---|
| 1 | 47.8 |
| 2 | 47.9 |
| 3 | 35.5 |
| 4 | 47.8 |
| 5 | 33.0 |
| 6 | 30.7 |
| 7 | 43.9 |
| 8 | 33.2 |
| 9 | 39.4 |
| 10 | 54.6 |
| 11 | 42.0 |
| 12 | 46.9 |
| 13 | 59.0 |
| 14 | 54.6 |

**Central East LHIN has the second highest number of 'Top 5%' high cost user patients (62,000), however the per population rate of high cost users is among the lowest across LHINs.**

# Distribution of top 5% high cost user patients and costs across LHINs

**This group includes approximately 554,700 patients**
**These patients cost the system $15.8 Billion and accounted for 65% of hospital, homecare, LTC and OHIP costs**
*Distribution of patients and costs is based on LHIN of patient*

**Distribution of total costs for top 5% high cost user patients ($ in Millions)**

| LHIN | Total Cost ($ Millions) |
|---|---|
| Erie St. Clair | $851 |
| South West | $1,323 |
| Waterloo Wellington | $707 |
| HNHB | $1,979 |
| Central West | $733 |
| Mississauga Halton | $966 |
| Toronto Central | $1,628 |
| Central | $1,662 |
| Central East | $1,779 |
| South East | $785 |
| Champlain | $1,576 |
| N Simcoe Muskoka | $612 |
| North East | $1,023 |
| North West | $396 |

**Millions**

**Average cost per top 5% high use patient ($ in Thousands)**

| # | Average cost |
|---|---|
| 1 | $27,600 |
| 2 | $28,800 |
| 3 | $26,500 |
| 4 | $29,400 |
| 5 | $26,900 |
| 6 | $27,100 |
| 7 | $32,400 |
| 8 | $28,400 |
| 9 | $28,600 |
| 10 | $29,300 |
| 11 | $30,100 |
| 12 | $28,600 |
| 13 | $30,600 |
| 14 | $30,400 |

**Central East LHIN has the second highest number of 'Top 5%' high cost user patients (62,000), however the per population rate of high cost users is among the lowest across LHINs. These high use patients accounted for $1.8 B in costs.**
**The average cost per high use patient ranged from $26,500 to $32,400.**

# Predictive Modelling - Introduction

- A predictive model is a statistical model that uses information on characteristics of units to predict a future outcome (for those units)

- We are investigating if we can use predictive modelling to predict who would become an HCU in the future

- A model that predicts who will become an HCU in the future can help:

  - Forecast expenditures and manage budgets appropriately

  - Implement proactive healthcare to prevent patients from becoming HCUs

  - Reduce resource use/impact/cost of HCUs

# Predictive Modelling - Methodology

- Inputs:
  - various patient-level characteristics in the current year and two previous years
  - using various demographic, SES, clinical, and utilization information (variables)
- Study period:
  - The model will estimate HCU status among patients from FY 10/11 using patient characteristics from FY 07/08 - FY 09/10
  - The model is validated by applying it to patient characteristics from FY 06/07 - FY 08/09 to predict HCU status in FY 09/10 (out of sample prediction power)
- Statistical technique:
  - Logistic regression model

# Predictive Modelling – Population Scope

- All Ontario residents who are serviced by the health care system in Ontario during FY 09/10 in one of the following care types (database in brackets):

  - Physician services – OHIP (CHDB)
  - Acute care – AIP (DAD)
  - Day surgery – DS (NACRS)
  - Emergency – ER (NACRS)
  - Complex continuing care – CCC (CCRS)
  - Rehabilitation – Rehab (NRS)
  - Inpatient mental health – MH (OMHRS)
  - Long-term care – LTC (CCRS)
  - Home care – HC (HCD)
  - Dialysis – (NACRS)
  - Oncology – (NACRS)
  - Outpatient clinic – (NACRS)

# Predictive Modelling – Population Scope

- Exclusions:
  - Patients who died during the FY 09/10
  - Patients who were under 5 years of age in FY 09/10
  - WSIB claims
  - Telemedicine claims

# Predictive Modelling - Results

- Population of patients: 10,300,856

- Number of HCUs: 520,492 (5% of population)

- Number of variables in initial model: 97

- Variables that were transformed: 64

- Number of variables reduced due to clustering: 28

- Number of variables in final model: 69

# Predictive Modelling - Application

- Example of a patient who has a high probability of becoming an HCU:

    *Bart lives in a small town in Bruce County. He is a septuagenarian living in his house. Bart has a mental condition, congestive heart failure, arthritis and a cataract. All these health issues made him visit an ER and his physician several times during the last 3 years. He was hospitalized in an acute inpatient hospital twice 3 years ago. Bart has been supported at home by various homecare services during the past 3 years. Bart's chance of becoming a high cost user in the next year is about 80%.*

# Next Steps

- High Cost User Analysis

  - Additional descriptive analysis underway to examine patient characteristics (age, diagnoses, disposition etc)

- Predictive Modelling

  - Look at different definitions of HCUs (1%, 10%)

  - Model on senior population only

  - Explore different imputation methodologies

  - Use population-based case mix groupers when accessible

  - Add granularity to homecare sectors

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