

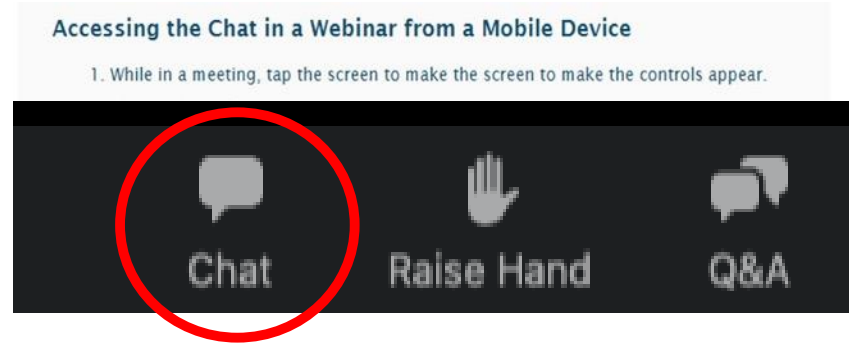
How Population Segmentation applies to Population Health Management

HSPN OHT Webinar

September 28, 2021

Welcome & thank you for joining us!

Please let us know who you are by introducing yourself (name & OHT or other org)



set response to all panelists and attendees
in the chat box

Land acknowledgement

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit.

Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

Poll 1

1. Have you joined us for an HSPN webinar previously? (Single Choice)

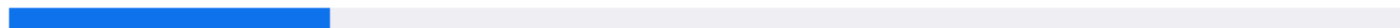
*

124/124 (100%) answered

Yes (95/124) 77%



No. This is my first event. (29/124) 23%



Agenda September 28, 2021

1. Overview & Key Takeaways
2. CIHI Population Health Grouper
3. Using Segmentation in British Columbia
4. Front Line Use of Segmentation in Ontario Health Teams
5. Insights from Providers Patients and Caregivers for Population Segmentation and Co-design

Today's event

Segmenting Your Population

Host



Dr. Walter Wodchis
Principal Investigator
HSPN

Presenters



Debra
Chen
CIHI



Samantha
Magus
BC MOH



Rob
Reid
RISE Lead



Christina
Southey
RISE Coach



Alex
Smith
London-Middlesex
OHT



Curtis
Handford
Downtown East OHT

Building on February 2021

Population Health Management

Host



Dr. Walter Wodchis
Principal Investigator
HSPN

<https://hspn.ca/evaluation/oht/webinars/>

Presenters



Lauren Tessier
PhD Student
HSPN



Mudathira Kadu
PhD Student
HSPN



Dr. Daniala Weir
Post-Doctoral Fellow
HSPN /
Trillium Health Partners



Dr. Rob Reid
Chief Scientist
Trillium Health Partners
RISE



Mike Hindmarsh
Head PHM Coach
CCMI
RISE

Population Health Management

Defining Population Health Management:

The concept of gathering data and insights about population health and well-being across multiple care and service settings, with a view to identifying the main health and social needs of the community and adapting services accordingly.

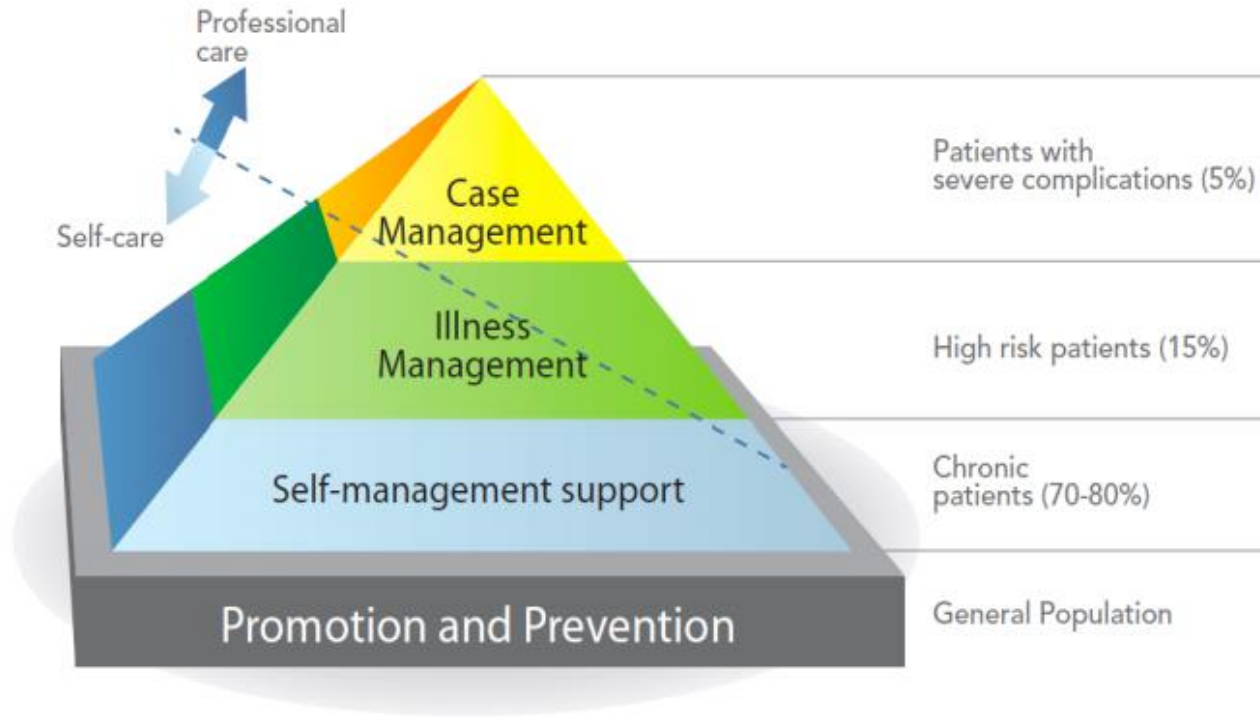
(Deloitte Centre for Health Solutions, 2019)

Population Health Management

A comprehensive model for evaluating PM, conveys core elements of the concept of PM in six steps (Population Health Alliance, 2012):

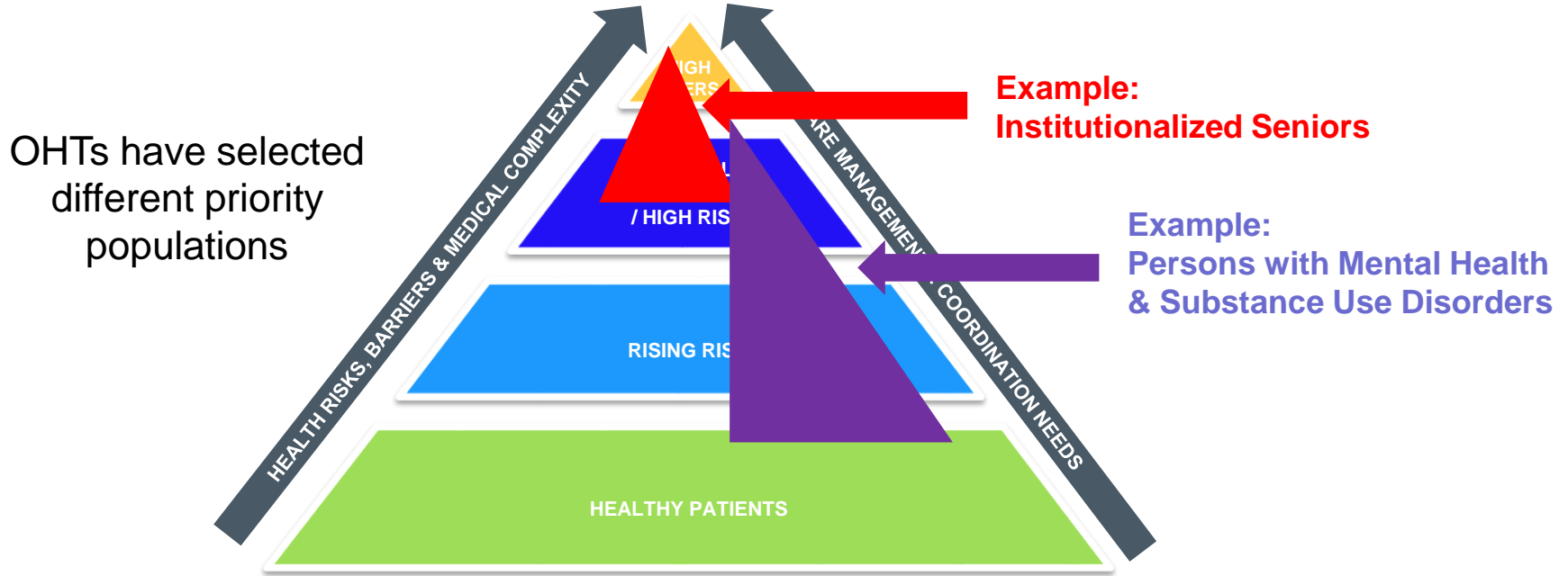
1. Population identification
2. Health assessment / Quadruple Aim Assessment
3. Risk stratification / Population Segmentation
4. Patient-centered interventions
5. Impact evaluation
6. Quality improvement process

Archetype of Risk Segmentation: Kaiser Pyramid

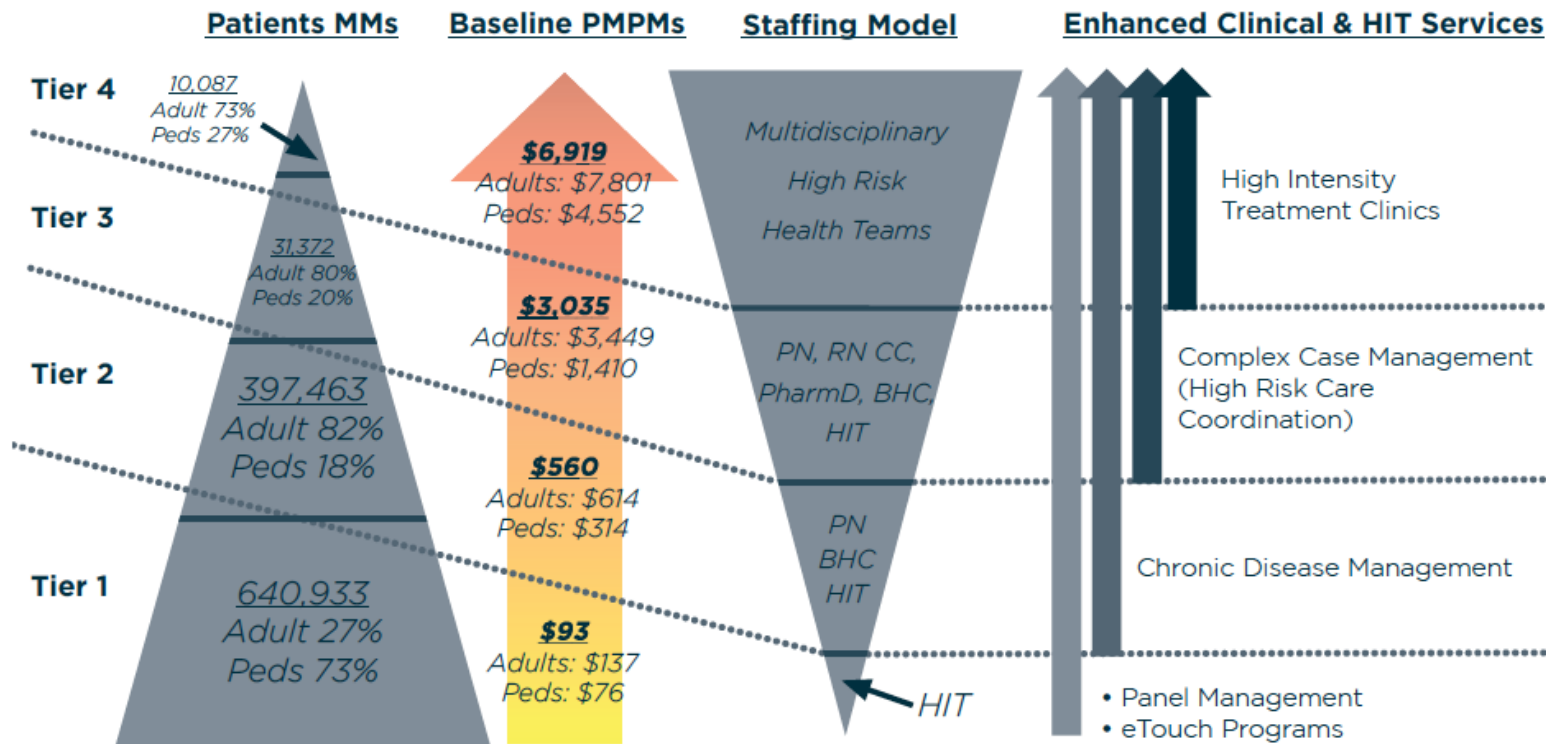


Source: Kaiser Permanent. Adapted

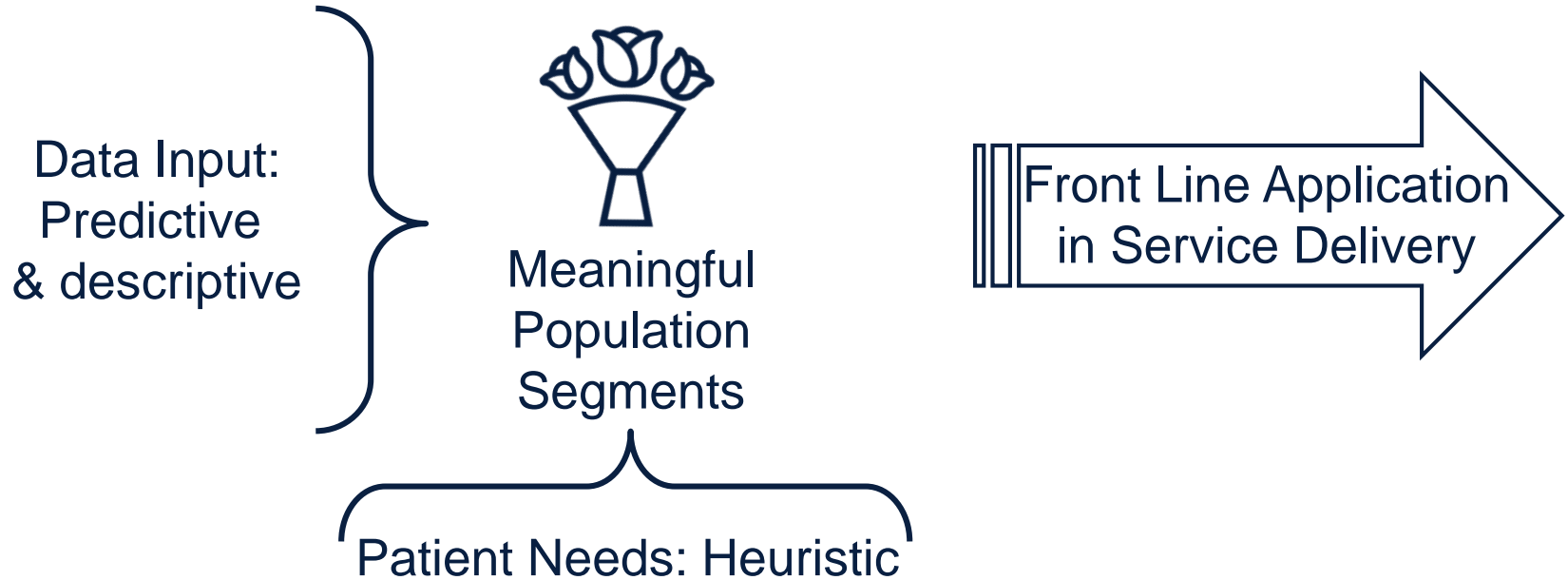
OHT Long Term Goal: Integrating Care for Full Attributed Population



Risk Stratification Model for Denver Health



How is segmentation realized ?



Key Takeaways

- Population health management is a multifaceted and complex undertaking
 - requires a very abstract macro view of the health needs of an entire (geographically) defined population
 - AND a very micro-precision implementation of appropriate interventions to meet the needs of specific segments of the population with common health needs and risks.
- Population health assessment and segmentation is an essential tool to enable population health management.
- OHTs are building population health management capabilities that, over time, will be applied to different segments & subpopulations.

Today's messages

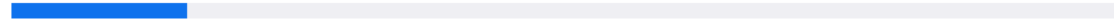
- There are many ways to segment a population. There is no single 'best' way to do this. Some form of segmentation is better than none.
- Segmentation is all about ensuring the right care is delivered to the right population. Ideally this is about risk and needs.
- We need to think about segmentation at the population level – for OHTs this is at the level of attributable populations.
- We also need to think about risk-segmentation within focus populations.
- There are multiple sources of data to understand population health needs.

Poll 2

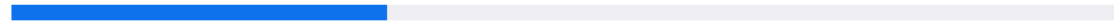
1. How familiar are you with using population segmentation and/or risk stratification of populations ? (Single Choice) *

137/137 (100%) answered

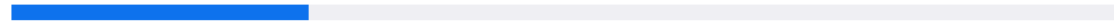
I understand and can use data to segment a population (22/137) 16%



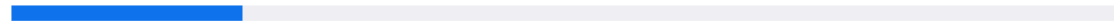
I understand the concepts but have not actually tried t... (47/137) 34%



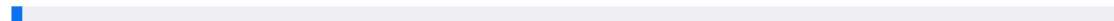
I am trying to understand segmentation (37/137) 27%



I am very new to the idea of segmentation (29/137) 21%



Segmentation/Stratification ... does that happen when I ... (2/137) 1%





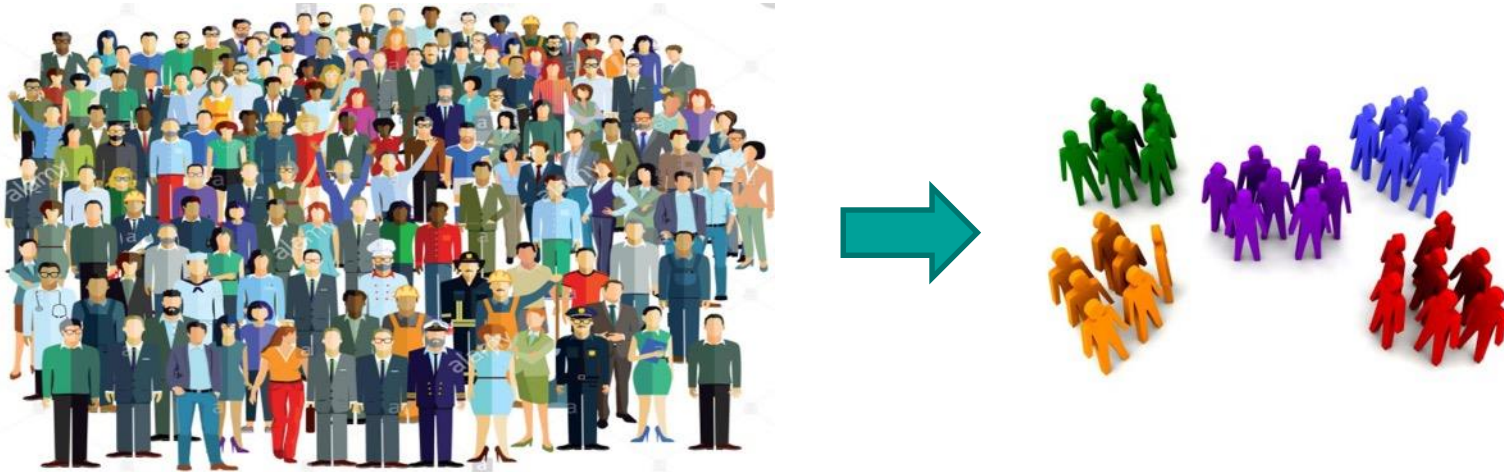
CIHI's Population Grouping Methodology (POP Grouper)

Debra Chen

Program Lead, Case Mix

Canadian Institute for Health Information

POP Grouper segments population into groups with similar clinical characteristics and resource requirements



Inputs →

POP Groupers

→ Outputs



Hospital care



Ambulatory care



Residential care



Community care



Comprehensive clinical profile

Information on 226 health conditions and functional status



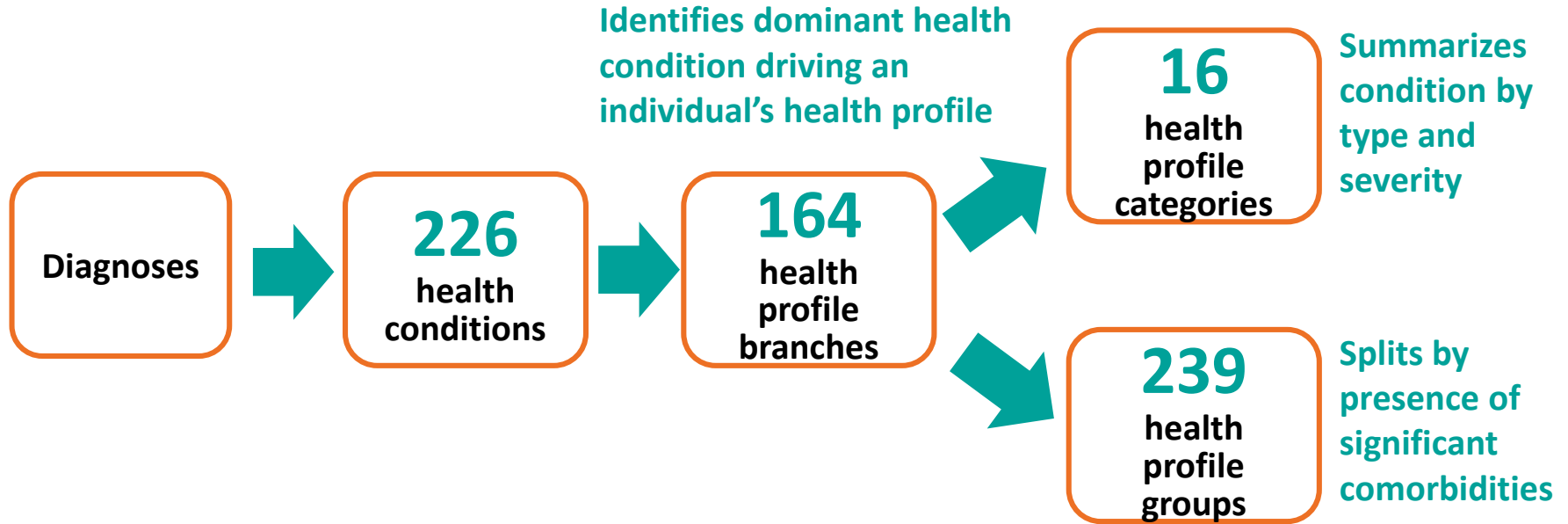
Predictive indicators

- Cost weights
- Number of primary care visits
- Number of emergency department visits
- Probability of admission to long-term care
- Risk of hospitalization for COVID-19



casemix@cihi.ca

From health conditions to health profile groups (HPGs)



Example: Assigning health conditions to a person



Mary
Female
60

Diagnosis code

ICD-9 (physician visit): 346.1
Common Migraine

RAI-2.0 (LTC): I1h Hypertension

ICD-9 (physician visit): 402
Hypertensive heart disease

ICD-9 (physician visit): 250
Diabetes Mellitus

ICD-10-CA (inpatient stay):
S72701 Multiple fractures of
femur, open

POP health condition

A83 Migraine

E10 Hypertension

J02 Diabetes

H43 Fracture femur

Example: Assigning Health Profile Group (HPG) to identify a person's dominant health condition



Mary
Female
60

POP health condition

A83 Migraine



E10 Hypertension



J02 Diabetes



H43 Fracture femur



Branch	Rank	Category
Migraine	131	Minor Acute
Hypertension	113	Minor Chronic
Diabetes w/o Chronic Kidney or Chronic Vasc Dx	95	Moderate Acute
Major Acute MSK	51	Major Acute



Rank	HPG
51	Major Acute MSK with significant comorbidity

Example: Rolling up to HPG categories

Summarizing conditions by type and severity



Mary
Female
60

1. Palliative
2. Major acute
3. Major chronic
4. Major cancer
5. Major mental health
6. Major newborn
7. Moderate acute
8. Moderate chronic
9. Other cancer
10. Other mental health
11. Minor acute
12. Minor chronic
13. Obstetrics
14. Healthy newborn
15. User with no health conditions
16. Non-user

Example: Assigning relative costs (i.e., cost weights) to understand resource utilization



Cost Weights		
Health Condition	2-year lookback window	1 year into future
A83 Migraine	0.09575	0.06272
E10 Hypertension	0.04043	0.40142
J02 Diabetes	0.06176	0.50852
E10 * J02	0.09209	-0.16681
Total	2.41835	1.71239
ON average	1	1

Example: How clients move to a more severe HPG category



Douglas
Male
55

- 4 health conditions, HPG Category = **Moderate Chronic**

1. Retinopathy
2. Chronic Obstructive Pulmonary Disease
3. Joint/Tendon Disorder and Injury (incl. Pain, Sprain, Strain)
4. Skin Cancer

- 1 more health condition was found after including additional Dx: **Stroke**, HPG Category changed to **Major Acute**

- More data coverage, more complete and accurate clinical profiles

1. Palliative
2. **Major acute**
3. Major chronic
4. Major cancer
5. Major mental health
6. Major newborn
7. Moderate acute
8. **Moderate chronic**
-

Wide spread use of POP Grouper across Canada



- **ON:** MoH grouped 8 years of POP outputs to support OHT implementation and primary care capacity planning. ICES and OMA's use of POP for research projects.
- **AB:** AHS grouped 18 years of data to monitor disease prevalence, cost variation and health service utilization
- **BC:** MoH grouped 10 years of data to profile population and identify service and funding gaps
- **SK:** use of POP to identify high cost health care users
- Other jurisdictions are exploring for future projects

Overview of population segmentation in B.C. with a brief example

Health Sector Information, Analysis and Reporting Division | Ministry of Health

September 28th, 2021

Samantha Magnus, Director
Methodologies and Cross-Sector Analysis



Ministry of
Health

Territorial Acknowledgement



Why categorize
people and
patients?



We 'put' patients in boxes
to understand patients
needs at a **population level**



Introducing CIHI's Population Grouping Methodology (CPOP) and Health System Matrix (HSM)

- Population segmentation is a concept taken from marketing (market segmentation) – a means of better understanding and catering to customers with similar demand for products and services.
- Population segmentation or grouping is **patient-focused** and includes the **whole population**.
- Goes **beyond any one part of the health system** to facilitate understanding the holistic needs of patients within each cohort.
- **In B.C., we use both CIHI's Population Grouping Methodology and Health System Matrix help us categorize the population into segments or groups, with different focuses**

What is the Health System Matrix or HSM?

- Links different Ministry of Health's administrative databases and creates a **summary view of each B.C. resident's healthcare use** and chronic disease diagnoses, including cost estimates across service lines
- The information is presented as a **single record per person per fiscal year.**
- Provides a picture of:
 - each individual's health status (primarily using chronic disease definitions from PHAC),
 - health care system utilization,
 - and the changes over time.
- Describe how B.C. residents' use publicly funded health services on an individual level including their health status, age, location, gender, whether they are attached to a family doctor, and other health services information.
- By contrast, CPOP focuses on diagnoses, and although it relies on healthcare use, in analysis we treat CPOP as relatively independent from usage.

Classification granularity for different purposes

CPOP →



Health conditions
zero, one or more
'tags' per person per
time period (n=227)



Health Profile Groups
one 'box' per person per
time period (n=239)



**Health Profile Group
Categories**
Boxes grouped, like
'pallets' (n=16)

Health System Matrix →

Population segments

Overlapping or mutual exclusive based on chronic
disease and recent health system use (n=14)

Together creating different lenses for profiling morbidity (burden of disease) for

- Demographic groups,
- Health regions,
- Physician rosters, or
- The province as a whole

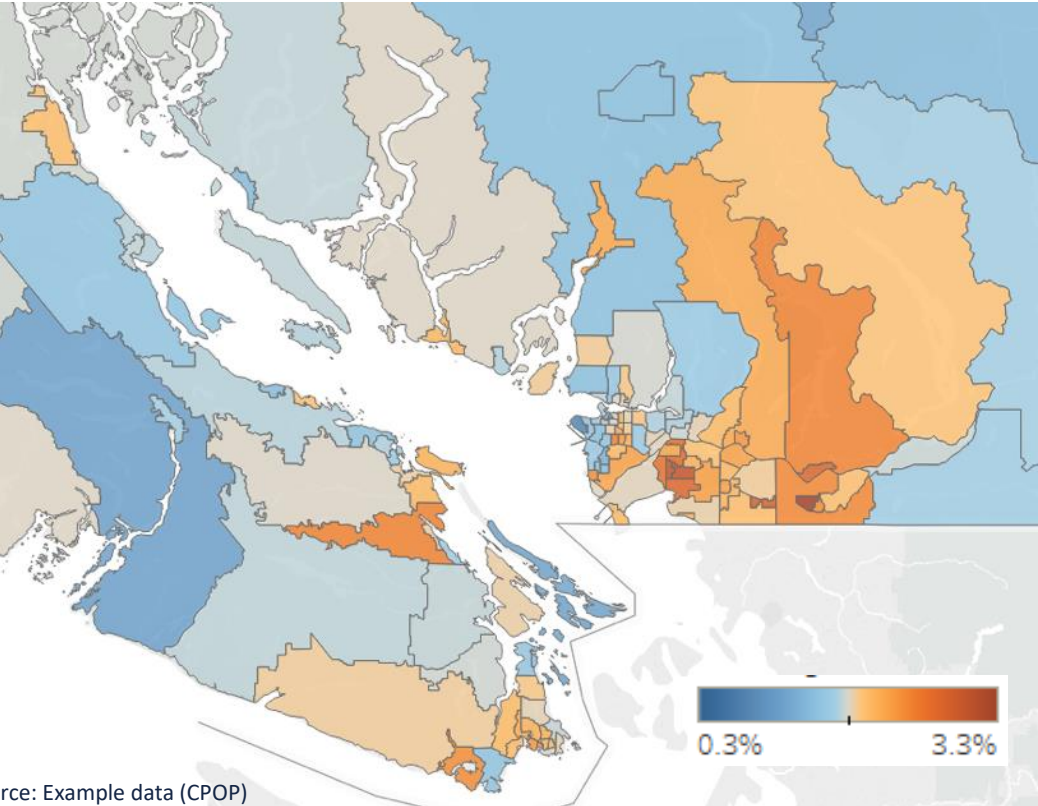




Health condition information can be used to monitor population health



Ministry of Health

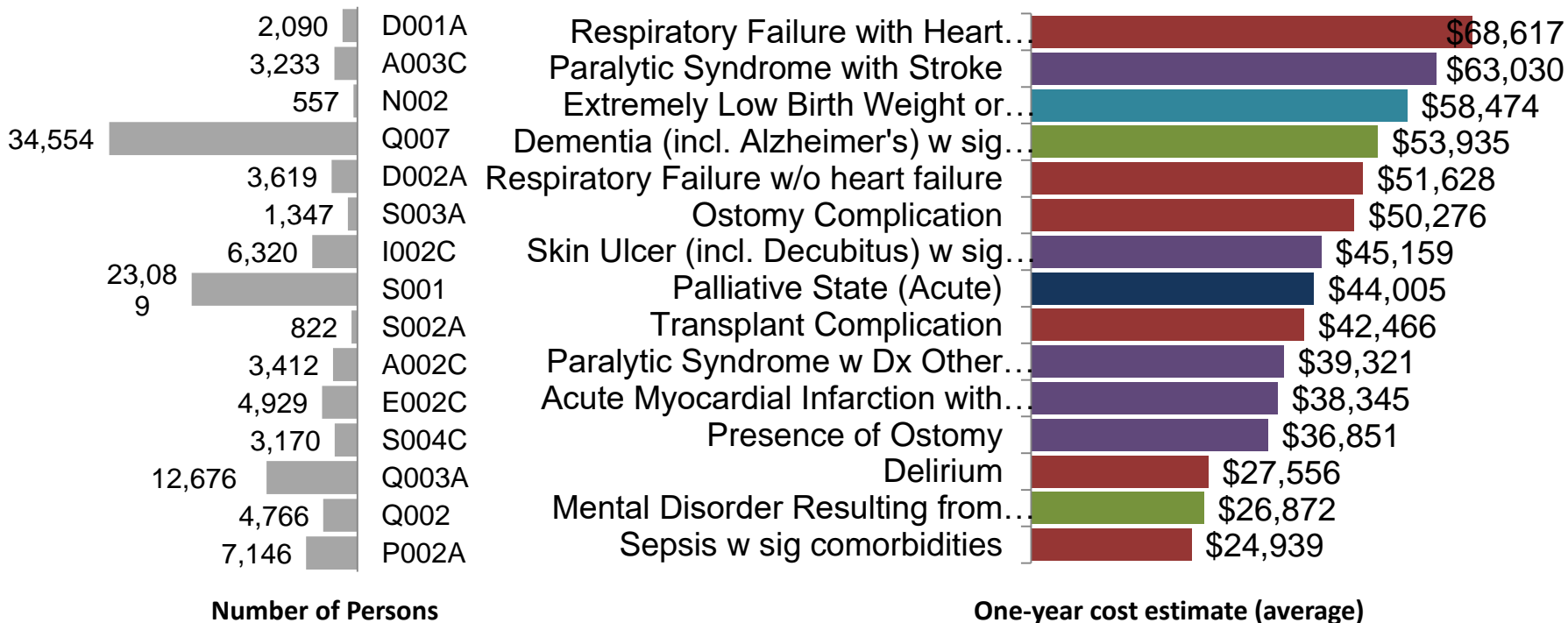


- D06 – Asthma
- Percent of population
- Considers utilization over past two years
- Similar analysis can be done for any of the 227 health conditions on distribution, utilization, prediction/forecast

Source: Example data (CPOP)
Population Grouping Methodology licensed by the Canadian Institute for Health Information, adapted for use in British Columbia by the B.C. Ministry of Health with permission. Version 2020. Two-year lookback.



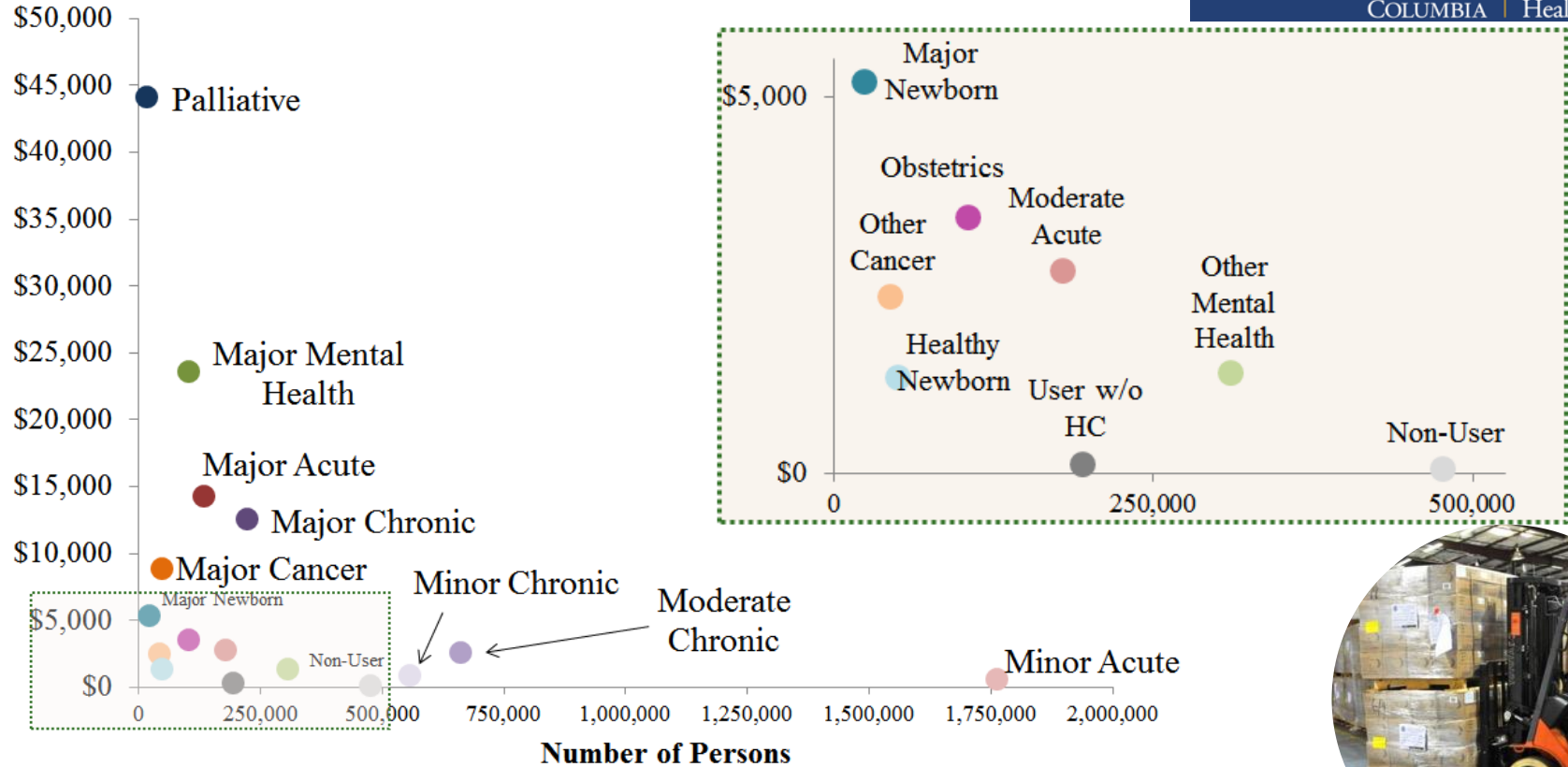
Most Costly Health Profile Groups by average estimate of publicly funded expenditures



Source: Example data (CPOP) & Health System Matrix
 Population Grouping Methodology licensed by the Canadian Institute for Health Information, adapted for use in
 British Columbia by the B.C. Ministry of Health with permission. Version 2020. Two-year lookback.

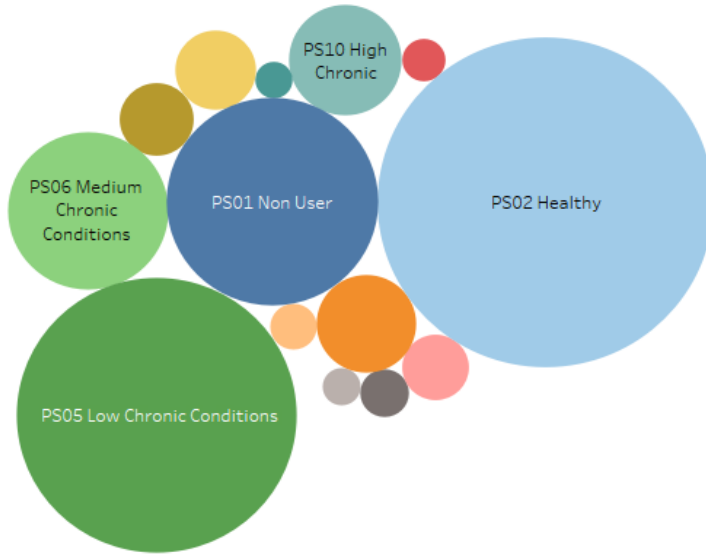
HPG Categories

Costs per person versus population count

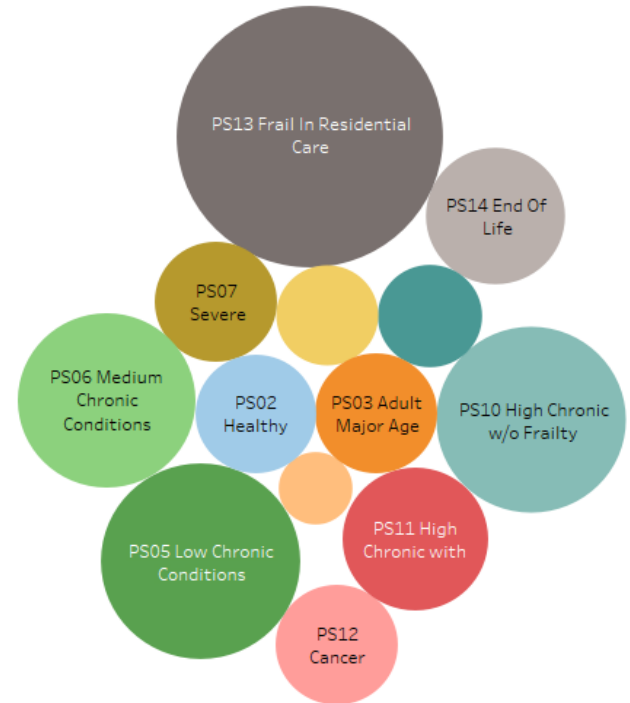


Source: Example data (CPOP) & Health System Matrix
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Share of BC Population 2016/17



Share in Publicly Funded Health Care 2016/17



Population segments are a B.C. Ministry of Health product, built with both diagnostic and utilization information from administrative records

Pop Segment

- PS01 Non User
- PS02 Healthy
- PS03 Adult Major Age 18+
- PS04 Child and Youth Major <18 ye..
- PS05 Low Chronic Conditions
- PS06 Medium Chronic Conditions
- PS07 Severe Mental Health & SU
- PS08 Maternity & Healthy Newborns
- PS09 Frail In Community
- PS10 High Chronic w/o Frailty
- PS11 High Chronic with Frailty
- PS12 Cancer
- PS13 Frail In Residential Care
- PS14 End Of Life

Source: Example data, Health System Matrix

COVID-19 daily hospitalization forecasts based on a logistic model



Methodology

- Data Source
- Clinical Characteristics
- Logistic regression



Results

- Goodness of fit
- Positive cohort vs. population cohort
- Validation



Application

- CHSA profile
- Hospitalization forecast

Data sources and linkage

Information	Source
COVID-19 Positive cases, hospitalizations and deaths	BC Centre for Disease Control COVID-19 Line list
Patient demographics (age, sex, location)	Client Roster (2019/20)
Health conditions	CIHI's Population Grouping Methodology (two-year lookback – 2018/19-2019/20)
Long-Term Care (LTC)	PharmaNet Plan B (Long-Term Care Drug Plan) and HCC MRR
Social economic status (SES)	Canadian Index of Multiple Deprivation (CIMD) <i>(results not shown)</i>

Clinical risk factors for COVID-19

Health conditions grouped into “at-risk health conditions”, based on literature review by Canadian Institute for Health Information (CIHI)

Code	At-risk condition
HC1	Chronic lung/respiratory diseases
HC2	Severe chest conditions
HC3	Serious heart conditions
HC4	Immunocompromised (exclude transplant)
HC5	Severe obesity
HC6	Diabetes
HC7	Chronic kidney disease
HC8	Liver disease
HC9	Pregnancy
HC10	Hypertension
HC11	Cancer
HC12	Chronic neurological conditions (include Dementia and Alzheimer's)
HC13	Problems with spleen
HC14	Transplant Recipient and complication
HC15	Rheumatoid & Other Inflammatory Arthropathy (excl. Gout)

Logistic regression results

Health conditions only for hospitalization or death

- **HC05:** insignificant in BC; **HC09:** odds ratio <1; **HC14:** significant; **HC11:** different in the 2 models

Parameter	Univariate model (N=48,989)	Positive model (N=48,989)		Population model (N=5,200,204)	
	OR [95% CI]	Estimate	OR [95% CI]	Estimate	OR [95% CI]
HC1 Respiratory diseases	3.95 [3.54 - 4.42]	0.78 ***	2.19 [1.93 - 2.48]	0.50 ***	1.65 [1.46 - 1.87]
HC2 Severe chest conditions	--	--		--	
HC3 Heart conditions	6.88 [6.32 - 7.49]	0.92 ***	2.52 [2.28 - 2.79]	0.73 ***	2.08 [1.88 - 2.3]
HC4 Immunocompromised	3.4 [2.62 - 4.42]	0.64 ***	1.89 [1.4 - 2.57]	0.28	1.32 [0.99 - 1.76]
HC5 Obesity	--	--		--	
HC6 Diabetes mellitus	5.14 [4.75 - 5.57]	1.00 ***	2.72 [2.48 - 2.98]	1.09 ***	2.96 [2.7 - 3.26]
HC7 Chronic kidney disease	10.66 [9.46 - 12.01]	0.94 ***	2.56 [2.22 - 2.94]	0.66 ***	1.94 [1.71 - 2.2]
HC8 Liver disease	4.82 [3.67 - 6.33]	0.70 ***	2.02 [1.46 - 2.78]	0.58 ***	1.79 [1.34 - 2.4]
HC9 Pregnancy	1.37 [1.04 - 1.81] †	-0.26 *	0.77 [0.59 - 1.01]	--	
HC10 Hypertension	3.74 [3.46 - 4.05]	0.69 ***	1.99 [1.82 - 2.17]	0.60 ***	1.82 [1.67 - 1.99]
HC11 Cancer	4.07 [3.57 - 4.65]	0.63 ***	1.88 [1.61 - 2.19]	--	
HC12 Chronic neurological conditions	7.99 [7.31 - 8.75]	1.21 ***	3.36 [3.02 - 3.73]	1.69 ***	5.43 [4.92 - 5.99]
HC13 Problems with spleen	7.76 [1.85 - 32.46]	--		1.36 *	3.91 [1.22 - 12.53]
HC14 Transplant recipient and complication	6.37 [3.98 - 10.2]	0.97 **	2.63 [1.5 - 4.61]	0.46 *	1.58 [0.99 - 2.54]
HC15 Rheumatoid & other inflammatory arthropathy (excl. gout)	3.21 [2.6 - 3.96]	0.59 ***	1.8 [1.42 - 2.29]	0.54 ***	1.71 [1.36 - 2.16]

Source: Example data (CPOP) & BCCDC line list & other sources (not current)

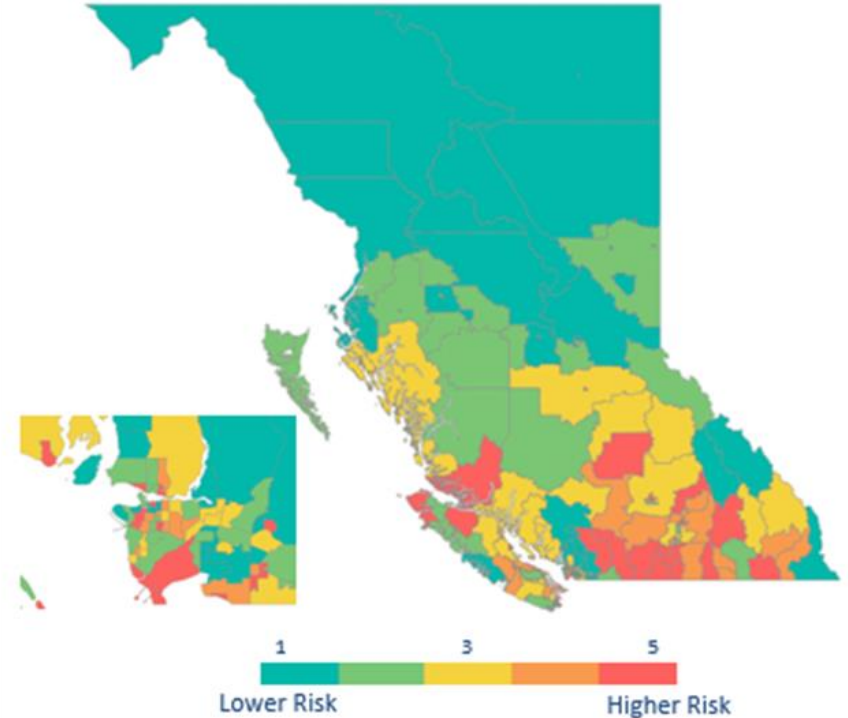
$p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

† OR calculated from model including only females aged 16-60 (n=17,856).

Model Applications

We visualized communities more at risk, based on weighted prevalence of at-risk health conditions and at-risk age groups

Currently, we apply the model to each day's cohort of COVID patients, to estimate the number likely to be hospitalized. Paired with hospital occupancy data, this offers a short-term alert of potential capacity issues.



Source: Example data (CPOP) & BCCDC line list & other sources (not current)

Acknowledging our team:

- Yongcai Liu, lead for CPOP
- Mengmeng Zhang
- Saiganesh Dhannewar
- Jason Flindall
- Anatoli Skripnitchenko, lead for HSM
- David Scott
- Linghong Lu



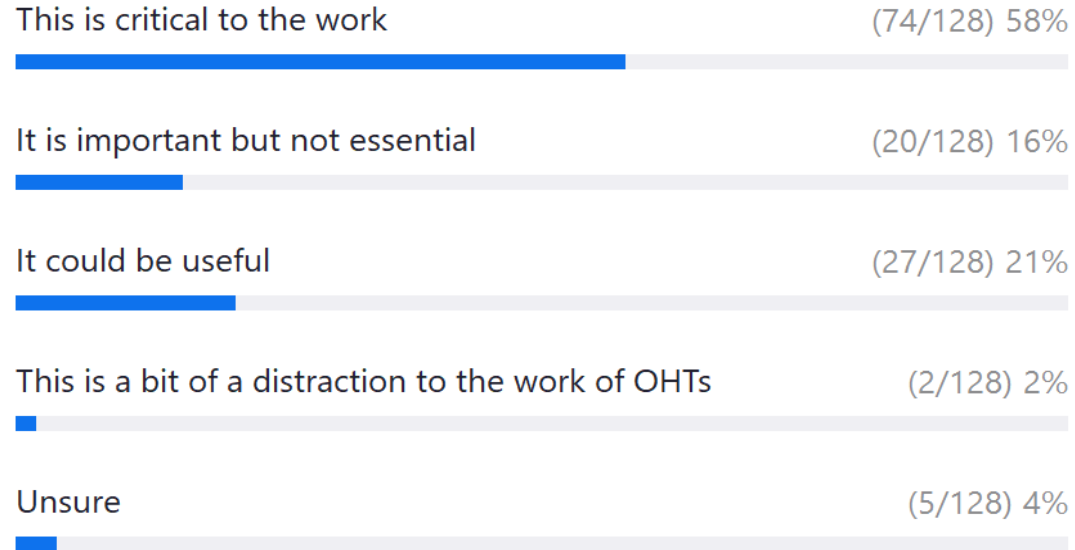
Acknowledging our leadership:

- Heather Richards, Executive Director, Performance, Partnerships & Methodologies Branch
- Martin Wright, Assistant Deputy Minister, Health Sector Information, Analysis and Reporting Division

Poll 3

1. How important do you think it is to use population segmentation to plan and implement care in the (OHT) population ? (Single Choice) *

128/128 (100%) answered



Discussion

What approaches and tools are you using to identify priority populations and / or to undertake population segmentation ?

Use the chat to all panelists and attendees to respond to this and ask questions

Connecting the dots: Getting from Here to There



Dr. Robert Reid, RISE Co-lead

Hazel McCallion Research Chair in Learning Health Systems
Chief Scientist, Institute for Better Health, Trillium Health Partners

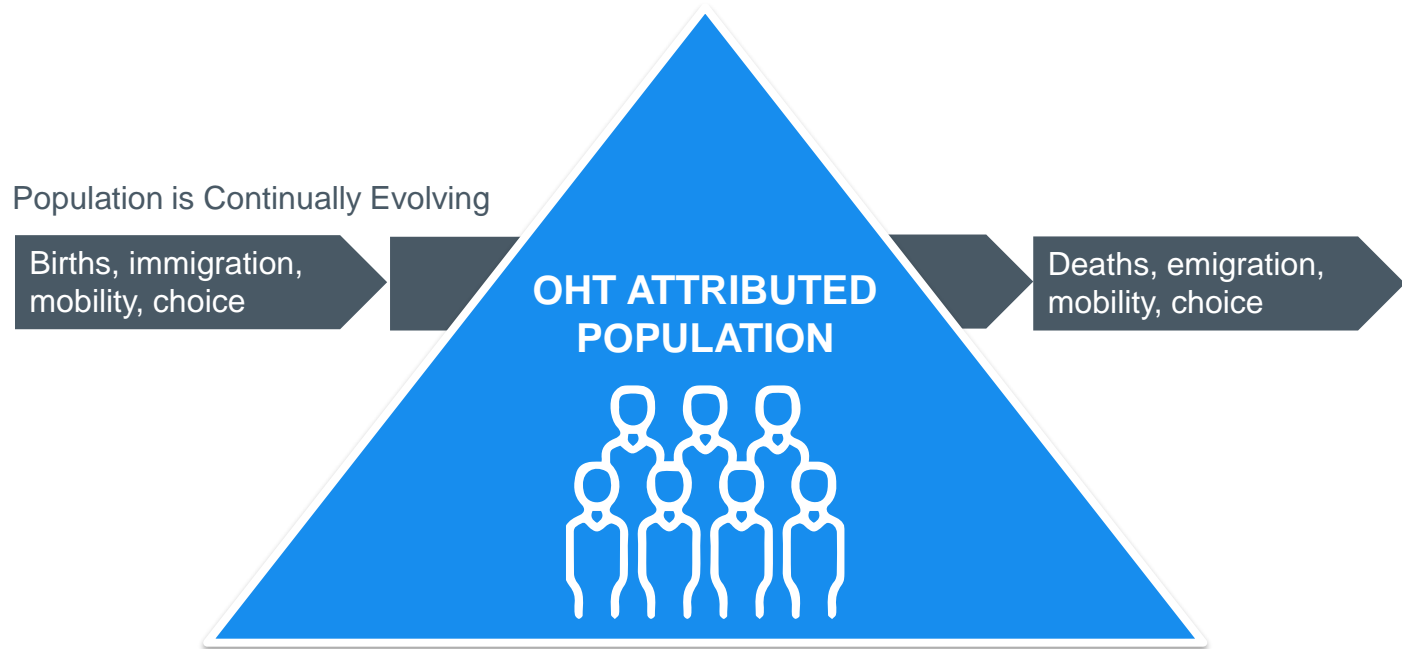


Christina Southey

RISE Population-health management coach

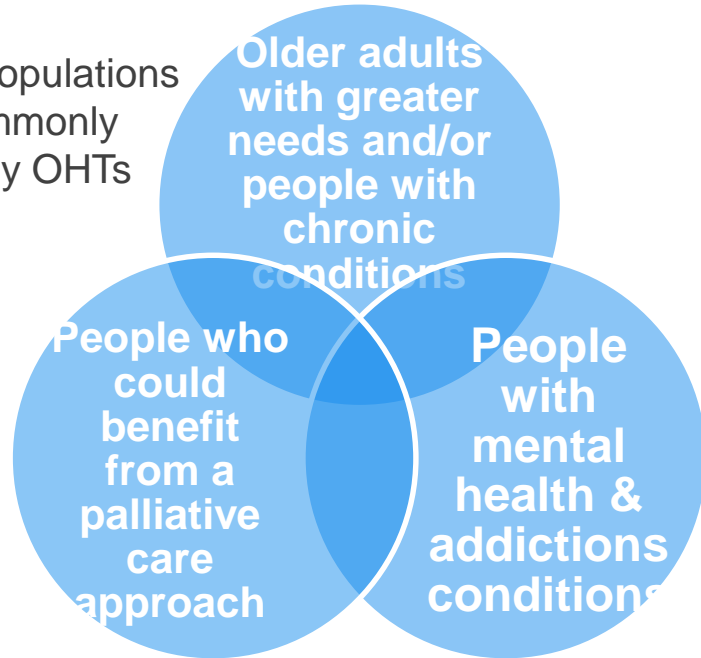
OHTs Attributed Populations

Caring for the whole population



Connecting the dots: within the attributed population there are multiple priority populations

Priority populations most commonly chosen by OHTs

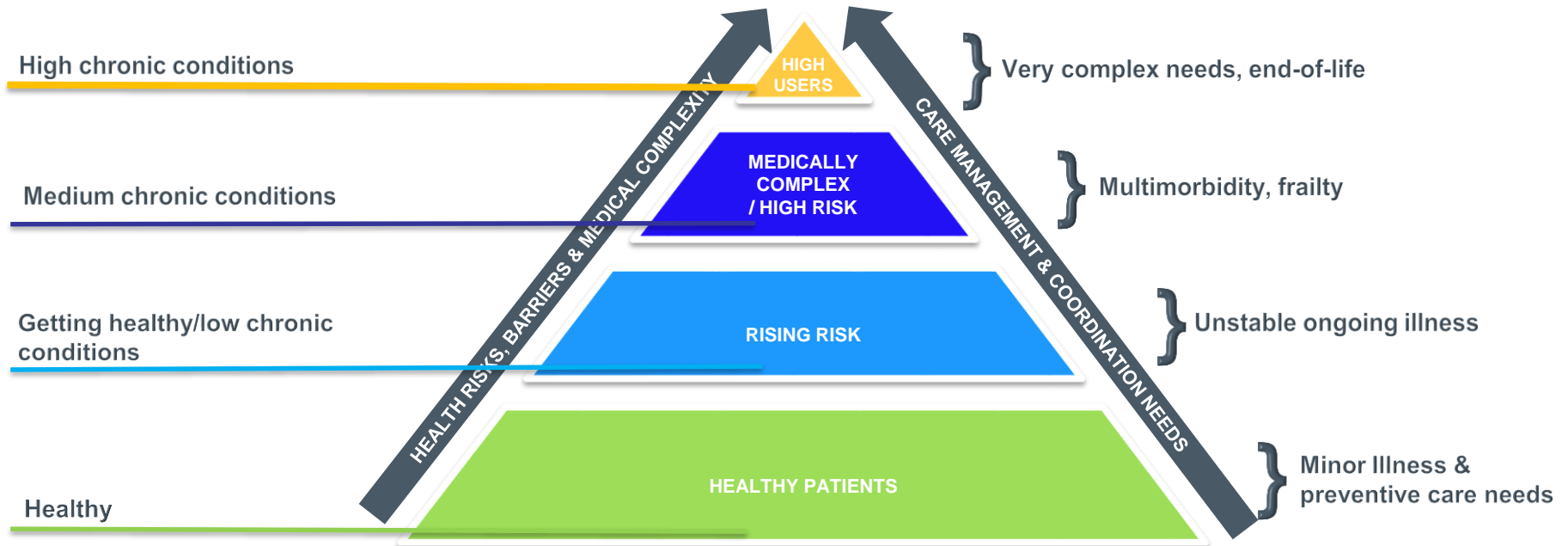


BC Health System Matrix



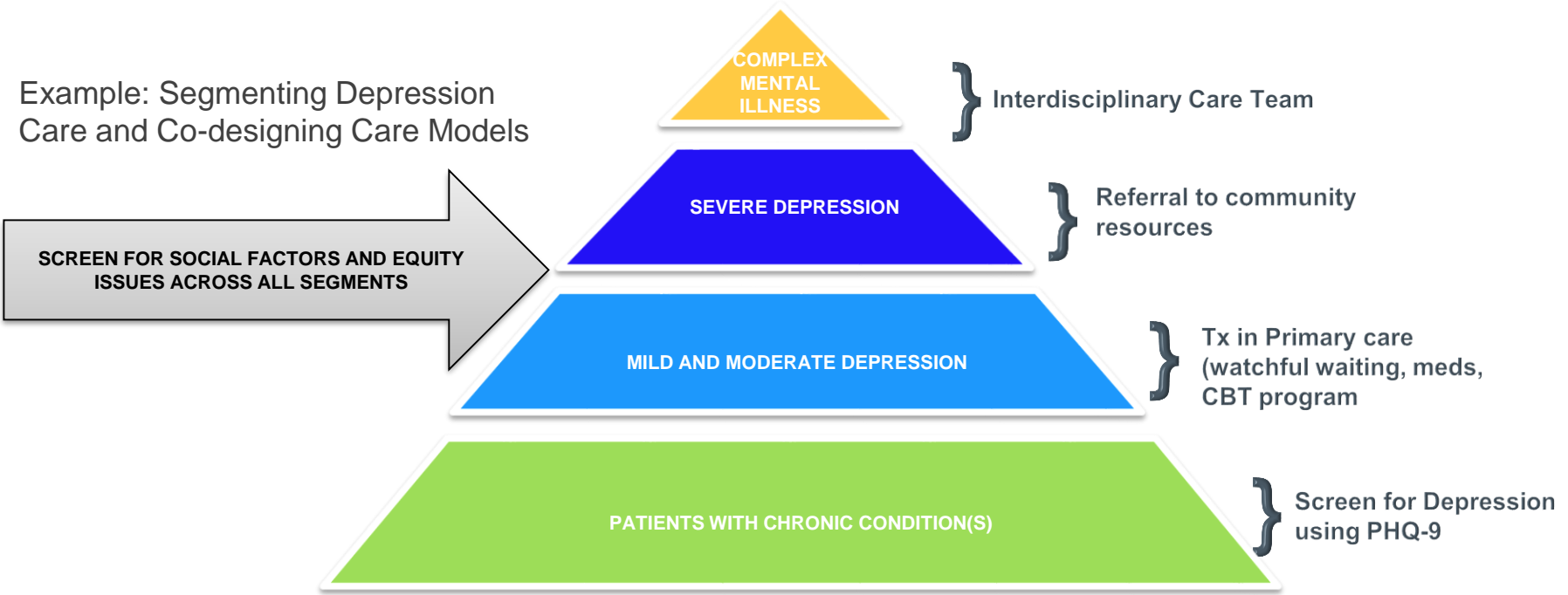
Strategic Planning Category/ Health Status Group	Population Segment
Staying Healthy	PS01 Non-User
	PS02 Healthy (Low User)
	PS08 Maternity & Healthy Newborns
Getting Healthy	PS03 Adult Major Age 18+
	PS04 Child and Youth Major <18 years
Living with Illness and Chronic Conditions	PS05 Low Chronic Conditions
	PS06 Medium Chronic Conditions
	PS07 Severe Mental Health & Substance Use
	PS10 High Chronic Conditions
	PS12 Cancer
Towards the End of Life	PS09 Frail in Community - not available
	PS11 High Chronic with Frailty - not available
	PS13 Frail in Long-Term Care
	PS14 End of Life

Connecting the dots: stratifying priority populations



Understand socioeconomic factors and apply an equity lens as you develop care models for each segment.

Example: Segmenting Depression Care and Co-designing Care Models

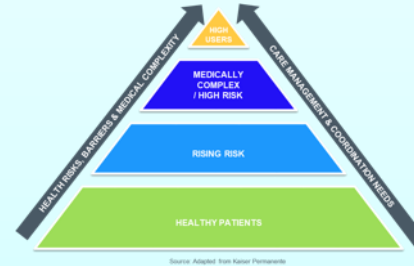


Data and segmentation - what the RISE PHM coaches are hearing

How do we identify who belongs to our attributed population?

cQIPs provides an opportunity to align work – teams would like to understand how to connect current indicators to community level interventions

Teams understand the need to move 'down the pyramid' but need examples supported by data and connections to the big dot measures.



Population-health management (PHM) resources

RISE resources:

- ❑ [Resources by priority population](#)
- ❑ **Overview of PHM including application to COVID management** [webinar](#), [deck](#) and [one page summary](#)
- ❑ **Redesigning care models through co-design** [webinar](#), [deck](#) and [one page summary](#)
- ❑ **A deep dive into designing care models for your priority populations** [webinar](#)
- ❑ **Applying an equity lens** [webinar and deck](#)
- ❑ **Additional webinars on PHM:** [Spring 2020](#) and [Fall 2019](#)

Resources by priority population

- ❑ **Older adults with greater needs**
 - [Provincial Geriatrics Leadership Ontario \(PGLO\)](#):
- ❑ **Palliative approach to care**
 - [Ontario Palliative Care Network \(OPCN\)](#) including the [Palliative Care Health Services Delivery Framework](#)
- ❑ **Mental health and addictions**
 - [Centre for Mental Health and Addictions Provincial System Support Program](#): including the [Ontario structured psychotherapy program](#)
 - [Mental Health and Addictions Centre of Excellence](#)

Experience From the Frontlines

DOWNTOWN EAST TORONTO

ONTARIO HEALTH TEAM

Using provider and patient data to inform
our priority population

Curtis Handford



Western (Middlesex London) Ontario Health Team

Co-Designing Care Pathways with Patients and Providers

Alexander Smith

Process Design & Change Management Lead
London Health Sciences Centre
alexander.smith@lhsc.on.ca

A Standard Approach to Care Pathway Co-Design

Step 1: Build Co-Design Team

Step 2: Identify Existing Knowledge Sources

Step 3: Capture Current System Experiences through Co-Design

Step 4: Identify 'Always for Everyone' or 'Minimum Standard of Care' Events

Step 5: Validate 'Always for Everyone' Events

Step 6: Model 'Always for Everyone' Events into a Care Pathway

Step 7: Model Roles into Care Pathway

Step 8: Model Non-Clinical Flow into Care Pathway

Step 9: Capture Data and Simulate

Step 10: Change Management

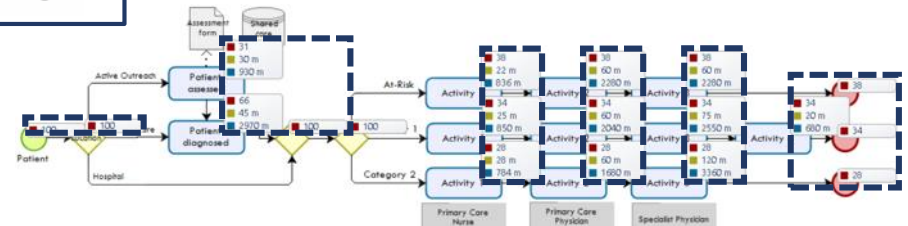
Steps 4-5: Modified Delphi Method

	Should not be done for everyone (only necessary for a subset of patients or not necessary at all)	Recommended for everyone, but not required	Should be required for everyone	Unable to respond
COPD and CHF				
Physical exam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medical history	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Comorbidity management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of life measure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fluid intake assessment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Step 1: Co-Design Team Structure

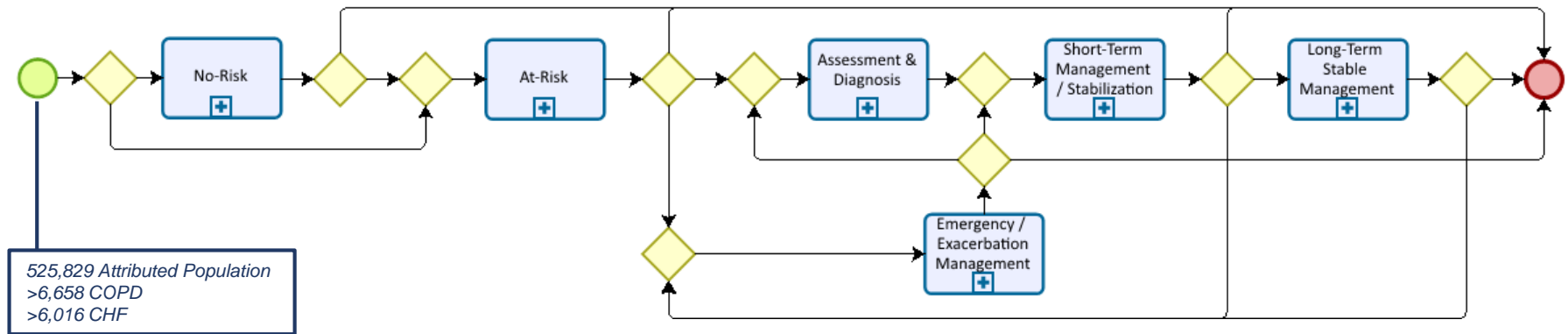


Steps 6-9: Modelling and Simulation (sample simulation output below)



Segmenting Whole Population by States of Progression

A standard, macro-level care pathway is used as patients flow through six states of disease progression. Each macro-level pathway is specific to one diagnostic group, but patients may be placed on multiple care pathways using the same macro-level architecture. At any point in time, the entire attributed population will be in one of these states for each diagnostic group.



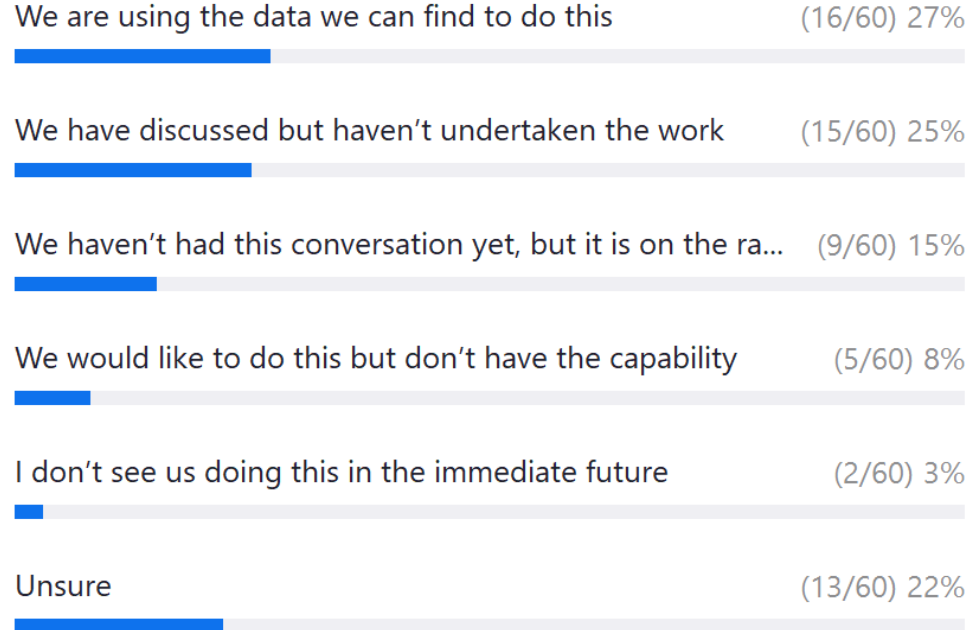
Co-Designing with Patients and Providers

Through our co-design discovery phase interviews, we identified system challenges for which our OHT can support solution development. Several of these co-design themes are being translated to activities in our care pathways which are being validated through a modified Delphi methodology.



Poll 4

Where is your OHT at in terms of thinking about or using risk-segmentation to define care needs for your population (overall or focus populations)?



Discussion and Q & A:

Have you used qualitative data and/or surveys from your population to help set priorities or define interventions? What did you find?

Do you have other questions of our panel today ?

Use the chat to all panelists and attendees to respond to this and ask questions

Up Next:

HSPN Webinar Series

- 4th Tuesday of the Month: 12:00 – 1:30pm

Upcoming Topics: October & November

- ***Stories from the Field*** – Live talks led by real OHTs
 - Governance
 - Patient and Caregiver/Family Engagement
 - Local Innovations

... and more.

Central OHT Evaluation Team

Co-Leads



Dr. Walter
Wodchis



Dr. Ruth
Hall

Team Members



Dr. Gaya
Embuldeniya



Dr. Shannon
Sibbald



Dr. Kaileah
McKellar



Jennifer
Gutberg



Nusrat S.
Nessa



Luke
Mondor

Key Resources Available

Teams are encouraged to access the **ministry's central program of supports** for resources and assistance to improve their readiness to implement the Ontario Health Team model wherever they are in the readiness assessment process.

Teams can access this central program through the Ministry of Health website:
<http://health.gov.on.ca/en/pro/programs/connectedcare/oht/default.aspx>

Key resources include:

- **Ontario Health Teams: Digital Health Playbook** – playbook to help understand how providers can build a digital health plan for OHTs that supports the delivery of integrated care (available at MOH website above).
- **Rapid-Improvement Support and Exchange (RISE)** – an interactive website (www.ohtrise.org) that provides access to resources, experts and assistance for potential Ontario Health Teams. Rapid learning and supports delivery partner.
- **HSPN – Central OHT Evaluation** – Evaluation resources and reports (www.hspn.ca)



HSPN Implementation Resources

<https://hspn.ca/evaluation/ontario-health-teams>

Practice Guides



Webinars



White Papers



OHT Evaluation Results



Everyone is involved !

Twitter: @infohspn

Email: OHT.Evaluation@utoronto.ca

<https://hspn.ca/evaluation/ontario-health-teams>

Subscribe on YouTube !

Thank you!