Displaying Health Data

Cases, Techniques, Solutions

Colloquium + Live-Webcast + Recording
Medical Sciences Building (MBS) 160
University of Victoria
November 28 – 30 , 1 – 3 pm PST

University of Victoria
INSTITUTE ON AGING & LIFELONG HEALTH
island health
British Columbia BSERVATORY Population & Public Health
IALSA
Health Sciences Center
UCF UNIVERSITY OF CENTRAL FLORIDA

Displaying Health Data

Cases, Techniques, Solutions

Health Data

DAY 1
2018-11-28
Wednesday

13:00 Transactional data of Island Health: How patients vote with their feet
Dr. Ken Moselle (Island Health) and Dr. Andriy Koval (BC Observatory, UCF)

14:00 Visualizing logistic regression with the "coloring book" technique: A study in ggplot2
Dr. Andriy Koval (BC Observatory for Population and Public Health, UCF)

Substance Use

DAY 2
2018-11-29
Thursday

13:00 Nuances of information sharing and data display in a mobile application for students with substance use disorder
Dr. Barbara (Basia) Andraka-Christou (University of Central Florida)

14:00 Optimizing public health surveillance through reproducible reporting: Response to opioid crisis on Vancouver Island
Shannon Tracey (University of Victoria) and Maritia Gully (Island Health)

Pipelines & Dashboards

DAY 3
2018-11-30
Friday

13:00 Building pipelines and dashboards for practitioners: Mobilizing knowledge with reproducible reporting
Dr. Will Beasley (University of Oklahoma Health Sciences Center)

14:00 Constructing workflows for reproducible analytics: Suppressing small counts for provincial chronic disease dashboard
Dr. Andriy Koval (BC Observatory, UCF) and Anthony Leamon (Island Health)

Transactional Data of Island Health

How patients vote with their feet

Andriy
Koval

Ken
Moselle

British Columbia
BSERVATORY
Population & Public Health

CIHR IRSC
Canadian Institutes of Health Research
Instituts de recherche en santé du Canada

UCF
UNIVERSITY OF CENTRAL FLORIDA

vancouver
island health
authority

4 years ago…

- Colloquium on methods and applications for aging research
- http://ialsa.github.io/COAG-colloquium-2014F/
- Ended with a talk on visualizing statistical models

Dialects of data expression

https://commons.wikimedia.org/wiki/File:Blind_men_and_elephant3.jpg

Tabular

id	time	attend	model
1	0	1	2.788
1	1	6	2.732
1	2	2	2.675
1	3	1	2.618
1	4	1	2.562
1	5	1	2.505
1	6	1	2.449
1	7	1	2.392
1	8	1	2.335
1	9	1	2.279
1	10	1	2.222
1	11	1	2.166
4	0	2	2.788
4	1	1	2.732

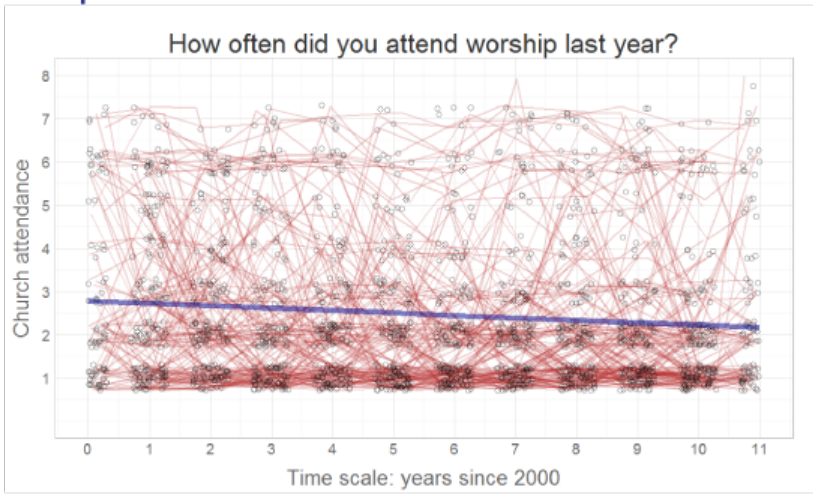
Algebraic

$$y_{it} = \beta_0 + \beta_1 time_t + \varepsilon_{it}$$
$$\beta_0 = \gamma_{00}$$
$$\beta_1 = \gamma_{10}$$

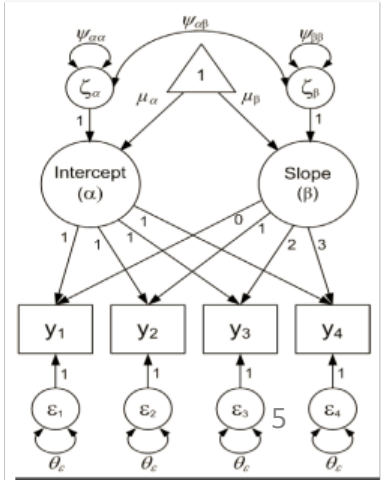
Semantic

In 2000 respondents attended church less than once a month (2.79) and gradually declined in their attendance since (.06 per year).

Graphical



Schematic



Syntactic

```
nlme::gls(attend ~ 1 + time, data=dsM)
```

Numeric

```
Coefficients:
               Value Std.Error t-value p-value
(Intercept)  2.7882   0.07774   35.86       0
time        -0.0566   0.01197   -4.73       0
```

	modelB
logLik	-3719
deviance	7438
AIC	7444
BIC	7461
df.resid	1858
N	1860
p	2
ids	155

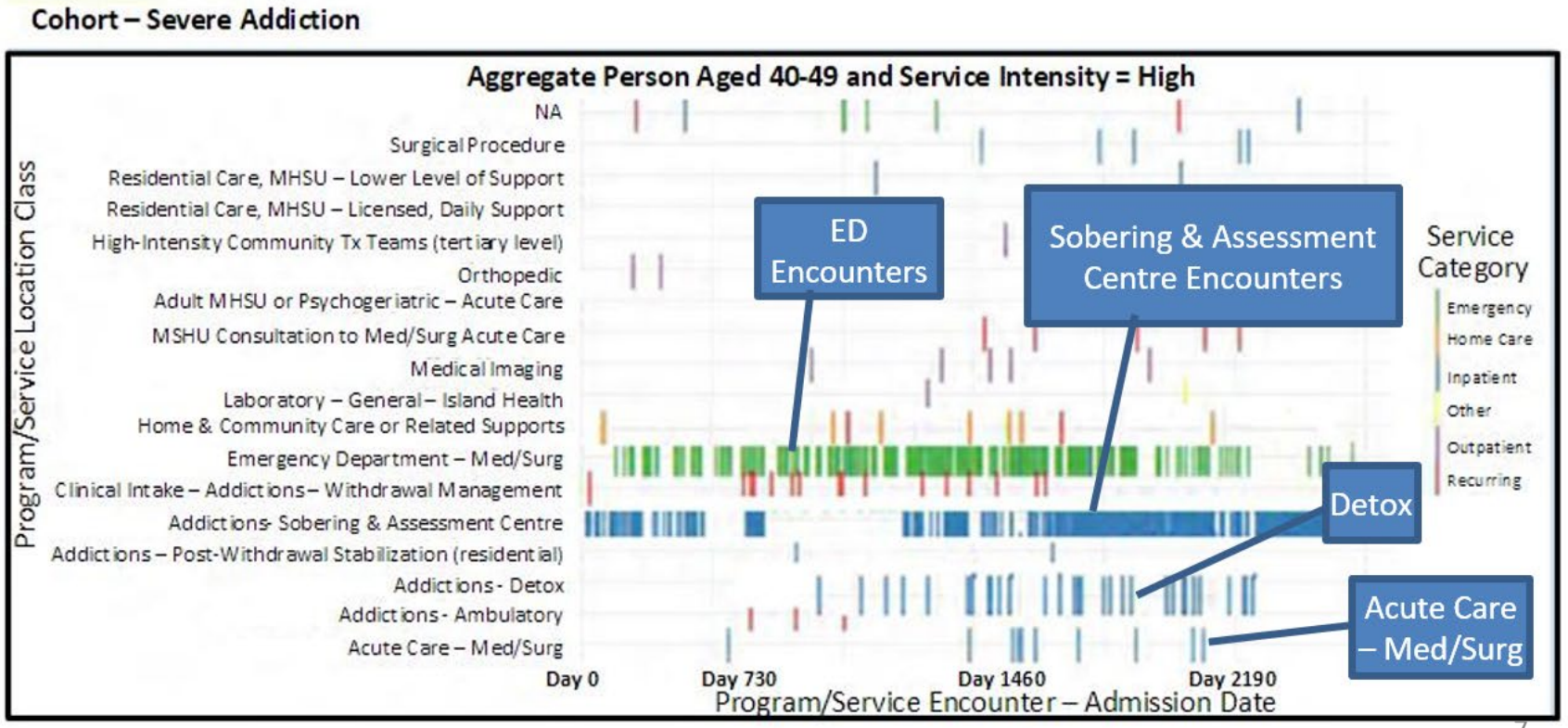
Today

- How do patients vote with their feet?

- We will demonstrate 2 solutions to:
  - 1) How to represent a journey of one patient?
    - Clinical Context Coding Scheme
  - 2) How to summarize a collective experience?
    - Sequence of alluvia/sankey plots (as an e.g.)

M

Figure 1. *Sample within-person-over-time trajectory (de- identified)[2]– cross-continuum encounter data*



1	Unit_Name
110	Respiratory Therapy-CDH
111	Respiratory Therapy
112	Respiratory Therapy Clinic-CVH
113	Respiratory Therapy Clinic-CRG
114	RJH - ROYAL BLOCK EXT 3 RESPIRATORY (old S3)
115	RJH - ROYAL BLOCK EXT 4 RESPIRATORY (old S3)
129	House 1
130	Mt. Doug Apts
131	House 2
132	A Wing-Cowichan
133	House 3
134	House 1
135	House 2
136	House 3
137	House 4
138	House 4
139	A Wing-Cowichan
140	A Wing
141	Sandringham Community Residential

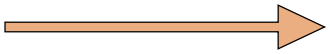
What does that mean?

location_class_code	location_class_description
78	ED - Med-Surg
148	Medical Imaging
146	Lab - Island Health - General
57	H&CC Services
66	Acute Care - Med-Surg - Mixed Ages
34	Clinical Intake - Adult MHSU
140	Surgery - Same Day - Mixed Ages
145	Electrodiagnostics
142	Surgery - Post - Acute Care
135	Med-Surg - Ambulatory Mixed Episodic - Chronic - Mixed Ages
91	Endoscopy
138	Surgery - Prep - Recovery - Mixed Ages
37	Clerical Intake - Older Adults
43	Psychiatric [only] Clinic Services - Adults
16	Time-limited Ambulatory Treatment Services - Mental Health - Adults (secondary level)

This is more meaningful!

Health Programs

N = 1700+

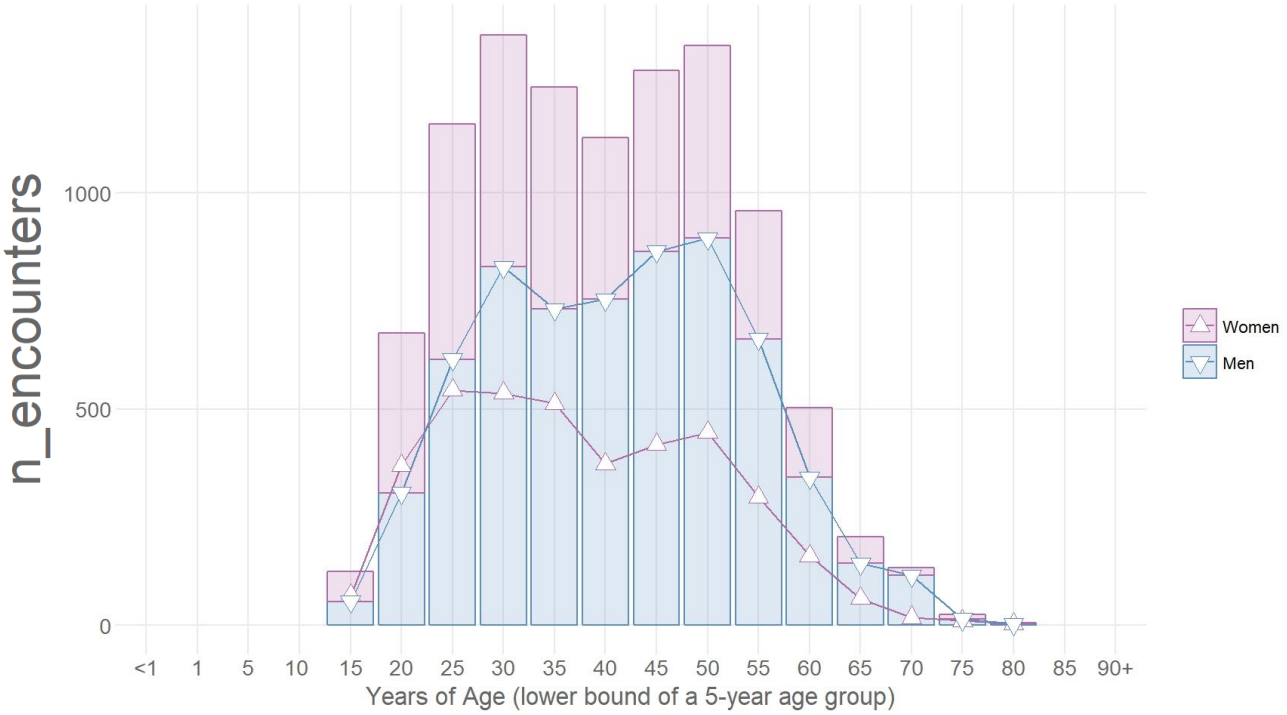


Service Classes

N = 150+

24 - Detox Facility

Service class - [24] - Addictions - Detox (2ary)
Clinical Focus - MHSU-Addictions
Intensity Type - ED, Urgent Care, Acute



— Clinical Context Coding Scheme (CCCS) Coordinate —

compressor	value
location_class_code	24
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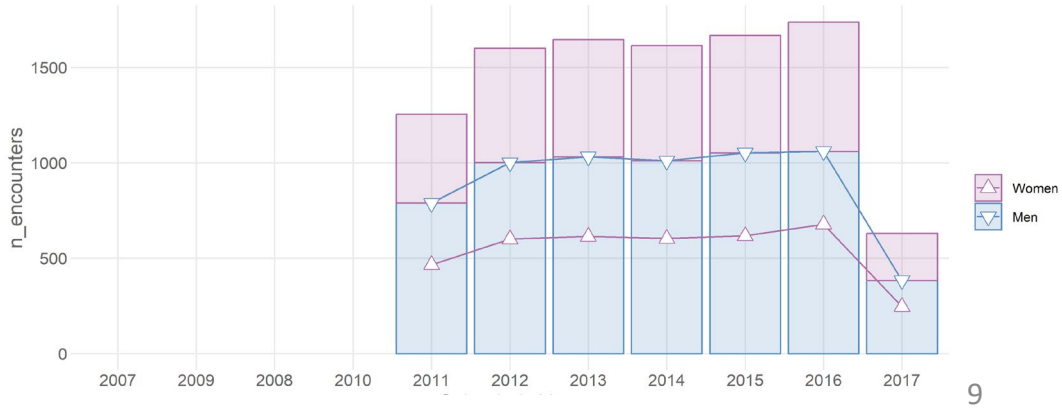
intensity_type	ED, Urgent Care, Acute
intensity_severity_risk	Acute Care
clinical_focus	MHSU-Addictions
service_type	Detox-MHSU
service_location	Detox Facility
population_age	Adults, some adols, older adults



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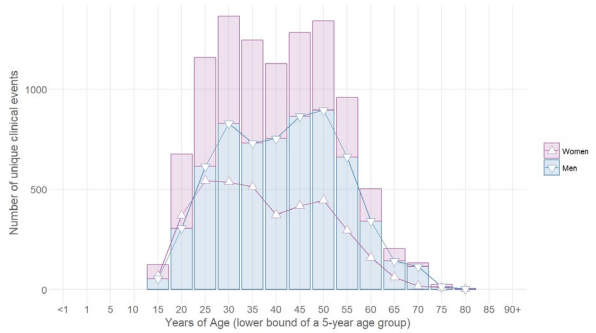

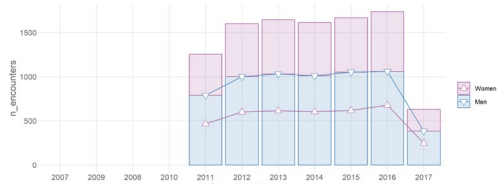

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CERNER

VIHA EDW

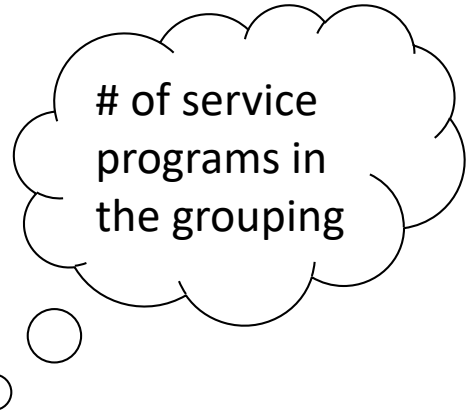
— CERNER EHR + VIHA EDW —

location_map_id	facility_name	building_name	unit_name	location_category	location_grouping	location_type
313	Mental Health & Addictions Service NI - Community Care	Lilli House	Lilli House Detox - Comox Valley	Inpatient-Residential	Inpatient-Residential	Inpt-ResCare-MHAS
1035	MHSU - Residential - Detox	Clearview Detox, Nanaimo - MHSU	Clearview Detox	Inpatient-Residential	NA	Inpt-ResCare-MHAS
1237	Mental Health & Addictions Service CI - Residential Care	Clearview Detox, Nanaimo - MHAS	Clearview Detox	Inpatient-Residential	Inpatient-Residential	Inpt-ResCare-MHAS
1748	MHSU - Residential - Stabilization / Supportive Recovery	Royal Jubilee Eric Martin Pavilion	EMP 5A - Detox Unit-RJH	Inpatient-Residential	NA	Inpt-ResCare-MHAS
1866	MHSU - Residential - Mt Waddington	New Beginnings	Mount Waddington Outpatient Detox	Community-MHAS	Mental Health Community Care Services	Community-MHAS
2116	Mental Health & Addictions Services Community Care	Eric Martin Pavilion	EMP 5A - Medical Detox	Inpatient-Residential	Inpatient-Residential	Inpt-ResCare-MHAS
2238	Mental Health & Addictions Services - Residential Care	Eric Martin Pavilion	EMP 5A - Detox Unit	Inpatient-Residential	Inpatient-Residential	Inpt-ResCare-MHAS

Intensity Type

14 groupings

intensity_type	Totals
Administrative	2
Ambulatory-Chronic	110
Ambulatory-Episodic	314
Ambulatory-Mixed	116
Community Support	89
ED, Urgent Care, Acute	325
Intake, Assessment	31
Laboratory	114
Medical Imaging	50
Morgue	20
Pharmacy	10
Primary Care	6
Residential Care	230
Surgery	136
Totals	1,553



1553 unique service programs engaged by this cohort

— Clinical Context Coding Scheme (CCCS) Coordinate —

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population_age	Adults, some adols, older adults

Intensity, Severity, Risk

36 groupings

Medium Intensity Res Care - Bridging, Crisis	10
Medium-Intensity Community Tx & Support	75
Morgue	20
Pharmacy	10
Primary Care-IH Clinic	6
Rental Supplement	13
Surgery-Anaesthesia	7
Surgery-Day Procedure	16
Surgery-Procecure-Same Day	21
Surgery-Procedure-Acute Admission	13
Surgical-Care, Support	44
Surgical-Post-Acute Care	35
Tertiary Acute	4
Totals	1,553

intensity_severity_risk	Totals
Acute Care	191
Administrative	2
Ambulatory Chronic Care-High Intensity	27
Ambulatory Chronic Care-Moderate Intensity	83
Ambulatory Episodic-High Intensity	38
Ambulatory Episodic-Low Intensity	28
Ambulatory Episodic-Moderate Intensity	227
Ambulatory Mixed-Moderate Intensity	116
Clerical Intake	5
Emergent-Community	12
Emergent-Hospital	84
High Intensity Community Tx & Support	14
High Intensity Res Care	7
High-Intensity Assessment, Intake, Referral	21
Intensive Care	23
Lab-General	109
Lab-Genetics	5
Licensed Residential Care	133
Lower Intensity Res Care	7
Lower-Intensity Assessment, Intake, Referral	26
Lower-Intensity, Time-Delimited	11
Medical Imaging	50
Medium Intensity Res Care	60

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population_age	Adults, some adols, older adults

Clinical Focus

46 groupings

clinical_focus	Totals
Med-Surg	178
Medical Imaging	50
Medical-Intensive	19
Misc	13
Morgue	20
Neurological	22
Nutrition	13
Oncology	27
Ophthamology	7
Orthopedic	20
Pain	5
Pharmacy	10
Physical or Functional Issues	59
Primary Care	6
Psychogeriatrics	6
Respiratory	11
Sleep	2
Surgical	120
Thoracic	7
Urological	18
Wound Care	6
Totals	1,553

clinical_focus	Totals
Administrative	2
Brain Injury or Intellectual Disability	1
Breast Health	2
Cardiovascular	23
Developmental - Phys,Cog	19
Developmental - Phys,Cog,Psych	3
Diabetes	10
Digestive System	16
ENT	4
Early Childhood Care and Development	1
Electrodiagnostics	12
Emergency Response	79
End of Life	13
Endocrine	1
Female Reproductive	7
Frailty, Non-Specific or Mixed	172
Frailty-Mainly ADL	48
Frailty-Neurocog, Psychiatric	8
Genetics	5
Kidneys	23
Lab	114
Liver	6
MHSU	277
MHSU-Addictions	56
Maternity, Perinatal	32

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population_age	Adults, some adols, older adults

Service Type

54 groupings

— Clinical Context Coding Scheme (CCCS) Coordinate —

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clinical_focus	MHSU-Addictions
service_type	Detox-MHSU
service_location	Detox Facility
population_age	Adults, some adols, older adults

Laboratory	114
Maternity	20
Medical Imaging	50
Morgue	20
Multi-Service	6
Outreach-MHSU	12
Palliative, End of Life	13
Pharmacy	10
Primary Care	6
Rehab-MHSU	12
Rehab-Phys-or-Cog(Therapies)	87
Rental Supplement-MHSU	13
Res Care - MHSU - Supported Independent Living	7
Res Care-MHSU-Crisis	16
Res Care-MHSU-Family Care Home	1
Res Care-MHSU-Group Home, Apartment Cluster	11
Res Care-MHSU-Licensed	7
Res Care-MHSU-Post Detox	10
Residential Care-CHS-Assisted Living	38
Residential Care-CHS-Brain Injury, Int-Dis	1
Residential Care-CHS-Licensed	126
Specialist Consultation	2
Surgery-Ambulatory Prep, Procedure	18
Surgery-Day Procedure	22
Surgery-Prep, Recovery	32
Surgery-Procedure	13
Surgical-Post-Acute Care	35
Totals	1,553

service_type	Totals
Acute Care	142
Acute Care-Adjunct Therapies	18
Acute Care-Tertiary	4
Administrative	2
Ambulatory-Chronic	76
Ambulatory-Clinical Psychology	8
Ambulatory-Episodic	150
Ambulatory-Intensive	11
Ambulatory-Mixed	114
Ambulatory-Mixed-Group	2
Assertive Community Treatment (ACT)-MHSU	9
Assessment-Intensive	26
Case Management-MHSU	33
Case Management-SARIN	4
Crisis Response-Community	12
Detox-MHSU	5
Diagnostics	61
Dialysis	19
ECT	2
ED-Medical	79
ED-PES or Psychiatric Bed	5
EPI Protocol	4
H&CC Nursing, Support	10
Intake-Clerical	5
Intake-Clinical	26
Intensive Care	19
Intensive Case Management (MHSU)	5

Service Location

14 groupings

service_location	Totals
Administrative	2
Ambulatory Clinic	513
Community	107
Community Facility	220
Detox Facility	5
Family Care Home	1
Home	42
Hospital	411
Hospital-ED	9
IH Lab	114
Medical Imaging	50
Morgue	20
Pharmacy	10
Telehealth	49
Totals	1,553

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intensity_severity_risk	Acute Care
clinical_focus	MHSU-Addictions
service_type	Detox-MHSU
service_location	Detox Facility
population_age	Adults, some adols, older adults

Population Age

7 groupings

population_age	Totals
Administrative	2
Adults, some adols, older adults	303
Children, Adolescents	51
Mixed Ages	936
Mother-Baby	34
Older Adults Targeted	226
Young Children	1
Totals	1,553

— Clinical Context Coding Scheme (CCCS) Coordinate —

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clinical_focus	MHSU-Addictions
service_type	Detox-MHSU
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population_age	Adults, some adols, older adults

All possible combination of compressors' levels

=

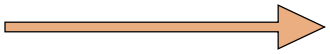
154 service classes

location_class_code	location_class_description
78	ED - Med-Surg
148	Medical Imaging
146	Lab - Island Health - General
57	H&CC Services
66	Acute Care - Med-Surg - Mixed Ages
34	Clinical Intake - Adult MHSU
140	Surgery - Same Day - Mixed Ages
145	Electrodiagnostics
142	Surgery - Post - Acute Care
135	Med-Surg - Ambulatory Mixed Episodic - Chronic - Mixed Ages
91	Endoscopy
138	Surgery - Prep - Recovery - Mixed Ages
37	Clerical Intake - Older Adults
43	Psychiatric [only] Clinic Services - Adults
16	Time-limited Ambulatory Treatment Services - Mental Health - Adults (secondary level)

CCCS

Health Programs

N = 1700+



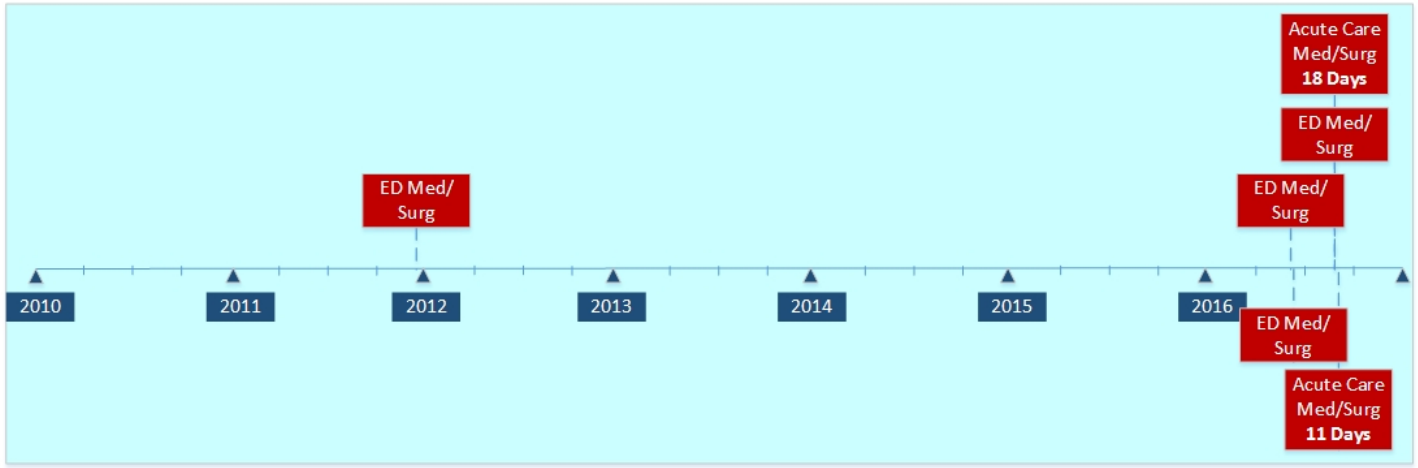
Service Classes

N = 150+

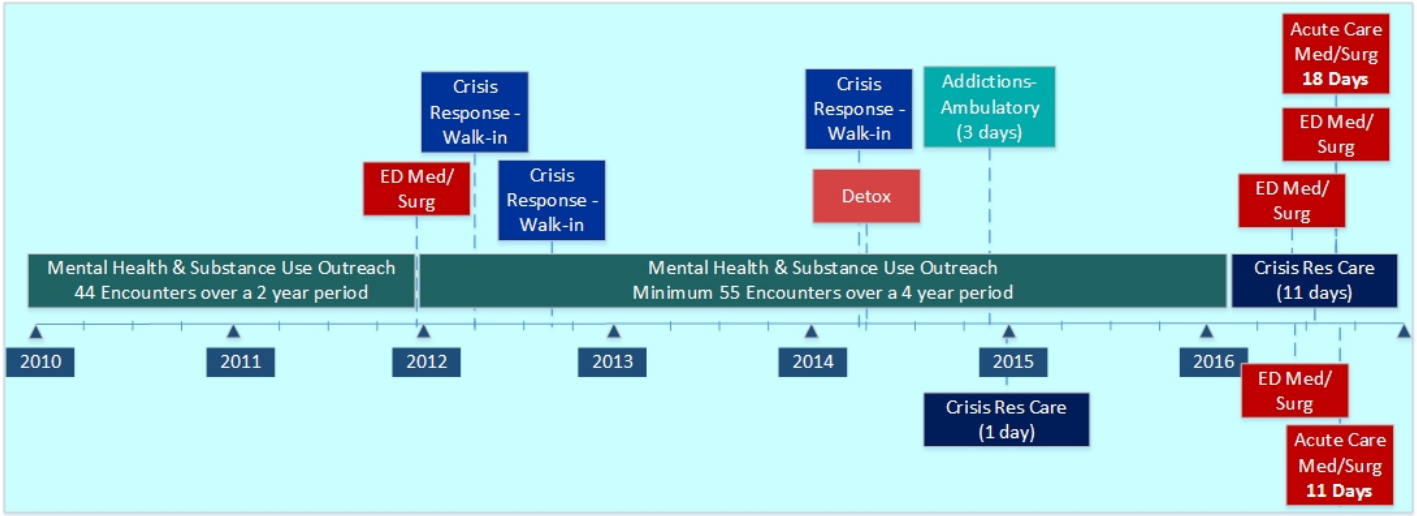
But, do we *really* need **non-primary** care data?

N

View based on CDC study/administrative data



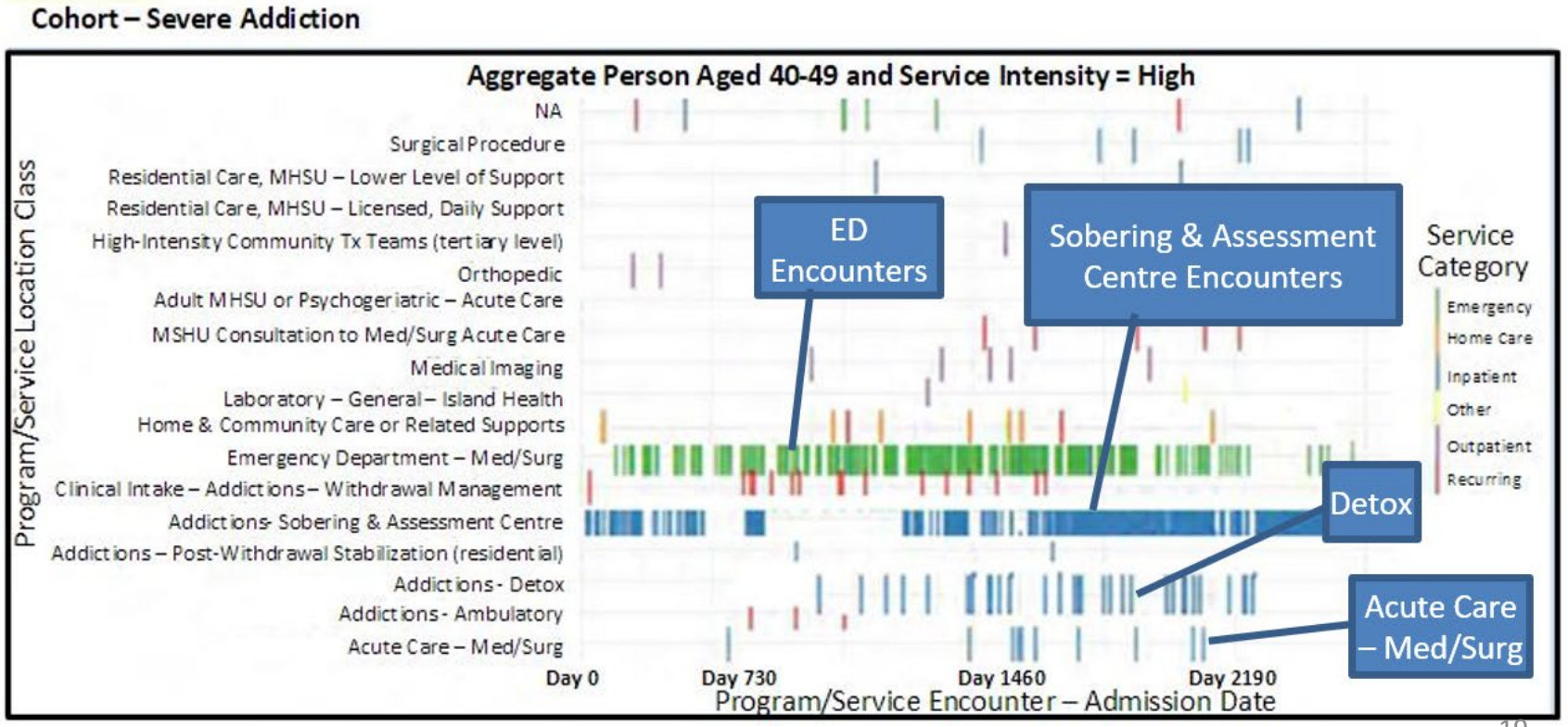
View based on administrative plus transactional/clinical encounter data (3Ts data)



M

M M M M M M M

Figure 1. *Sample within-person-over-time trajectory (de- identified)[2]– cross-continuum encounter data*



Define “group”

Research Cohort is defined as anybody who

- had contact with any Mental Health & Substance Use (MHSU) program

AND/OR

- had contact with any acute care service (acute care admission)
  - with an MHSU discharge diagnosis established AND/OR
  - had an MHSU procedure performed

This formulation yielded a cohort of 170,533 individuals who had at least one encounter with at least one of any MHSU programs in Island Health between 2007 and 2017

Once we identified the individuals fitting these criteria we have retrieved all their transactions with all VIHA services.

Clinical Context Coding Scheme

Describing Utilisation of Services of Island Health between 2007-2017


Andriy V. Koval
Health System Impact Fellow
University of British Columbia


Ken Moselle
Applied Clinical Research Unit
Vancouver Island Health Authority

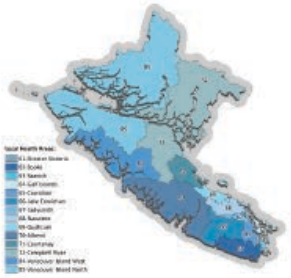
Vancouver Island Health Authority (VIHA, aka Island Health) is one of 5 health authorities of British Columbia.

VIHA administers about 1700+ individual programs (aka locations), spanning the full spectrum of health services.

Starting in 2007, VIHA has been recording patients' encounters with these programs using a single instance of Electronic Health Record system, CERNER-Millennium.

Cross-continuum nature of CERNER-Millennium and moated nature of the geographical area of VIHA created a data source that captures almost complete patient trajectories through the space of health services.

TTT cohort identifies users of Mental Health & Substance Use (MHSU) services of Island Health during the last ten years (2007 -2017).



source: http://www.viha.ca/about_viha.html

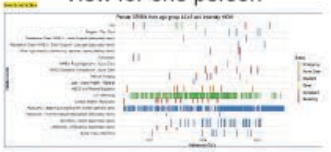
However, 1700+ programs are too much to make sense of, this is too granular of a view of the encounter data. Besides, some locations are recorded in a cryptic way and are hard or impossible to decipher for a researcher not familiar with VIHA.

To make encounter data less granular and less cryptic, we have grouped programs according to the similarity of services they provide (e.g. "Medical Imaging", "Detox", "Crisis Response Team", "Endoscopy", etc.)

Clinical Context Coding Scheme (CCCS) encodes how the complete universe of VIHA's 1700+ health programs maps onto a smaller set of descriptive labels (service classes).

While we need to be aware that service classes are groups of individual locations (programs), the latter are unlikely to be relevant for purposes of understanding patient trajectories (unless you are a system planner in VIHA).

View for one person



If we put time on the horizontal axis, we can use the vertical dimension to list classes of service the patient engaged at each point in time.

With only 150+ ways a patient can engage VIHA (instead of 1700+) it now becomes manageable to display the entire history of a patient's engagement with the health system.

This fictionalized history of a patient with a server substance addition, shows the type of patterns we can now discern and

Research Cohort is defined as anybody who

- had contact with Mental Health & Substance Use (MHSU) program

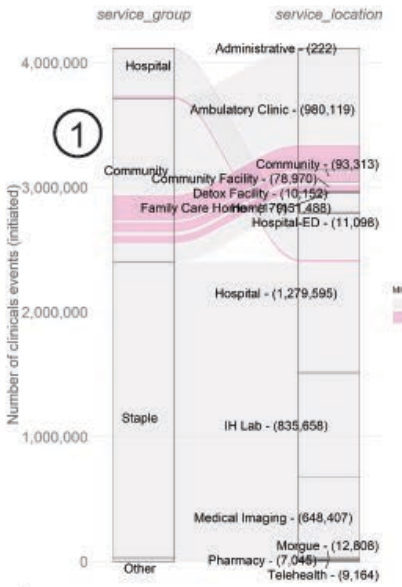
AND/OR

- had contact with any acute care service (acute care admission)
  - with an MHSU discharge diagnosis established AND/OR
  - had an MHSU procedure performed

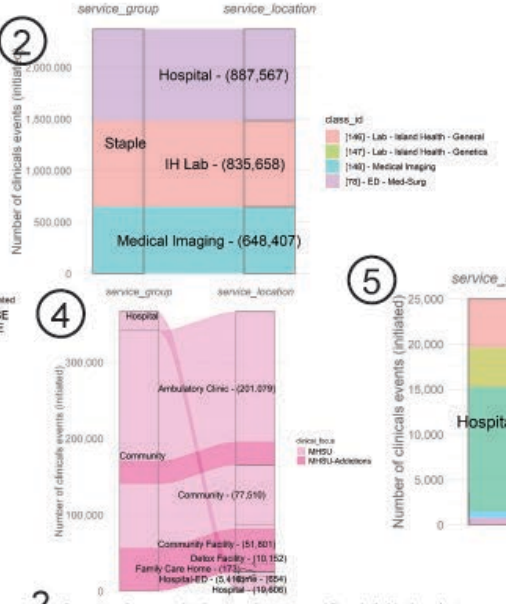
This is how we defined the general cohort of interest (MHSU patients during 2007 – 2017) in order to formulate the query for data retrieval.

This formulation yielded a cohort of 170,533 individuals who had at least one encounter with at least one of any MHSU programs in Island Health during between January 1, 2007 and September 1, 2017

Once we identified the individuals fitting these criteria we have retrieved all their transactions with all VIHA services.



1 Counts of all clinical events generated by the research cohort between 2007-01-01 and 2017-09-01. Our focus is with services related to Mental Health and Substance Use.



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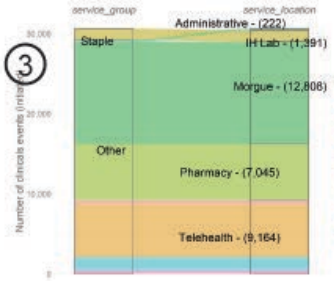

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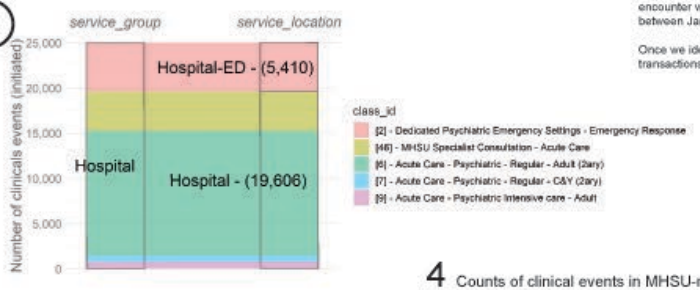
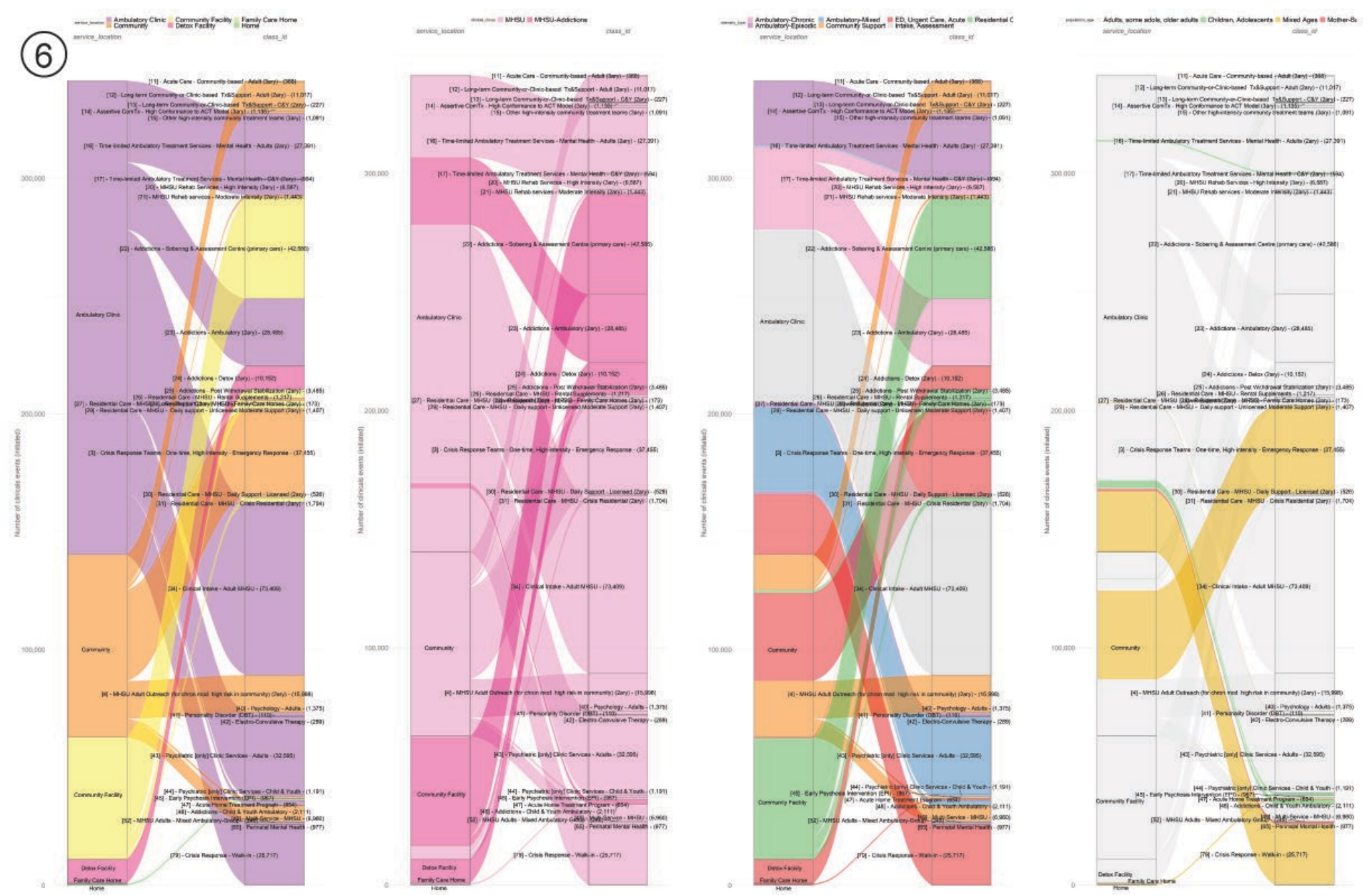


5 Counts of MHSU-related services that took place in a hospital setting.

4 Counts of clinical events in MHSU-related services. Notice that most MHSU events occur in community-based services

6 Counts of MHSU-related services that took place in a community setting. Each panel colors the (identical) breakdown of service locations into service classes according to four dimensions of the Clinical Context Coding Scheme.

View PDF of the handout at github.com/dss-ialh/displaying-health-data



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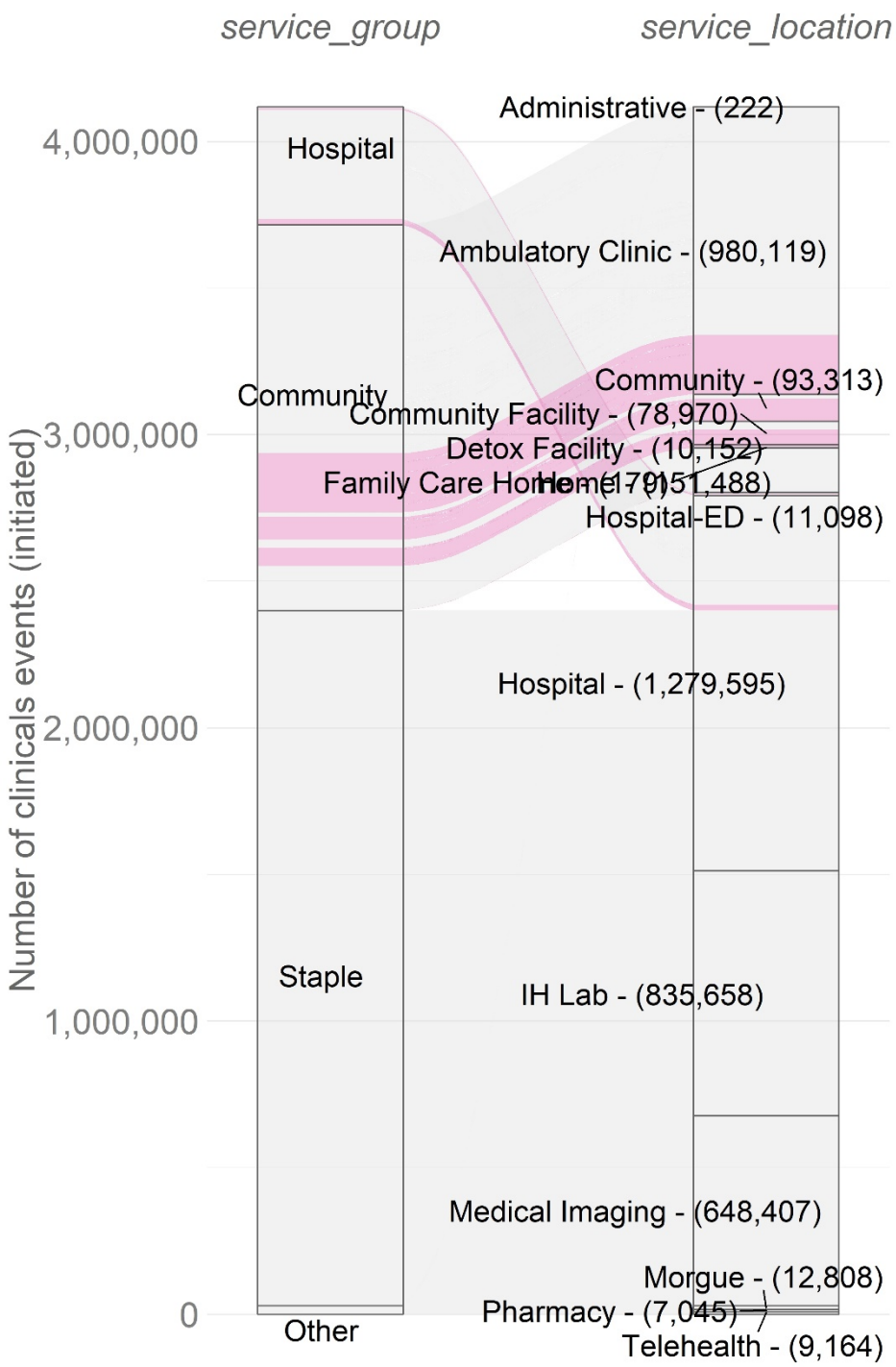
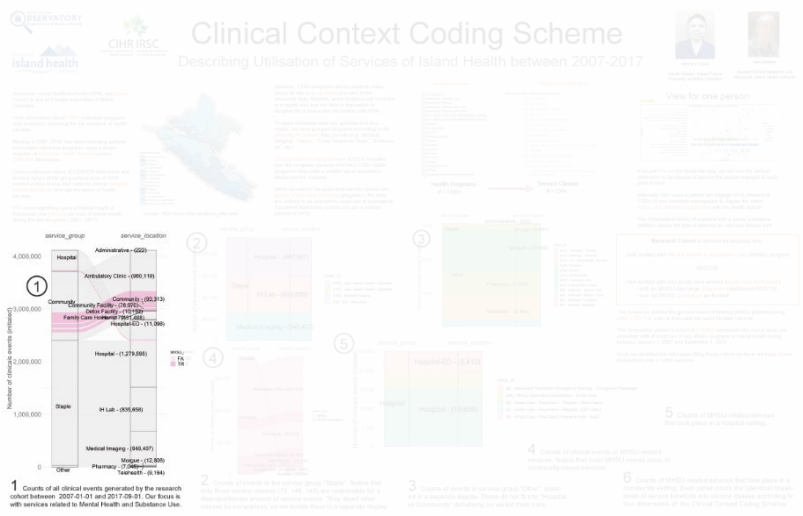
service_group	service_location
Community	Community
	Community Facility
	Detox Facility
	Family Care Home
	Home
Hospital	Hospital
	Hospital-ED
Other	Administrative
	Morgue
	Pharmacy
	Telehealth
Staple	Hospital
	IH Lab
	Medical Imaging

— Clinical Context Coding Scheme (CCCS) Coordinate —

compressor	value
location_class_code	24
location_class_description	Addictions - Detox (2ary)
intensity_type	ED, Urgent Care, Acute
intensity_severity_risk	Acute Care
clinical_focus	MHSU-Addictions
service_type	Detox-MHSU
service_location	Detox Facility
population_age	Adults, some adols, older adults





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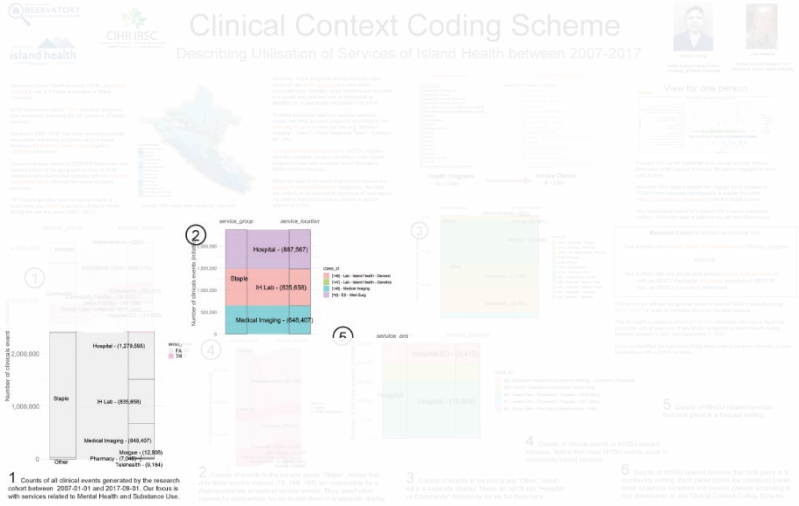

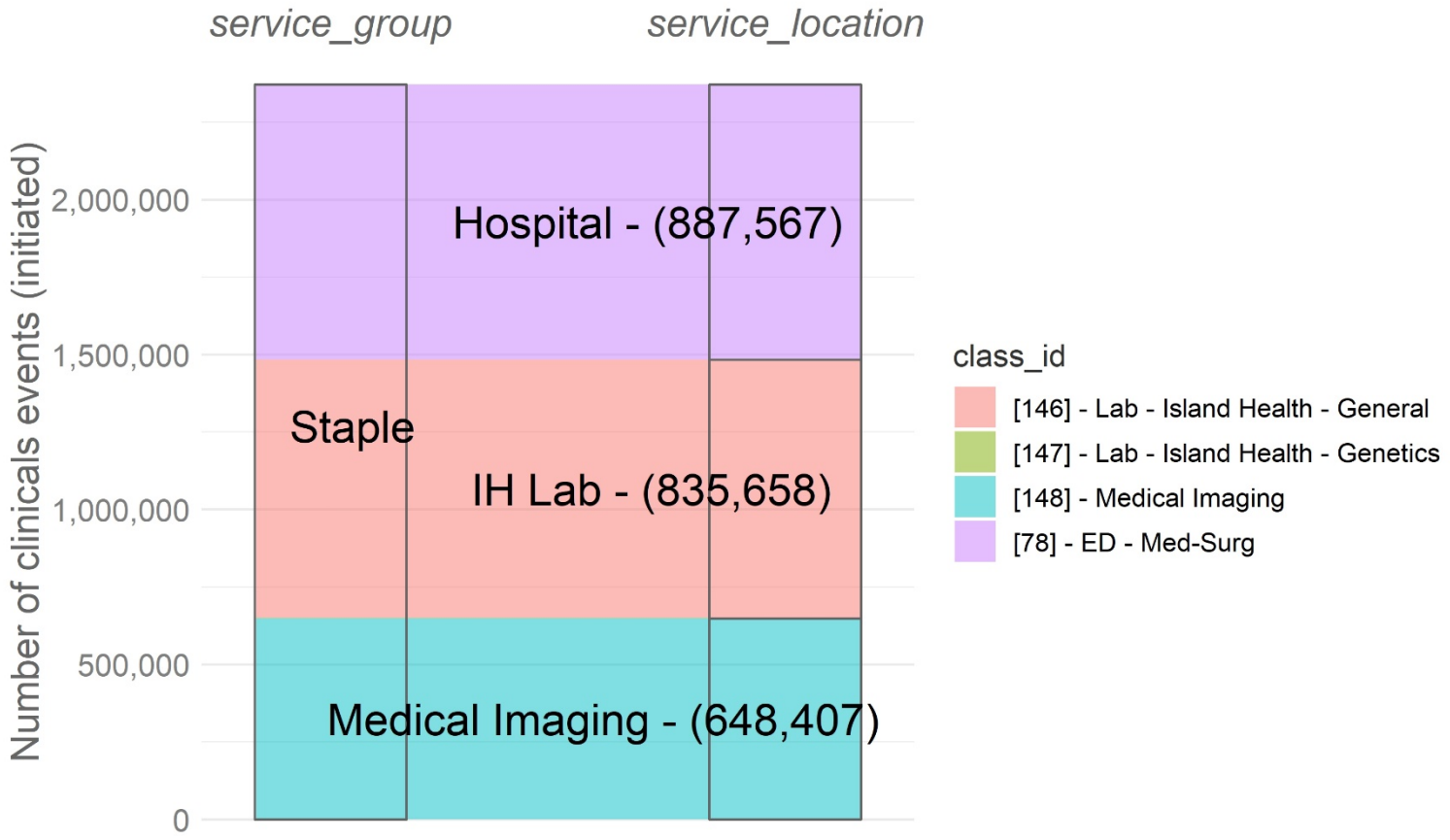

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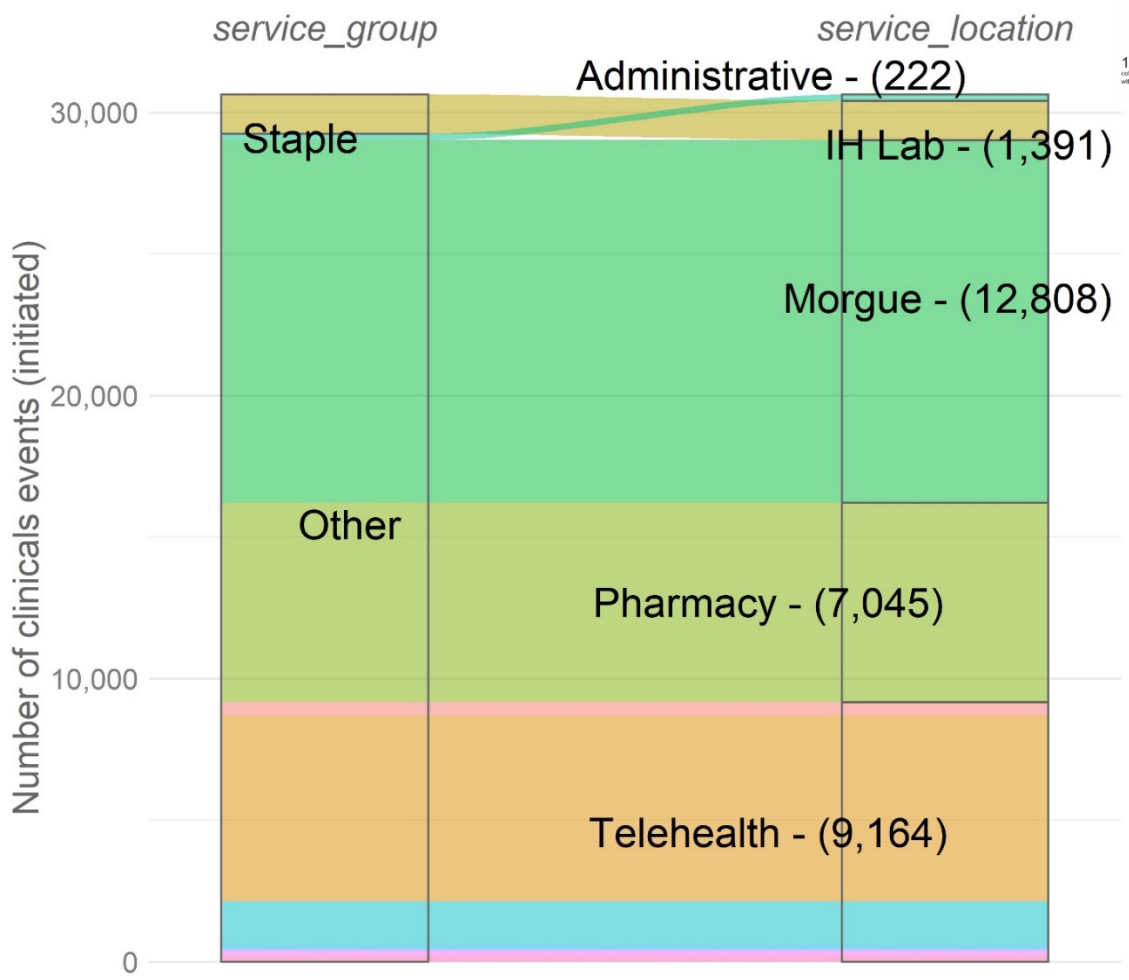
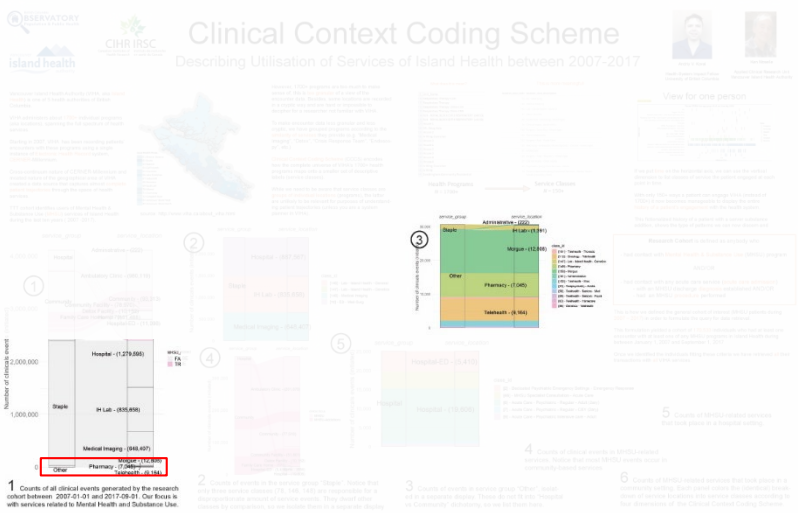
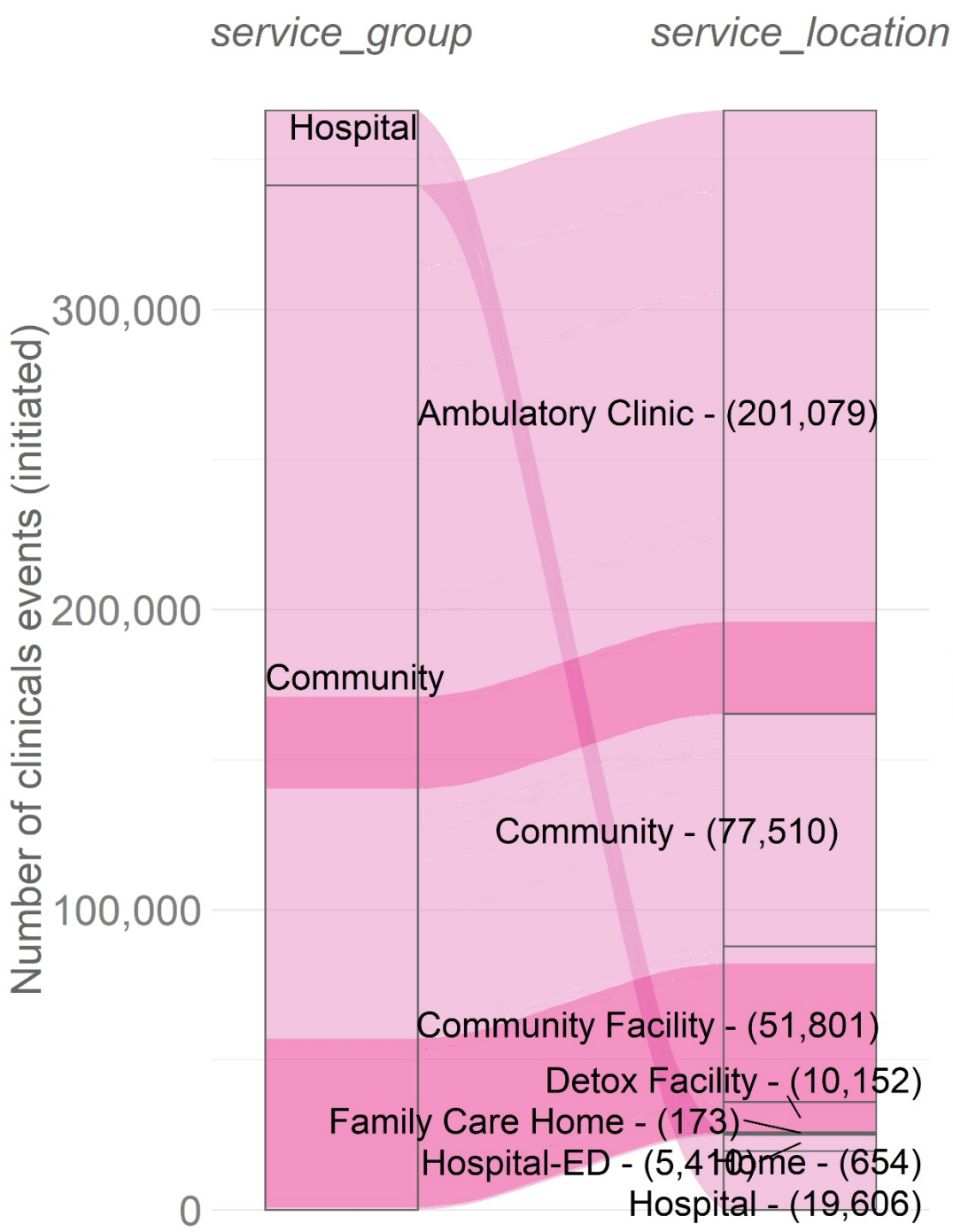
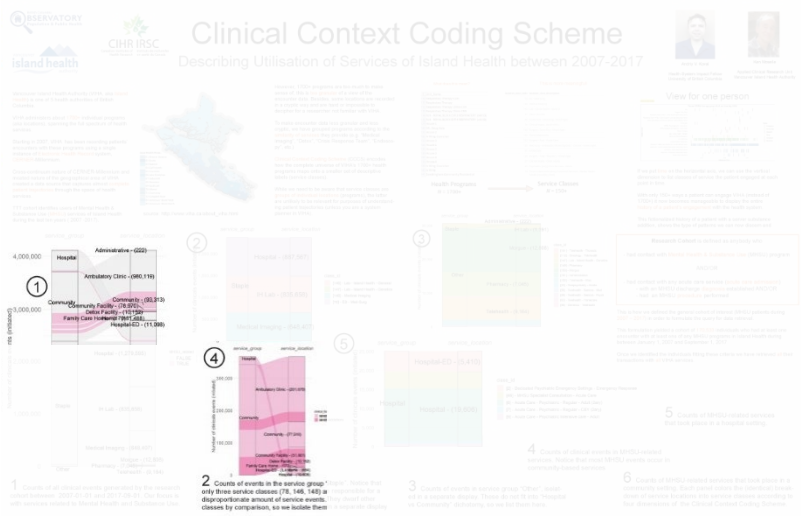




class_id

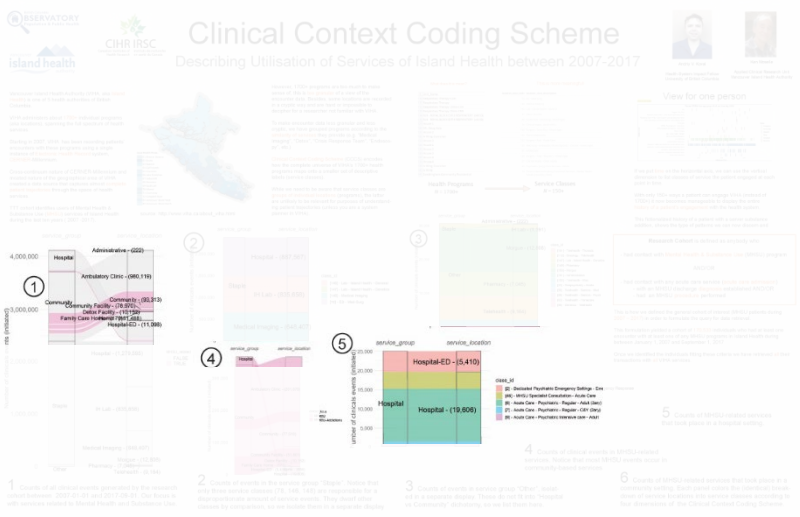
- [101] - Telehealth - Thoracic
- [112] - Oncology - Telehealth
- [147] - Lab - Island Health - Genetics
- [149] - Pharmacy
- [150] - Morgue
- [151] - Administrative
- [152] - Telehealth - Misc
- [33] - Telepsychiatry - Adults
- [58] - Telehealth - Seniors - Med
- [59] - Telehealth - Seniors - Psych
- [63] - Telehealth - Homecare
- [96] - Genetics - Telehealth

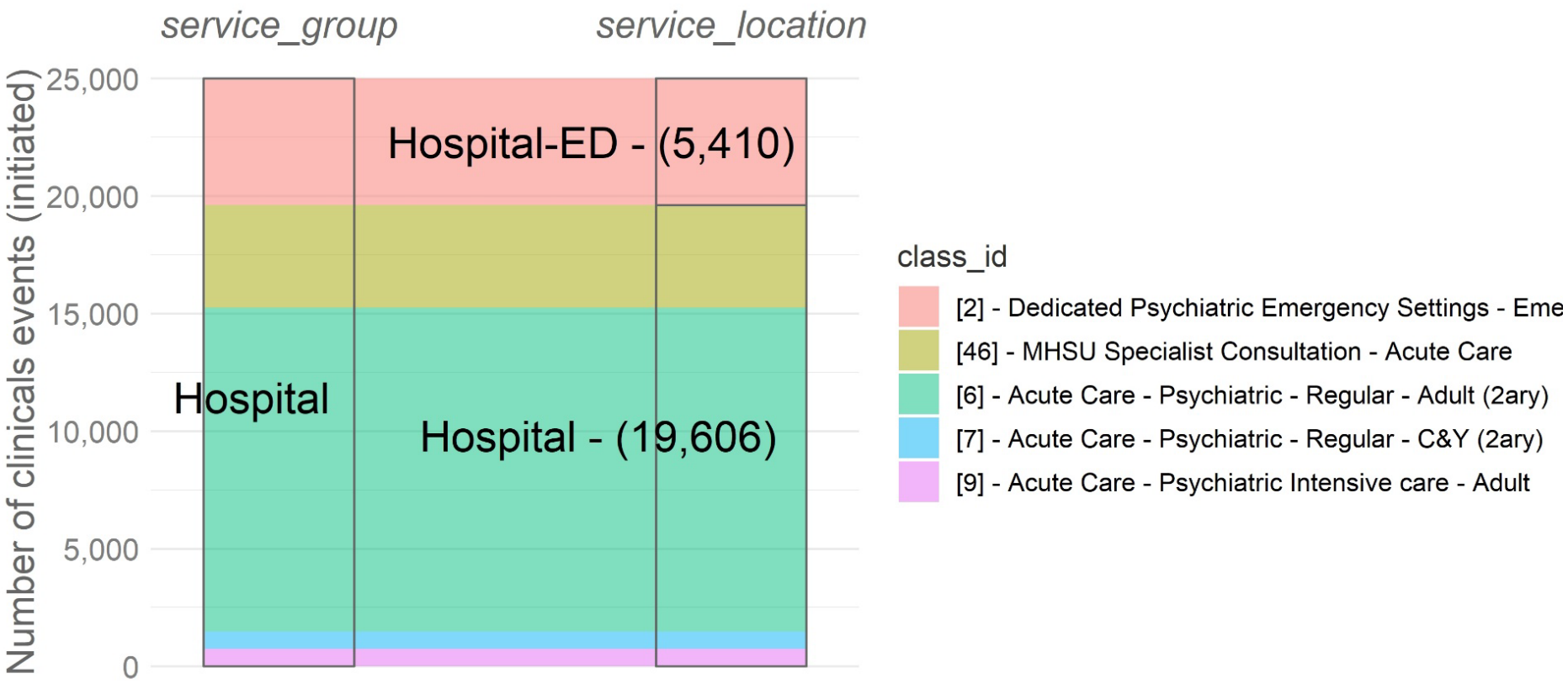


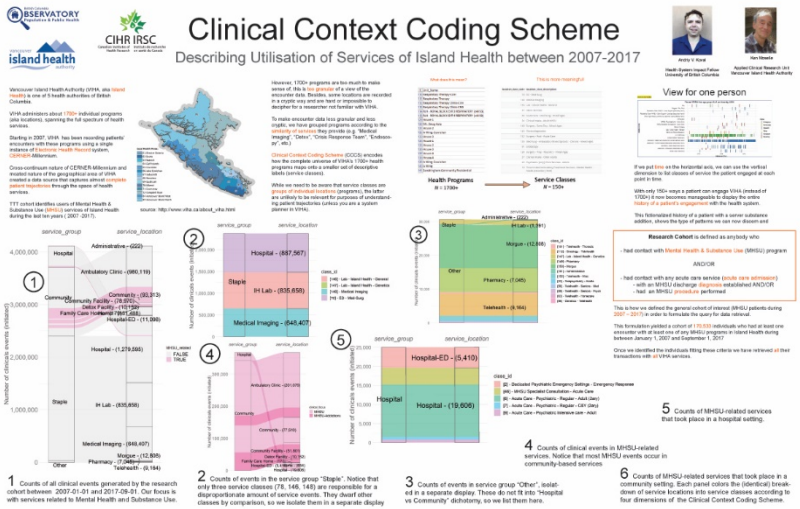


Counts of clinical events in MHSU-related services. Notice that most MHSU events occur in community-based services

Counts of MHSU-related services that took place in a hospital setting






Clinical Context Coding Scheme
Describing Utilisation of Services of Island Health between 2007-2017
Andriy V. Koval
Health System Impact Fellow
University of British Columbia
Dan Hocking
Applied Clinical Research Unit
Vancouver Island Health Authority
View for one person
Research Cohort is defined as anybody who
- had contact with Mental Health & Substance Use (MHSU) program
AND/OR
- had contact with any acute care service (acute care admission)
- with an MHSU discharge diagnosis established AND/OR
- had an MHSU procedure performed
1 Counts of all clinical events generated by the research cohort between 2007-01-01 and 2017-08-31. Our focus is with services related to Mental Health and Substance Use.
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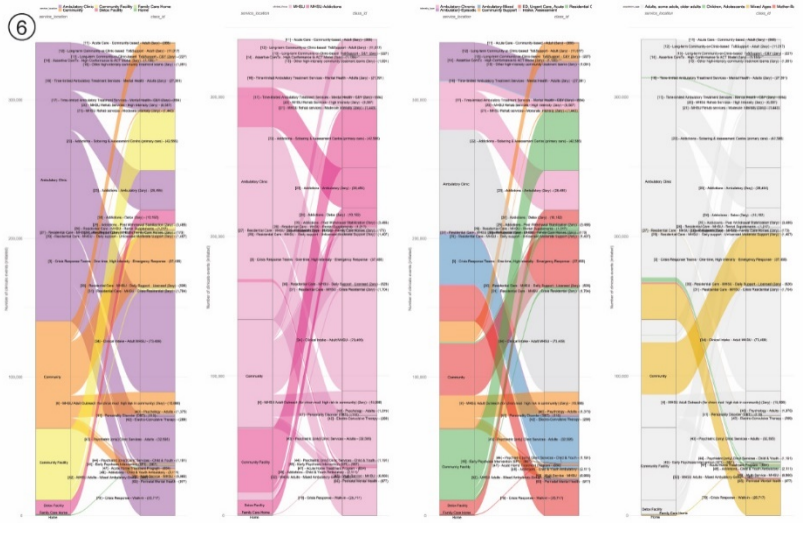
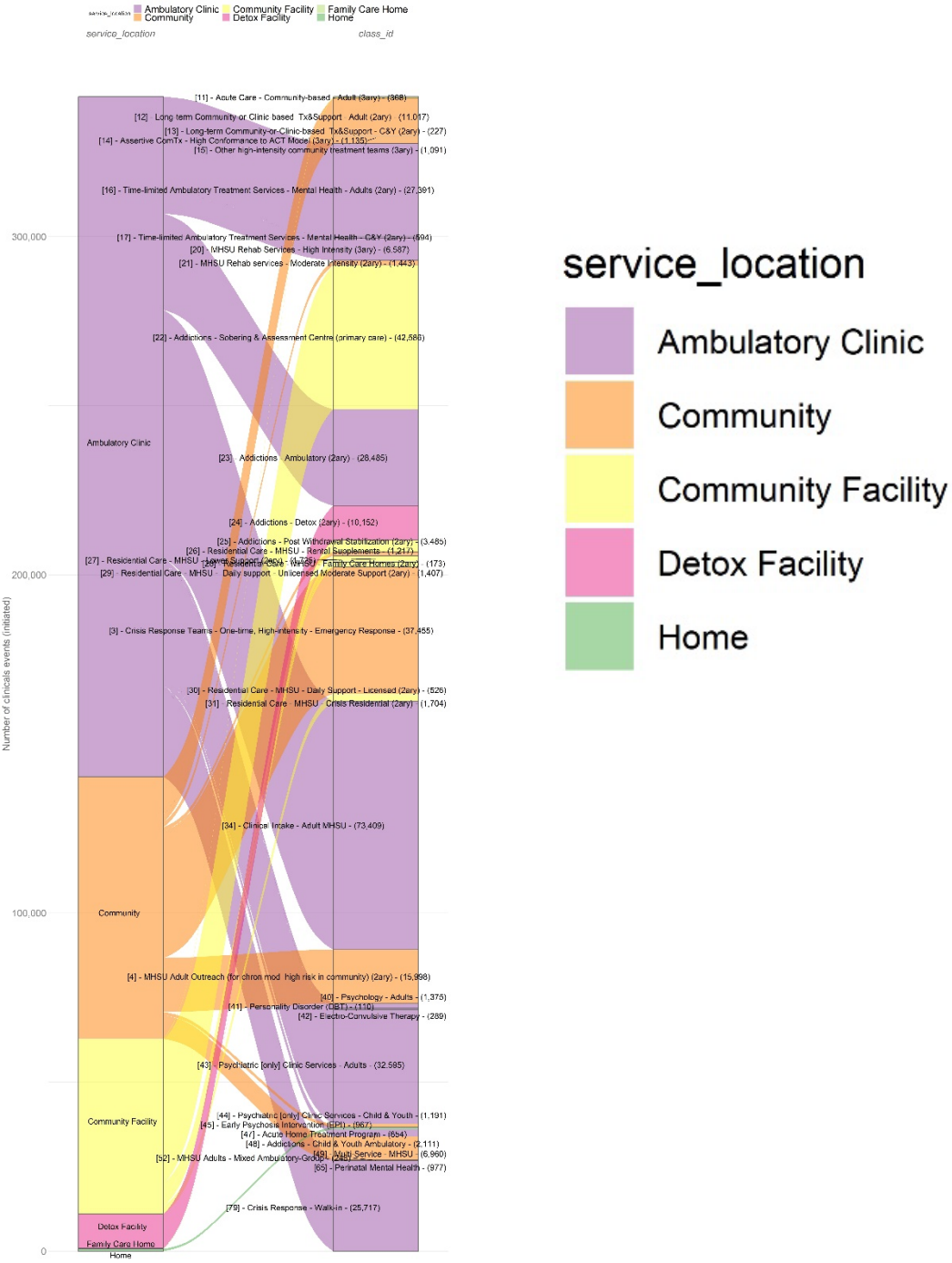
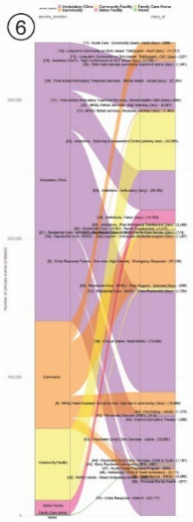
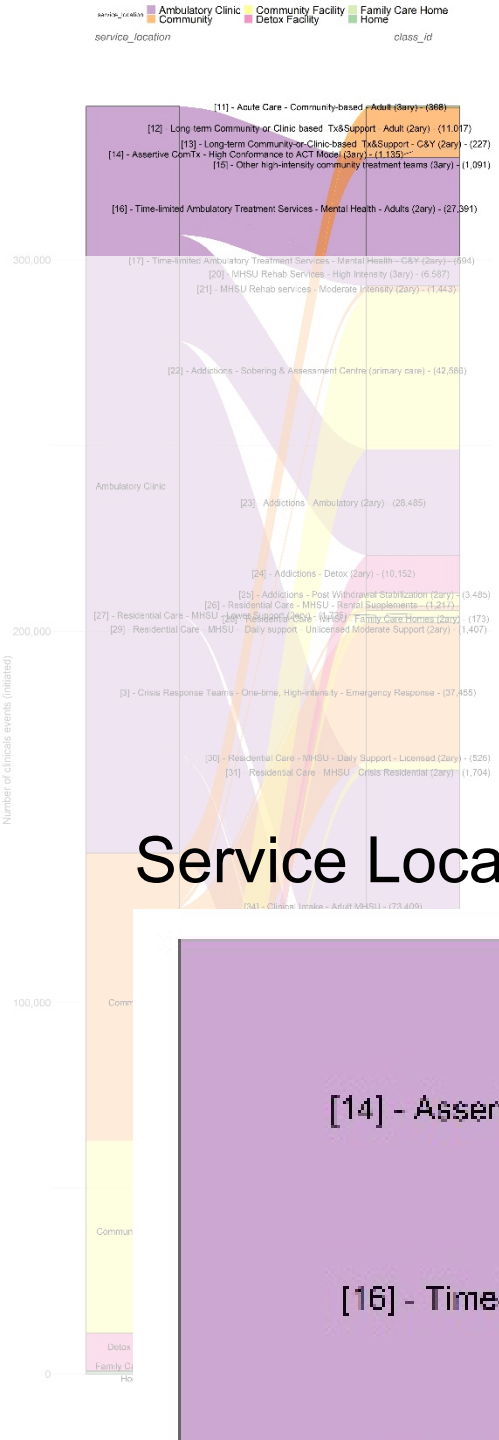




service_location

- Ambulatory Clinic
- Community
- Community Facility
- Detox Facility
- Home





service_location

- Ambulatory Clinic
- Community
- Community Facility
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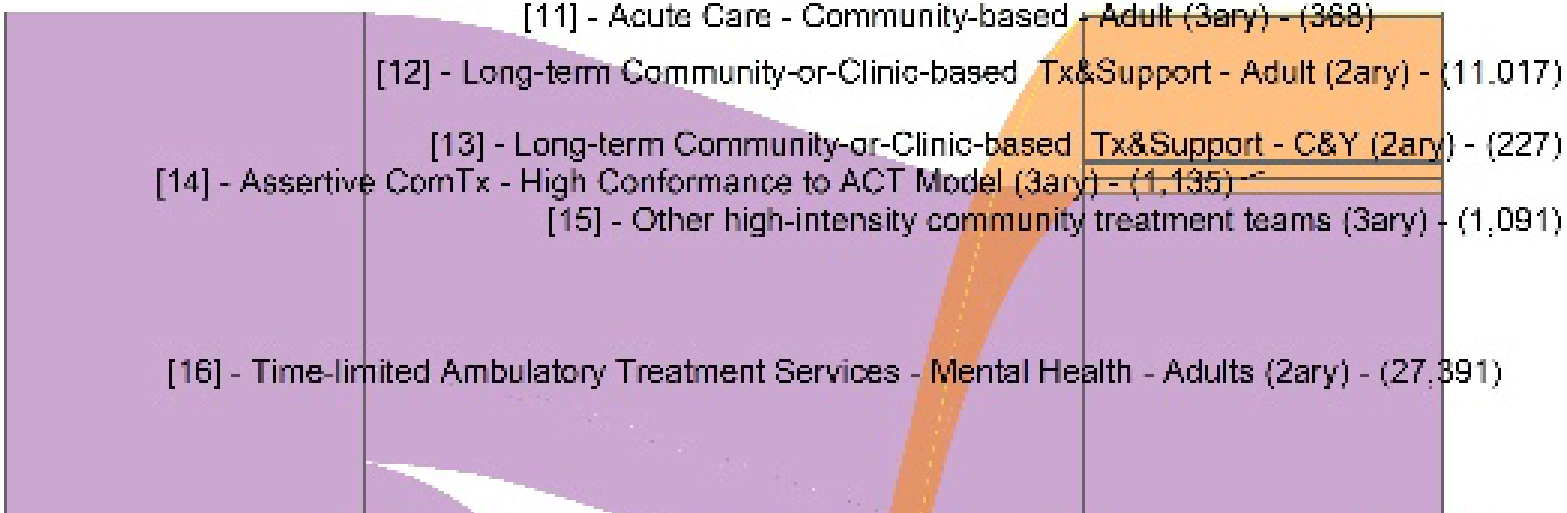
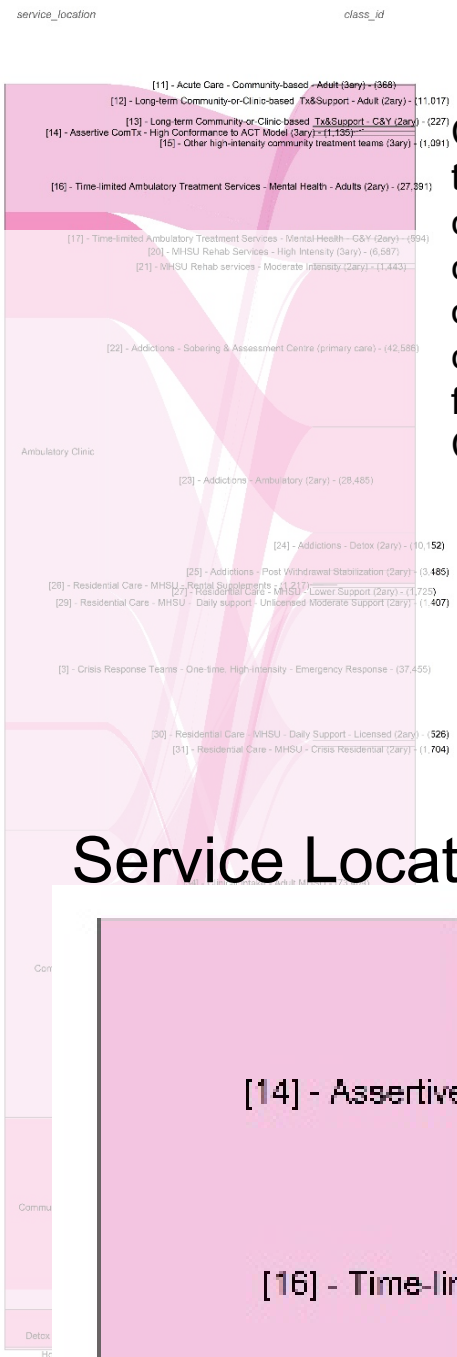
- Home

Counts of MHSU-related services that took place in a community setting. Each panel colors the (identical) breakdown of service locations into service classes according to four dimensions of the Clinical Context Coding Scheme.

Service Location

Class





Counts of MHSU-related services that took place in a community setting. Each panel colors the (identical) breakdown of service locations into service classes according to four dimensions of the Clinical Context Coding Scheme.

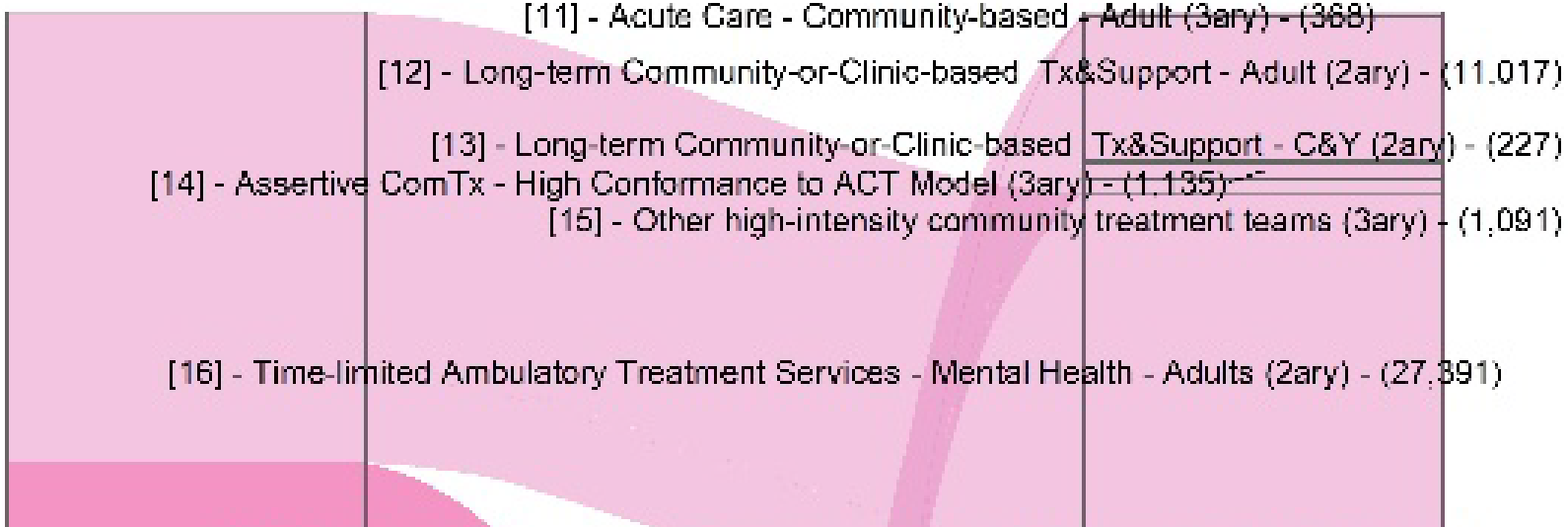
clinical_focus

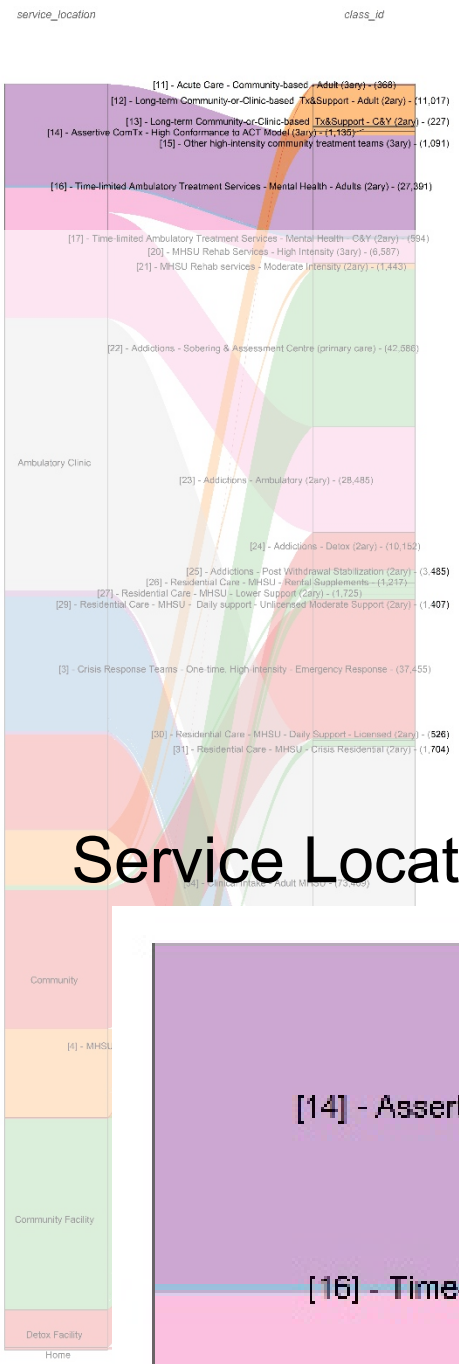
MHSU

MHSU-Addictions

Service Location

Class





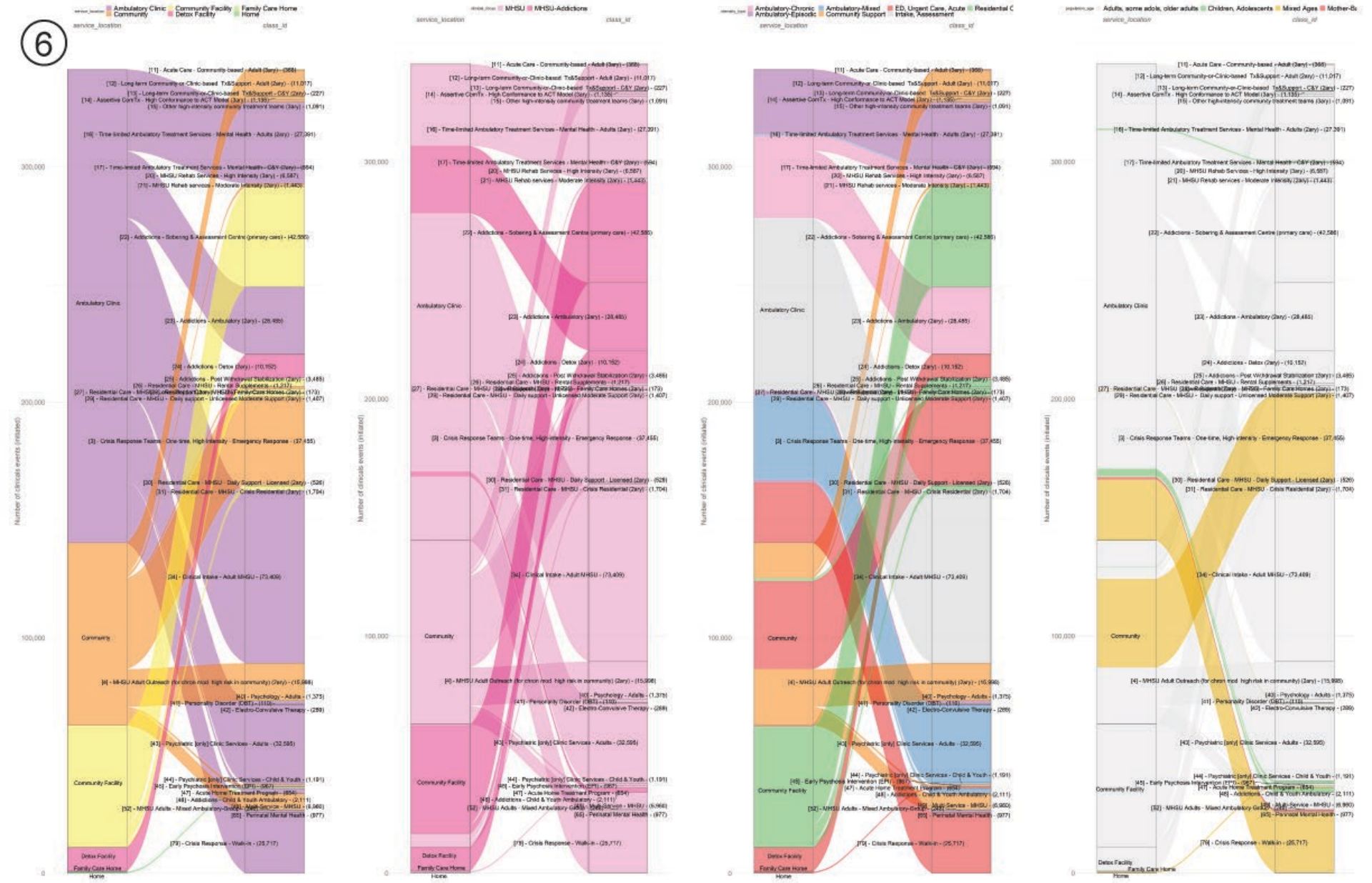
intensity_type

- Ambulatory-Chronic
- Ambulatory-Episodic
- Ambulatory-Mixed
- Community Support
- ED, Urgent Care, Acute
- Intake, Assessment
- Residential Care

Counts of MHSU-related services that took place in a community setting. Each panel colors the (identical) breakdown of service locations into service classes according to four dimensions of the Clinical Context Coding Scheme.

Service Location

Class



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In conclusion

- We demonstrated solutions to
  - How to represent a person's journey?
    - CCCS
  - How to represent a cohort experience?
    - Sequence of alluvia plots
- Now what can we do?
  - Similarities of individual trajectories
  - Compare target group to the reference groups

Transactional Data of Island Health

How patients vote with their feet

Andriy Koval

Ken Moselle

British Columbia OBSERVATORY Population & Public Health

CIHR IRSC Canadian Institutes of Health Research / Instituts de recherche en santé du Canada

UCF UNIVERSITY OF CENTRAL FLORIDA

vancouver island health authority

Please email questions to aging@uvic.ca

Displaying Health Data

Cases, Techniques, Solutions

Colloquium + Live-Webcast + Recording
Medical Sciences Building (MBS) 160
University of Victoria
November 28 – 30 , 1 – 3 pm PST

Please email questions to
aging@uvic.ca

University of Victoria
INSTITUTE ON AGING & LIFELONG HEALTH
island health
British Columbia BSERVATORY Population & Public Health
IALSA
Health Sciences Center
UCF
UNIVERSITY OF CENTRAL FLORIDA