Evolution of Analytics in Prescription Monitoring in AB

Health Analytics Community, Canada Health Infoway
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Who We Are

- OKAKI is Blackfoot for “Be Wise”
- Public Health Services and Informatics Social Enterprise, Founded in 2008
- Core Competencies
  - Public Health, Healthcare, Health Systems
  - Health Information Privacy and Security
  - Data Engineering, Analytics and Health Research
  - Software
  - IT Infrastructure and Operations
- Areas of Activity
  - Indigenous Health
  - Public Health and Immunizations
  - Prescription Monitoring
  - Population Precision Health

OKAKI™

Tracked Prescription Program (TPP) Alberta (est. 1986)

- Provincial Rx drug monitoring program
- Administered by CPSA, TPP AB is a multi-stakeholder partnership
- Monitors medications prone to non-medical or inappropriate use
- Works with stakeholders to enable system level change to ensure appropriate use of monitored medications.

Physician Prescribing Practices (PPP) Program (est. 2009)

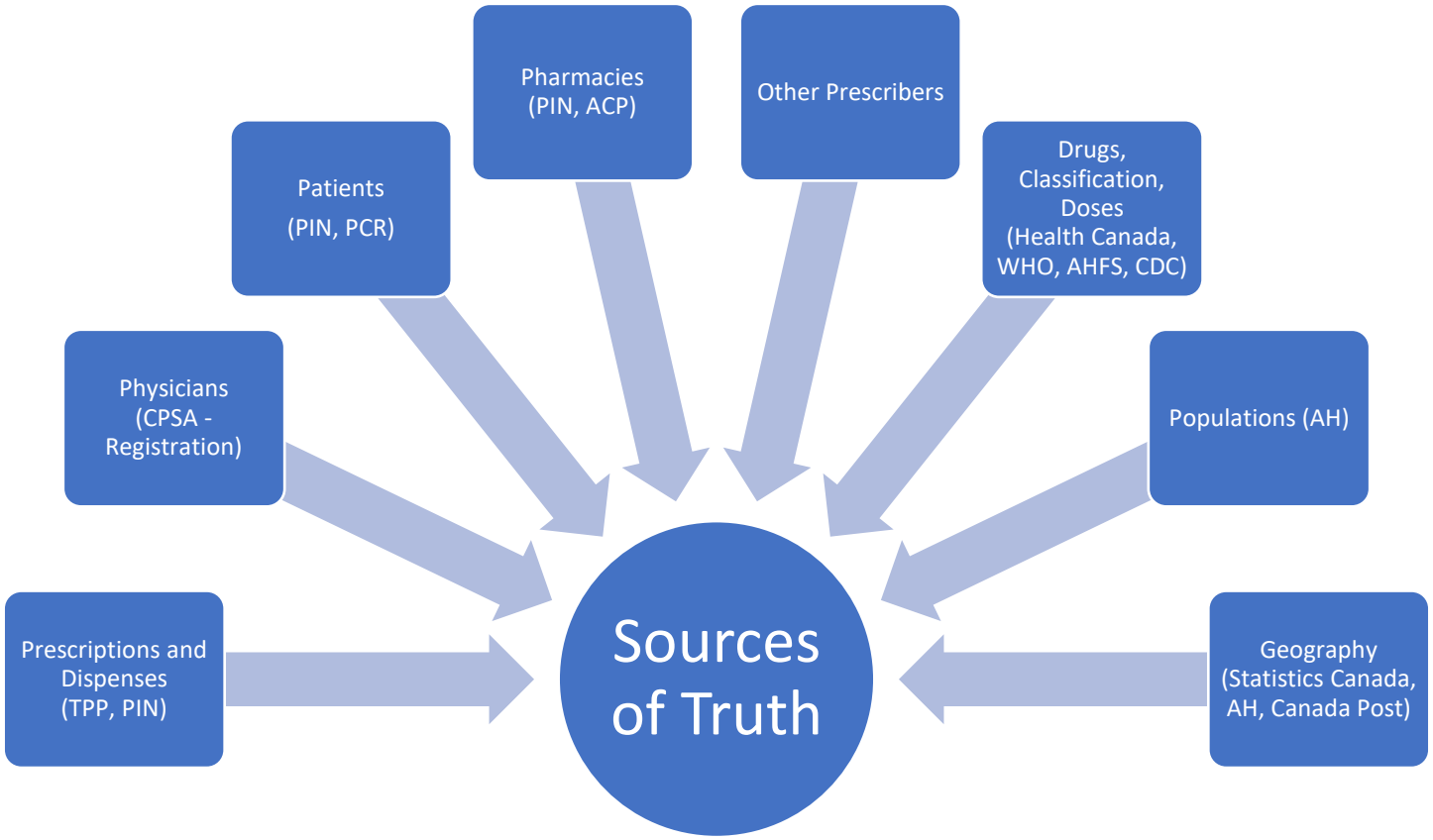
- Quality improvement program that provides educational support to all physicians generally to optimize quality of care provided to Alberta patients (introduced 2009)
- Direct MD and practice interventions for higher risk cases

TPP Alberta
TRACKED PRESCRIPTION PROGRAM

TPP Member Organizations

Alberta College of Pharmacy
ALBERTA MEDICAL ASSOCIATION
Alberta
Alberta Health Services
College & Association of Registered Nurses of Alberta
ALBERTA PHARMACISTS' ASSOCIATION
College of Podiatric Physicians of Alberta
alberta dental association & college
cpsa
COLLEGE OF PHYSICIANS & SURGEONS OF ALBERTA
ABVMA
Alberta Veterinary Medical Association

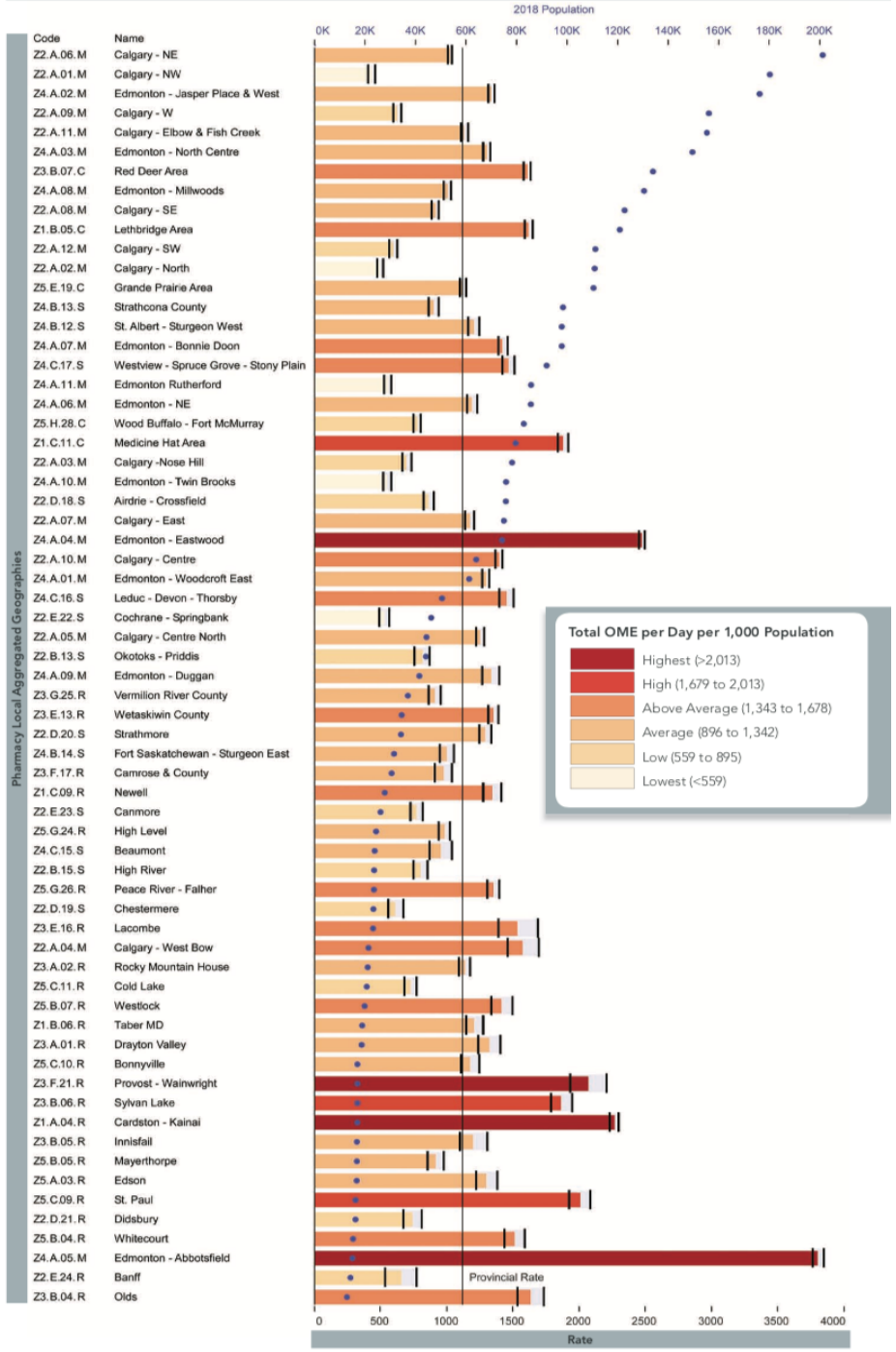
Data Sources Used Today



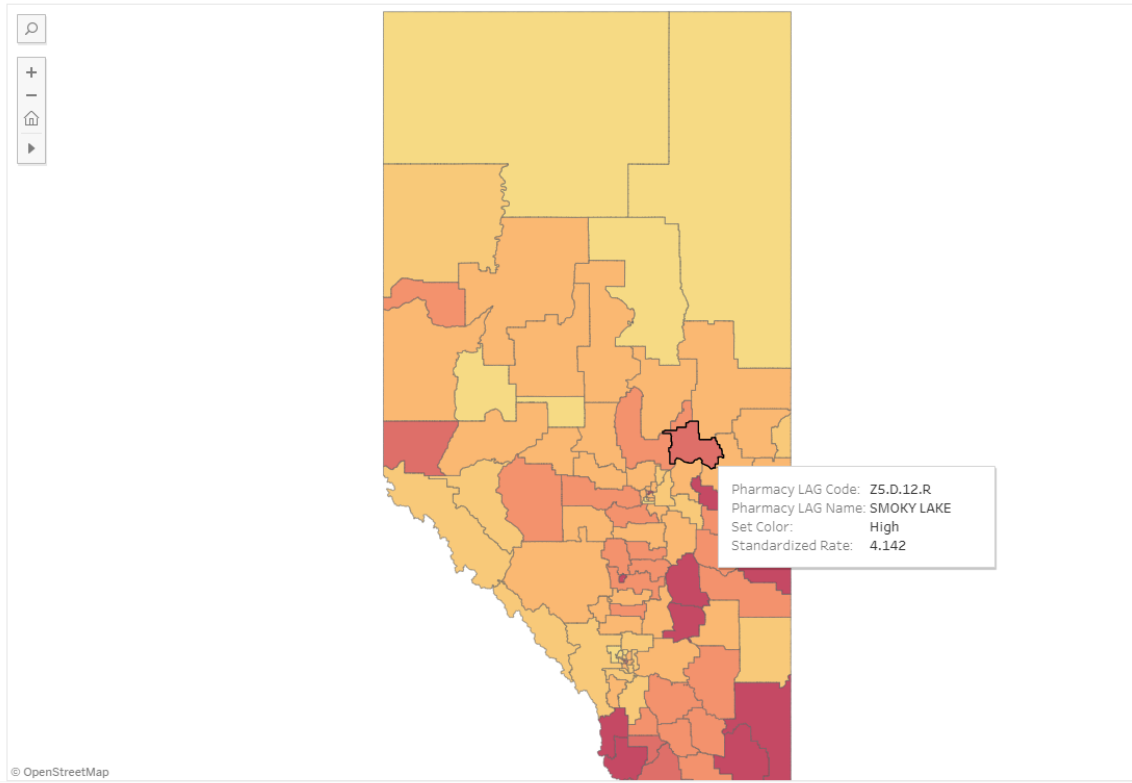
Aspects of our Work

Atlases – Population Trends and Profiling

Figure 6a. Age and Sex Standardized, Total OME per Day per 1,000 Population, by Pharmacy Local Aggregated Geographies, 2018*



Age and Sex Standardized Rate, Opioid Patients Who Received 90 OME+ per Day per 1000 Population by Pharmacy Local Aggregated Geography



Select a variable to display
Opioid Patients Who Receive...

Year
2019

Zone
- (All)
- Z1 South
- Z2 Calgary
- Z3 Central
- Z4 Edmonton
- Z5 North

Category
- Highest
- High
- Above Average
- Average
- Low
- Lowest

There is a downward trend at all dosage levels since 2016
The pattern is even stronger with higher dosages

Figure 3. Opioid **Patients** by Dose, 2014-2018

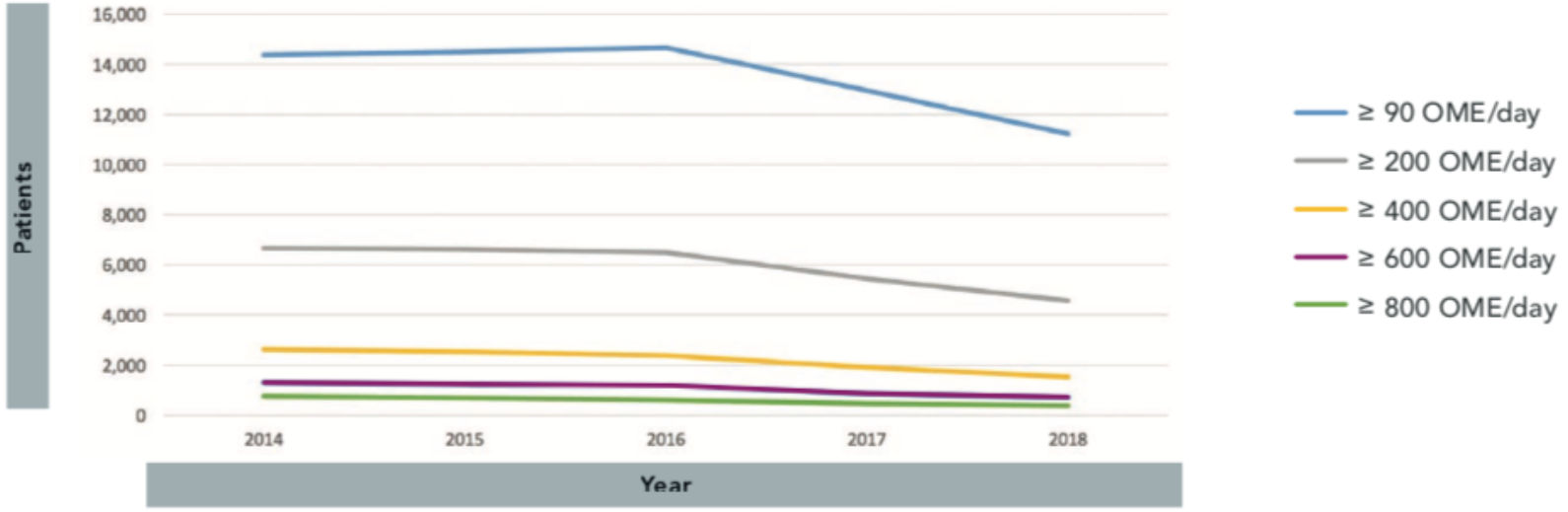
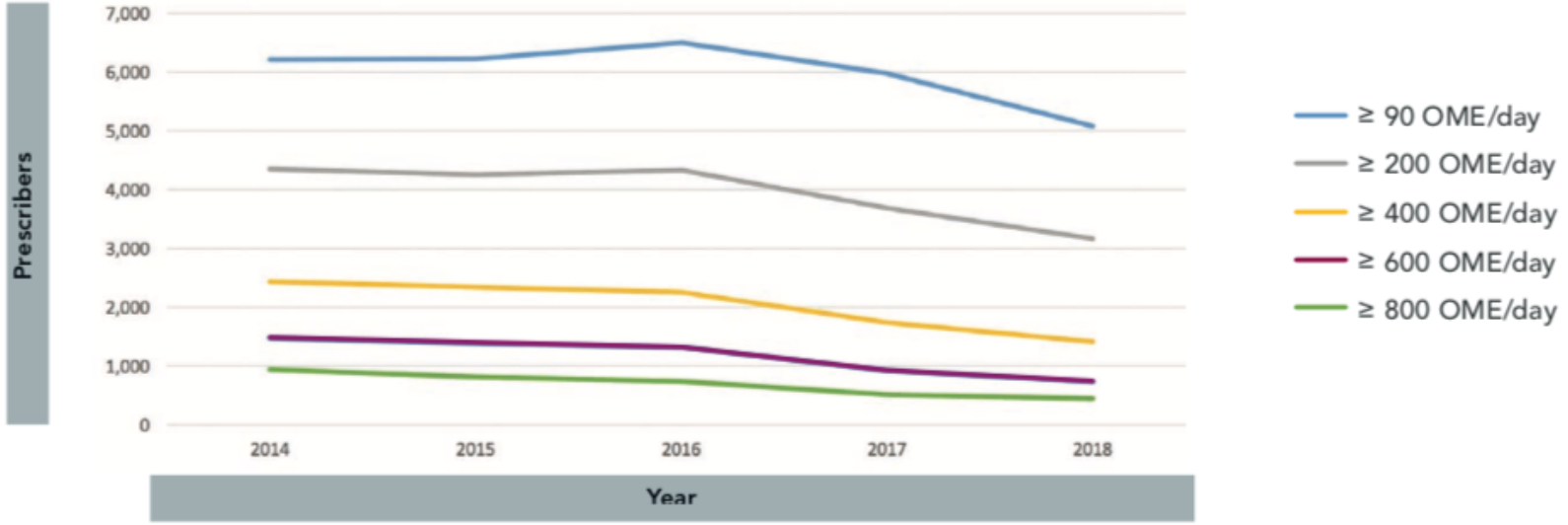


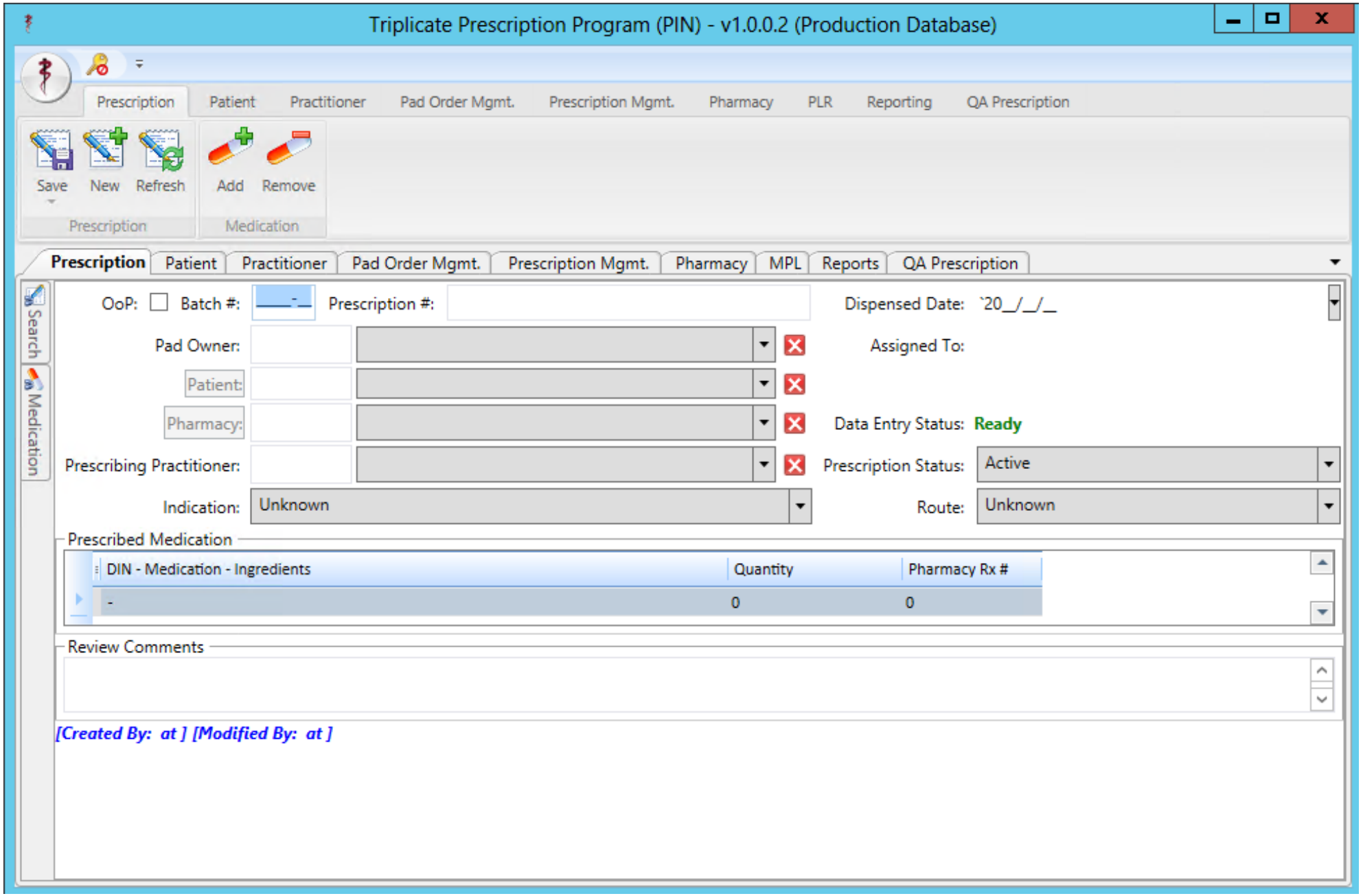
Figure 4. Opioid **Prescribers** by Dose, 2014-2018



Aspects of our Work

Atlases – Population Trends and Profiling

TPP Application – Management of TPP Data and Ops


Triplicate Prescription Program (PIN) - v1.0.0.2 (Production Database)
Prescription
Patient
Practitioner
Pad Order Mgmt.
Prescription Mgmt.
Pharmacy
PLR
Reporting
QA Prescription
Save
New
Refresh
Add
Remove
Prescription
Medication
Prescription
Patient
Practitioner
Pad Order Mgmt.
Prescription Mgmt.
Pharmacy
MPL
Reports
QA Prescription
Search
Medication
OoP:
Batch #:
Prescription #:
Dispensed Date:
`20__/__/__
Pad Owner:
Assigned To:
Patient:
Pharmacy:
Data Entry Status:
Ready
Prescribing Practitioner:
Prescription Status:
Active
Indication:
Unknown
Route:
Unknown
Prescribed Medication
DIN - Medication - Ingredients
Quantity
Pharmacy Rx #
-
0
0
Review Comments
[Created By: at] [Modified By: at]

Aspects of our Work

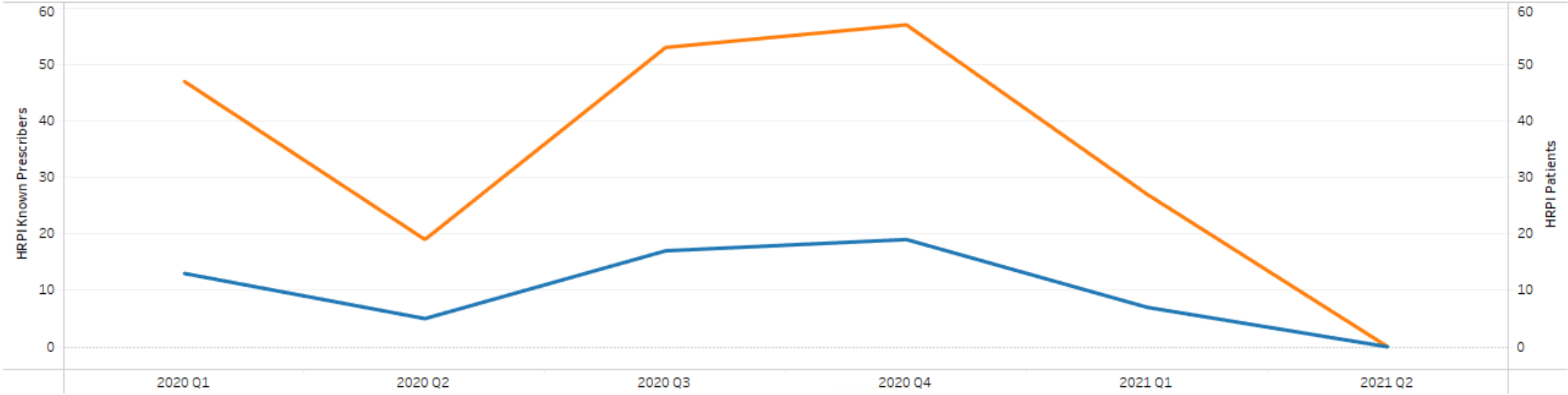
Atlases – Population Trends and Profiling

TPP Application – Management of TPP Data and Ops

SLICE – Patient and Prescriber Profiling

HRPI500 Patient and Prescriber Counts

Quarters to Display: Last 17 quarters



Select a patient or prescriber to display profile

Data Source: PIN, TPP

Year: 2020

Quarter: Q2

Select Number of Prescribers: 3

Select Number of Pharmacies: 3

Select OME/day cut off for HRPI: 500

Prescriber Type: (All)

OTC Codeine: Not available.

HRPI Known Prescribers

HRPI Patients

HRPI500 Patient-Prescriber Cases for Q2 2020

Cases: 23 (includes unknown prescribers)

PHN	Patient Name	Prescriber Name	Registration Number	Prescriber Type	Specialty	Total # Known Prescribers per Patient	Total # Pharmacies/Patient	Prescriber OME/day	Total Patient OME/day
UL110898600	Wilzak, Dunte	Rawicki-Gielniak, Agapita	021936	MD	Radiation Oncology	5	3	226	695
		Rejza, Flara	019940	MD	Family Medicine (Palli..	5	3	263	695
		Sudzinski-Parada, Michael	028896	MD	Family Medicine	5	3	16	695
		Wedkiewicz, Eura	4390	MD	Family Medicine	5	3	180	695
		Wiechec, Melinda	227	MD	Radiation Oncology	5	3	11	695
UL272848911	Markiefka-Zlotos, Auline	Prozorow, Margretta	027927	MD	Family Medicine	6	3	37	542
		Przegienda, Boyce	015736	MD	Family Medicine	6	3	237	542
		Remczynski, Bertram	008598	MD	Addiction Medicine	6	3	116	542
		Repa, Hildagarde	029039	MD	Family Medicine	6	3	5	542
		Staszecki, Belle	026304	NP	None	6	3	9	542
		Wodara, Ednah	100777	MD	Family Medicine	6	3	137	542

Click the orange buttons below to view more information

Prescriber Summary

Year - Quarter: 2020-Q3

Registration Number: 017748

Prescriber Name	Registration Number	Practitioner Geography	Prescriber Age	Prescriber Type	Specialty
Wojczal, Lindsey	017748	CALGARY - WEST BOW	Null	MD	Family Medicine

Dispenses	80
Total Patients	64
ABX Patients	47
Active ABX Prescriptions	55
ABX DDDs	3.83
Benzo Patients	6
Active Benzo Prescriptions	7
BDZ DDDs	2.19
Opioid Patients	11
Active Opioid Prescriptions	13
OME/day	42
Stimulant Patients	0
Active Stimulant Prescriptions	0
Gabapentinoid Patients	0
Active Gabapentinoid Prescriptions	0
BDZ and Opioid Patients	0
Pharmacies	41
Max. Single Patient BDZ DDDs	0.99
Max. Single Patient OME/Day	19.8
Distinct count of OAT Patients	2.00
Highest Total Dispenses From One Pharmacy	8.00

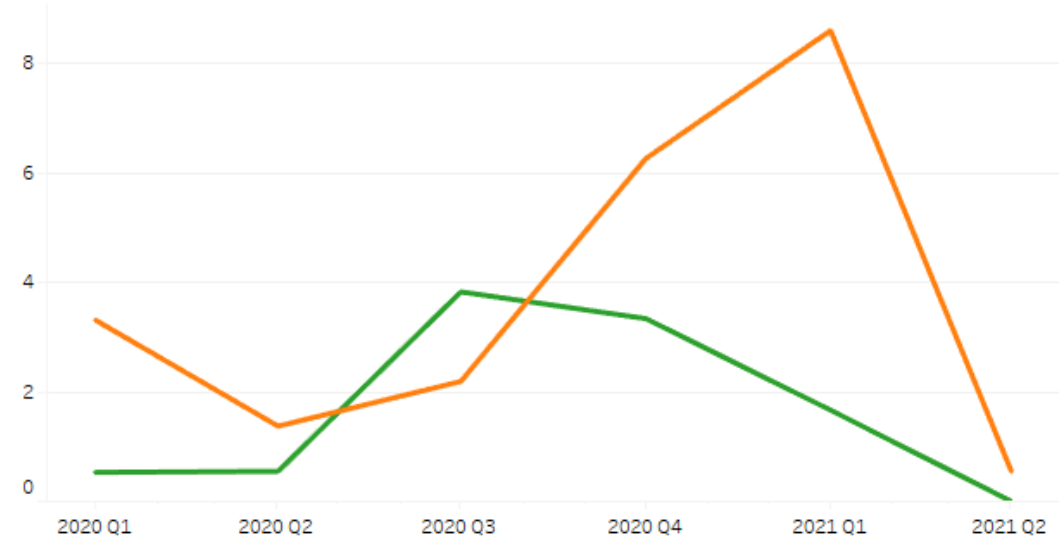
Dispense and Patient Proportions

View Pharmacies

Dosage Trends by Long/Short Opioid, Benzo, ABX

Quarters to Display: Last 17 quarte...

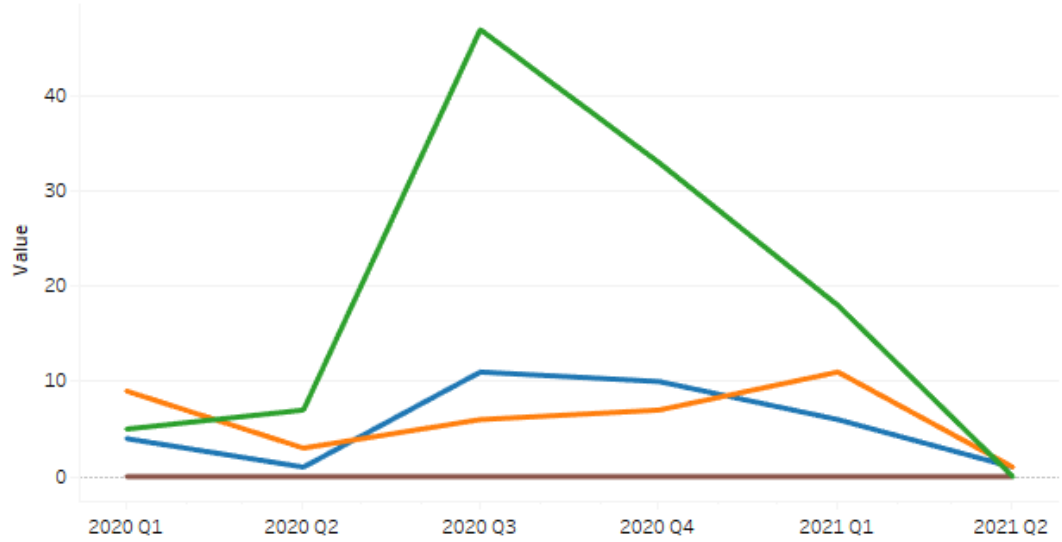
Dosage Measure
- Prescriber BDZ DDDs
- Prescriber ABX DDDs



Trends of Patients

Quarters to Display: Last 17 quarters

Measure Names
- ABX Patients
- Benzo Patients
- Opioid Patients
- Stimulant Patients
- Gabapentinoid Patie..
- BDZ and Opioid Pati..



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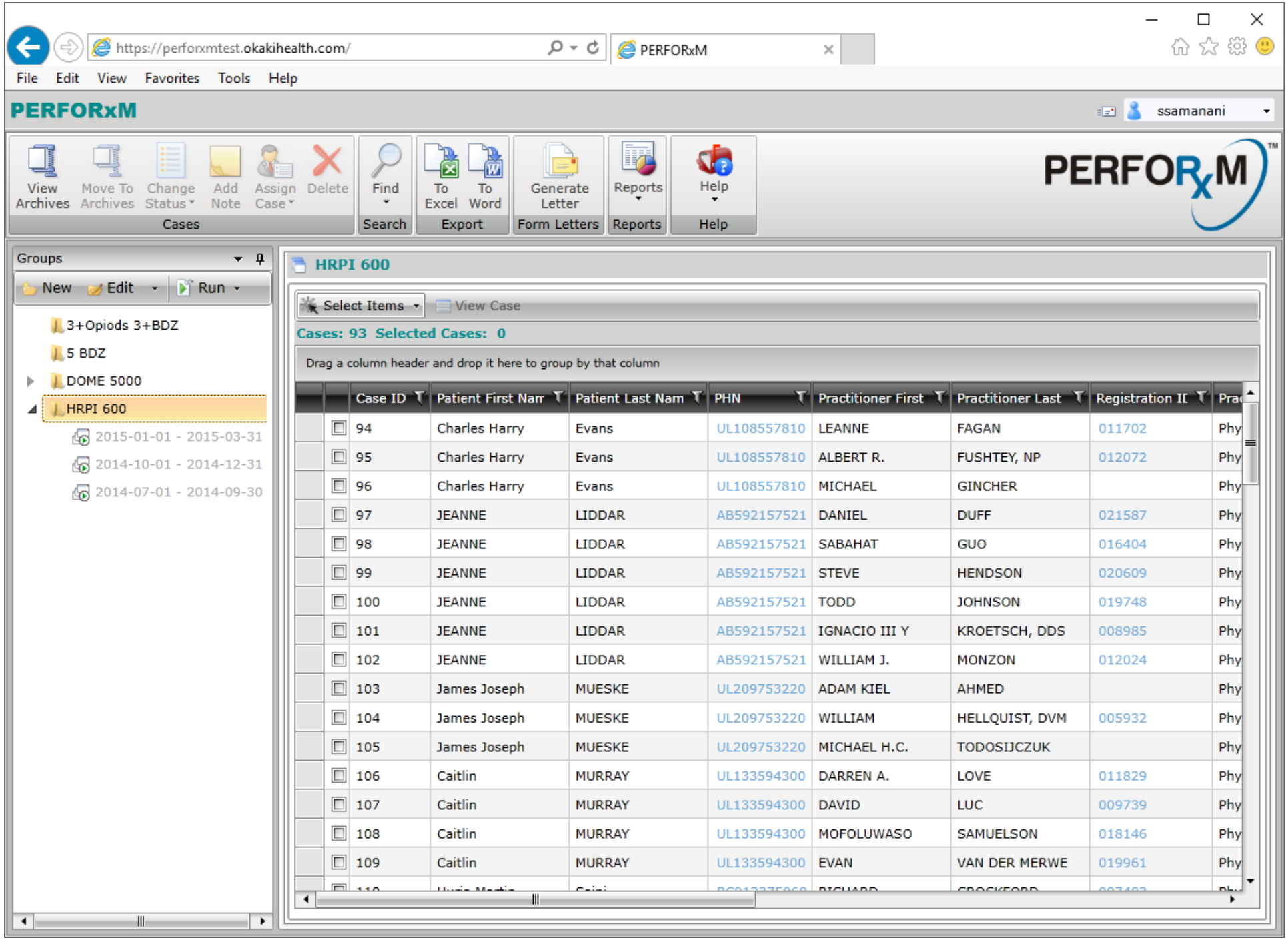
SLICE – Patient and Prescriber Profiling

PERFORxM – High Risk Case Management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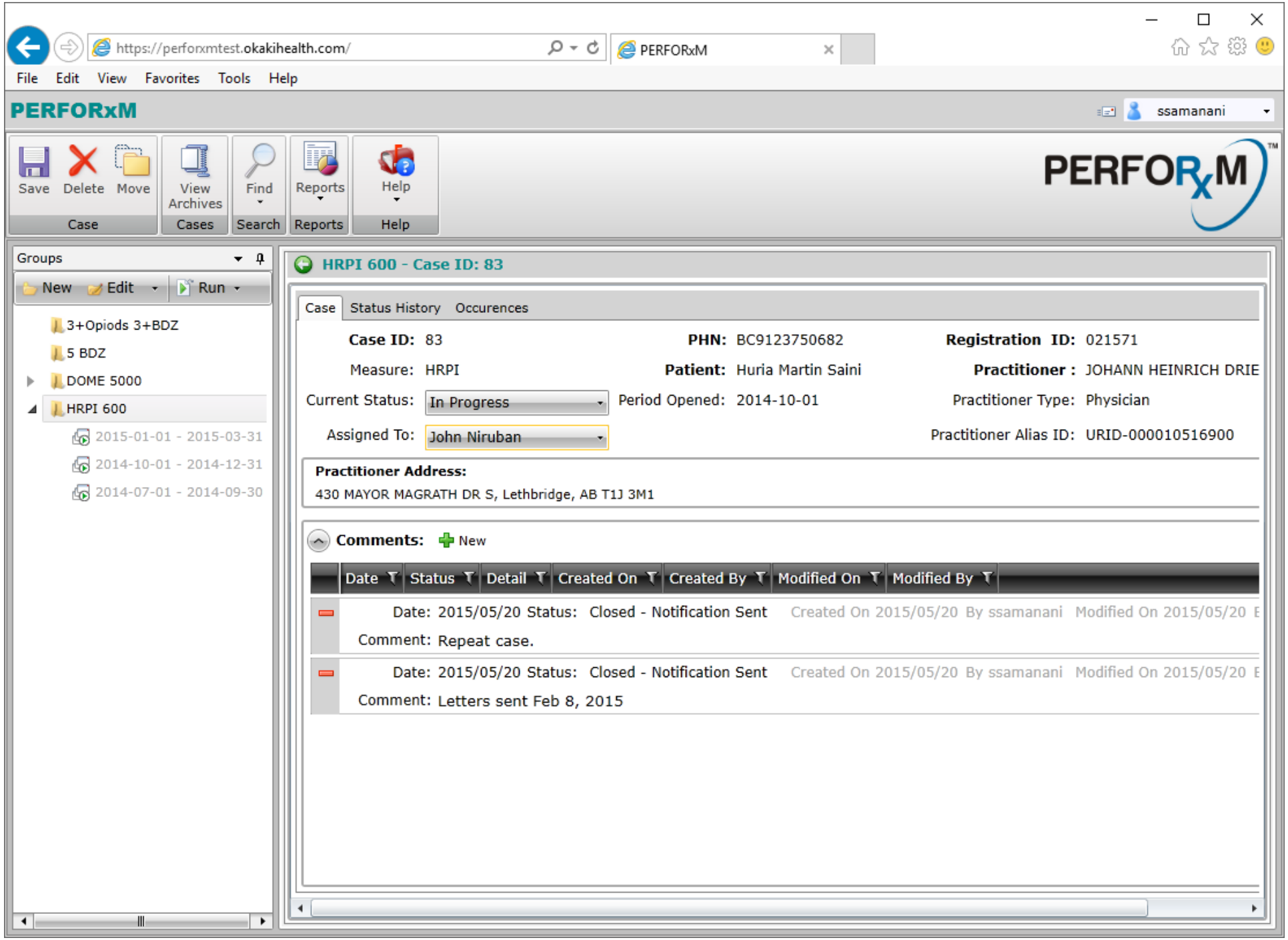
PERFORxM
File Edit View Favorites Tools Help
PERFORxM
ssamanani
View Archives
Move To Archives
Change Status
Add Note
Assign Case
Delete
Cases
Find
Search
To Excel
To Word
Export
Generate Letter
Form Letters
Reports
Reports
Help
Help
PERFORxM
Groups
New
Edit
Run
3+Opiods 3+BDZ
5 BDZ
DOME 5000
HRPI 600
2015-01-01 - 2015-03-31
2014-10-01 - 2014-12-31
2014-07-01 - 2014-09-30
HRPI 600
Select Items
View Case
Cases: 93 Selected Cases: 0
Drag a column header and drop it here to group by that column
Case ID
Patient First Nam
Patient Last Nam
PHN
Practitioner First
Practitioner Last
Registration II
94 Charles Harry Evans UL108557810 LEANNE FAGAN 011702
95 Charles Harry Evans UL108557810 ALBERT R. FUSHTEY, NP 012072
96 Charles Harry Evans UL108557810 MICHAEL GINCHER
97 JEANNE LIDDAR AB592157521 DANIEL DUFF 021587
98 JEANNE LIDDAR AB592157521 SABAHAT GUO 016404
99 JEANNE LIDDAR AB592157521 STEVE HENDSON 020609
100 JEANNE LIDDAR AB592157521 TODD JOHNSON 019748
101 JEANNE LIDDAR AB592157521 IGNACIO III Y KROETSCH, DDS 008985
102 JEANNE LIDDAR AB592157521 WILLIAM J. MONZON 012024
103 James Joseph MUESKE UL209753220 ADAM KIEL AHMED
104 James Joseph MUESKE UL209753220 WILLIAM HELLQUIST, DVM 005932
105 James Joseph MUESKE UL209753220 MICHAEL H.C. TODOSIJCZUK
106 Caitlin MURRAY UL133594300 DARREN A. LOVE 011829
107 Caitlin MURRAY UL133594300 DAVID LUC 009739
108 Caitlin MURRAY UL133594300 MOFOLUWASO SAMUELSON 018146
109 Caitlin MURRAY UL133594300 EVAN VAN DER MERWE 019961


https://perforxmtest.okakihealth.com/
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File Edit View Favorites Tools Help
PERFORxM
ssamanani
Save Delete Move
Case
View Archives
Cases
Find
Search
Reports
Reports
Help
Help
PERFORxM
Groups
New Edit Run
3+Opiods 3+BDZ
5 BDZ
DOME 5000
HRPI 600
2015-01-01 - 2015-03-31
2014-10-01 - 2014-12-31
2014-07-01 - 2014-09-30
HRPI 600 - Case ID: 83
Case Status History Occurences
Case ID: 83
PHN: BC9123750682
Registration ID: 021571
Measure: HRPI
Patient: Huria Martin Saini
Practitioner : JOHANN HEINRICH DRIE
Current Status: In Progress
Period Opened: 2014-10-01
Practitioner Type: Physician
Assigned To: John Niruban
Practitioner Alias ID: URID-000010516900
Practitioner Address:
430 MAYOR MAGRATH DR S, Lethbridge, AB T1J 3M1
Comments: New
Date Status Detail Created On Created By Modified On Modified By
Date: 2015/05/20 Status: Closed - Notification Sent
Created On 2015/05/20 By ssamanani
Modified On 2015/05/20
Comment: Repeat case.
Date: 2015/05/20 Status: Closed - Notification Sent
Created On 2015/05/20 By ssamanani
Modified On 2015/05/20
Comment: Letters sent Feb 8, 2015

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MD Snapshot – Individualized MD Practice Information

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Test, Prescriber

Registration Number:
tableau-admin

MDsnapshot Prescribing

Quick links to summaries and resources:

Click on the menu in the top left to see other dashboard views and more

- Opioid Naive Summary
- Opioid Summary
- Benzodiazepine Summary
- Antibiotic Summary
- Opioid Trends
- Benzodiazepine Trends
- Antibiotic Trends
- Patients by Drug Ingredient
- Supporting Material
- View Full Prescribing Snapshot

This snapshot was generated with data current as of October 20, 2023.
Data for the most recent quarter is visible three weeks after the last day of the quarter.

CPSA Analytics Prescribing Snapshot View Full Prescribing Snapshot Practice Checkup Sign Out

MDsnapshot Prescribing

Test, Prescriber

Date: 2022-Q3

Comparator Group: Specialty

Three Month Prescribing Snapshot: Antibiotics[1]

	Your Practice	Comparator Group Median[2]	Your Percentile
Patient(s) receiving antibiotics prescribed by you	322	322.00	322.0
Total antibiotic DDDs prescribed[3]	322.00	322.00	322.0
Antibiotic DDDs/patient[3]	322.00	322.00	322.0
Total antibiotic prescriptions from you	322	322.00	322.0
Average antibiotic prescriptions per day prescribed by you[4]	322.00	322.00	322.0
Average number of prescriptions per patient receiving an antibiotic[4]	322.00	322.00	322.0
Patient(s) receiving three or more different antibiotics[5]	2		
Patient(s) receiving antibiotics from three or more prescribers[5]	2		

(1) Analytic group includes drug dispenses for antibiotics, excluding topical formulations.
(2) Information from your annual renewal (RIF) determines your assignment to a comparator group. In addition, if you belong to a Primary Care Network (PCN) and have selected the PCN comparator group, your prescribing practice is compared to physicians identified as members of your PCN. Comparator group members may have similar qualifications, clinical practices, or prescribing distribution, but variations at an individual level are possible. Please take your context into consideration as you review and interpret the information provided.
(3) The DDD of a drug is the average daily maintenance dose for its primary use in adults. Total DDDs is the sum of the DDDs for all antibiotics dispensed under your name in the quarter, except topical formulations and where a DDD is not assigned, e.g. otic and ophthalmic preparations. DDDs serves as a proxy for the actual dose and days of treatment. Doses are measured in multiples of Defined Daily Doses (DDDs). The measure must be interpreted in the context of individual practice type (e.g. episodic vs. chronic), typical number of patients seen per day and practice scope (e.g. Infectious Diseases).
(4) Includes dispenses only. Refills or Part-fills on a given prescription are individually counted. Prescriptions that the patient does not fill are not included.
(5) Multiple prescriber types, including other physicians, pharmacists, nurse practitioners and dentists, may contribute to this antibiotic measure.

This snapshot was generated with data current as of October 20, 2023.
Data for the most recent quarter is visible three weeks after the last day of the quarter.

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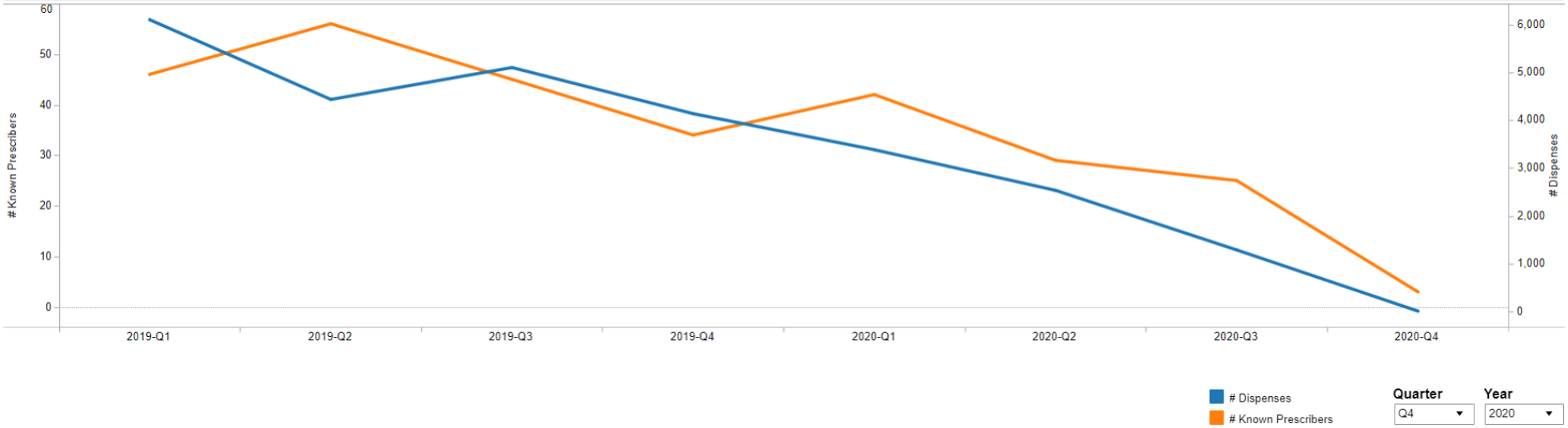
SLICE – Data Quality Assurance

Prescribers and Prescriptions of Deceased Physicians



Dispenses of Deceased Physicians in Q4 2020

Dispenses: 9

Prac Death Date	Prescriber Name	Registration Number	Dispense Date	Brand Name	Patient Name	PHN	Pharmacy Licence Number	Pharmacy Name	Pharmacy Phone Number	Days Between Dispense Date and Prescriber Death Date

Number of Reversals After 14 Days by Year and Quarter

Aspects of our Work

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PERFORxM – High Risk Case Management

MD Snapshot – Individualized MD Practice Information

SLICE – Data Quality Assurance

Ad Hoc Requests – Anything Not Captured Above

Use the filters to change the line graphs below independently

OAT Modalities
(Multiple values)

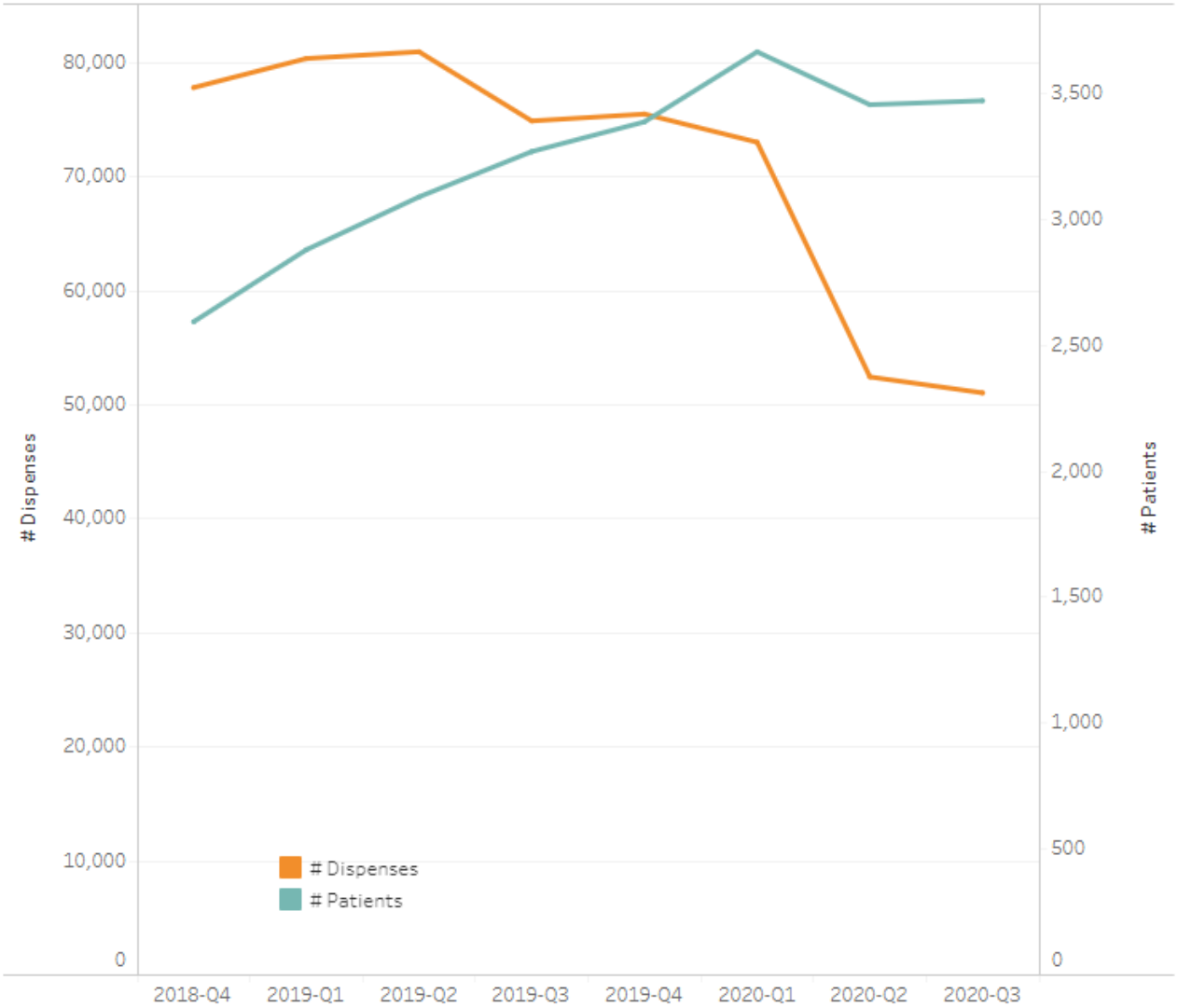
Injectables
☑ Non-Injectable

Number of Quarters to Display
Last 8 quarters

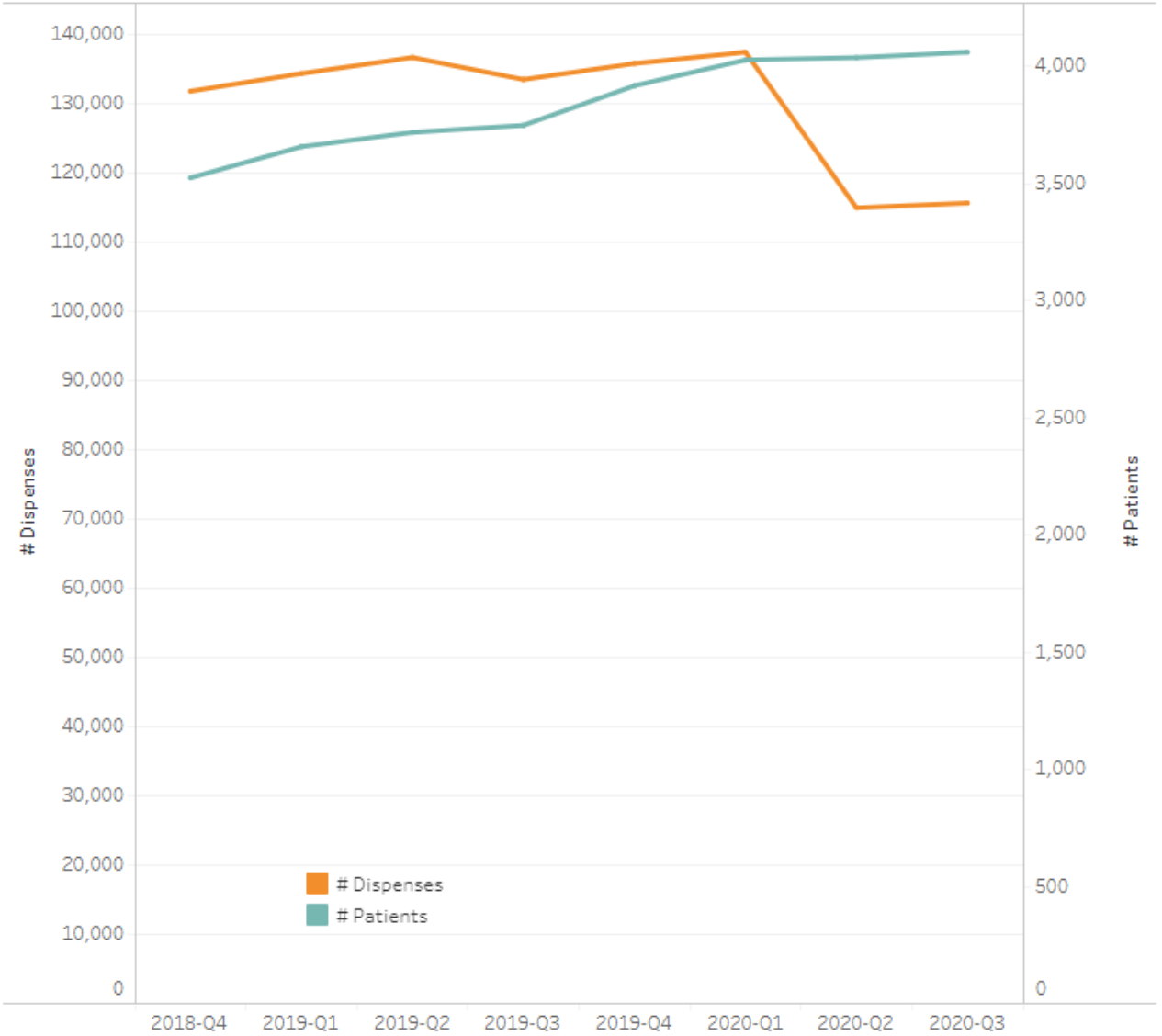
OAT Modalities
Methadone

Injectables
☑ Non-Injectable

Patients and Dispenses Over Time for Buprenorphine - Implant, Buprenorphine - Subcutaneous, Buprenorphine/Naloxone



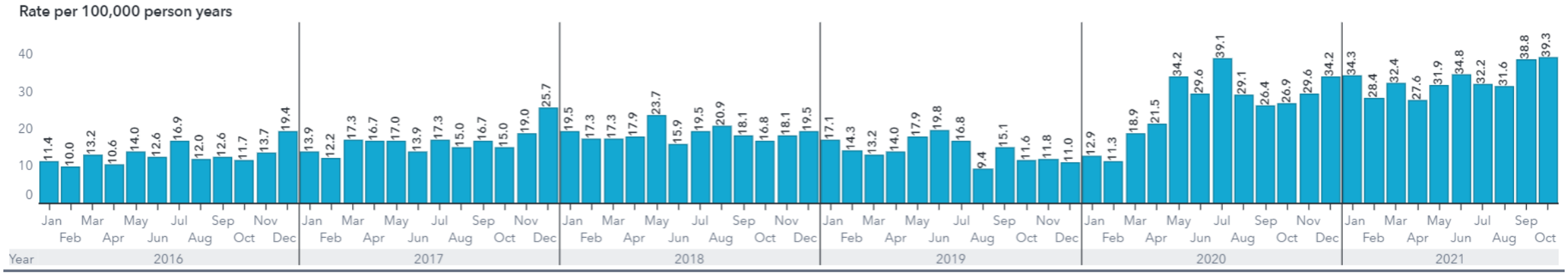
Patients and Dispenses Over Time for Methadone



Alberta

Any opioid

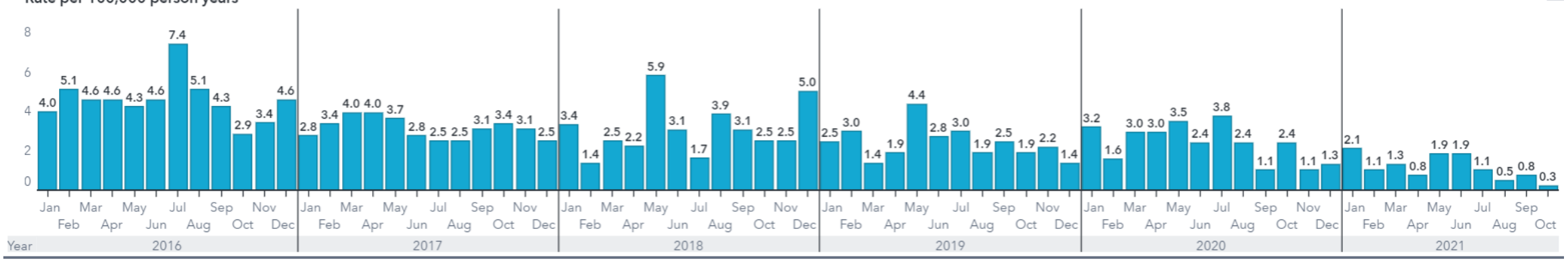
Rate of drug poisoning deaths per 100,000 person years by month



Alberta

Pharmaceutical opioids

Rate of drug poisoning deaths per 100,000 person years by month



Alberta Substance Use Surveillance Data

Alberta's Prescription Monitoring Programs

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- The goal is to identify patients at risk of adverse outcomes and their associated prescribers, and to intervene to improve safe/appropriate practice and reduce patient risk.
- Since 2008, TPP Alberta and the CPSA have continuously enhanced their capacity to use data to support safe prescribing and professional regulation.

Guideline-Based Risk Assessment

- 2019 Centers for Medicare & Medicaid Services (CMS) uses these safety measures to identify high risk opioid use from administrative health data sets:
    - >120 OME/day for >90 days, AND
    - 4 or more opioid prescribers and pharmacies, AND
    - Concurrent use of opioids and benzodiazepines for >30 day
- 2017 Canadian opioid prescribing guidelines for non-cancer pain:
    - Avoid use if history of substance use disorder or mental illness
    - >90 OME/day is high risk

Outcome-Specific Risk Prediction

- Framingham Heart Study (1976) – 8491 participants between 30 and 74 years of age, from the town of Framingham MA, who were free of cardiovascular disease (CVD) at the time of entering the study, were followed for development of a first CVD event.
- Framingham Risk Score estimates the 10 year risk of CVD events (e.g., heart attack, stroke, peripheral vascular disease, heart failure). Patients at higher risk warrant more aggressive preventative therapy.
- The original model achieved good discrimination (C statistic 0.763 men and 0.793 women) and calibration.
- **Widely adopted around the world**

The Absolute CVD Risk/Benefit Calculator

Framingham
US Data, 10 Year Risk
Heart attacks + angina/coronary insufficiency + heart failure + strokes + intermittent claudication

QRISK®2-2014
UK Data, 10 Year Risk
Heart attacks + strokes

ACC/AHA ASCVD
US Data, 10 Year Risk
CHD death + nonfatal heart attacks + fatal/nonfatal strokes

PREDICT
New Zealand Data, 5 Year Risk
Heart attacks + angina + heart failure + strokes/TIAs + peripheral vascular disease

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Age
51 years

Gender
✓ Male | Female

Smoker
Yes | ✓ No
CVD risk is reversed after 5-10 years of no smoking

Diabetes
Yes | ✓ No

Systolic Blood Pressure
120 mmHg
Enter present blood pressure regardless of treatment
120 mmHg is used for baseline risk

On treatment for BP
Yes | ✓ No
Click YES if taking blood pressure medication
Only applies if SBP is greater than 120 mmHg

Total Cholesterol
3 mmol/L
Cholesterol should be prior to drug treatment
3 mmol/L is used for baseline risk.

Relative Benefit: 0%

Benefit often has *nothing* to do with the effect on the surrogate marker. At present, you can only select one intervention at a time.

- Physical Activity
- Mediterranean Diet vs Low fat
- Vitamin/Omega-3 supplements
- BP meds (not atenolol/doxazosin)
- Low-mod intensity statins
- High intensity statins
- Fibrates
- Niacin
- Ezetimibe
- Metformin
- Sulfonylureas
- Insulins
- Glitazones
- GLPs
- DPP-4s
- Meglitinides
- SGLT2
- Smoking Cessation
- ASA

Benefit Estimate Details

Risk Time Period

10 years

	94.7%	No event
	5.3%	Total with an event
	0.0%	Number who benefit from treatment
NNT	∞	Number needed to treat

https://cvdcalculator.com/

Some Issues With Prediction Models

- Study population is not similar to yours (middle class, urban, Caucasians)
- Omit important predictive factors (e.g., physical activity, family history, SES)
- Does not take into account risk or treatment over time (e.g., BP medications)
- Crude and imprecise thresholds (few risk categories for entire population)
- The risk applies to the group, and does not provide a specific individual's risk
- Expensive to update or recreate for your specific population
- **Population paradox – a preventive measure brings large benefits to the community but offers little to each participating individual.**

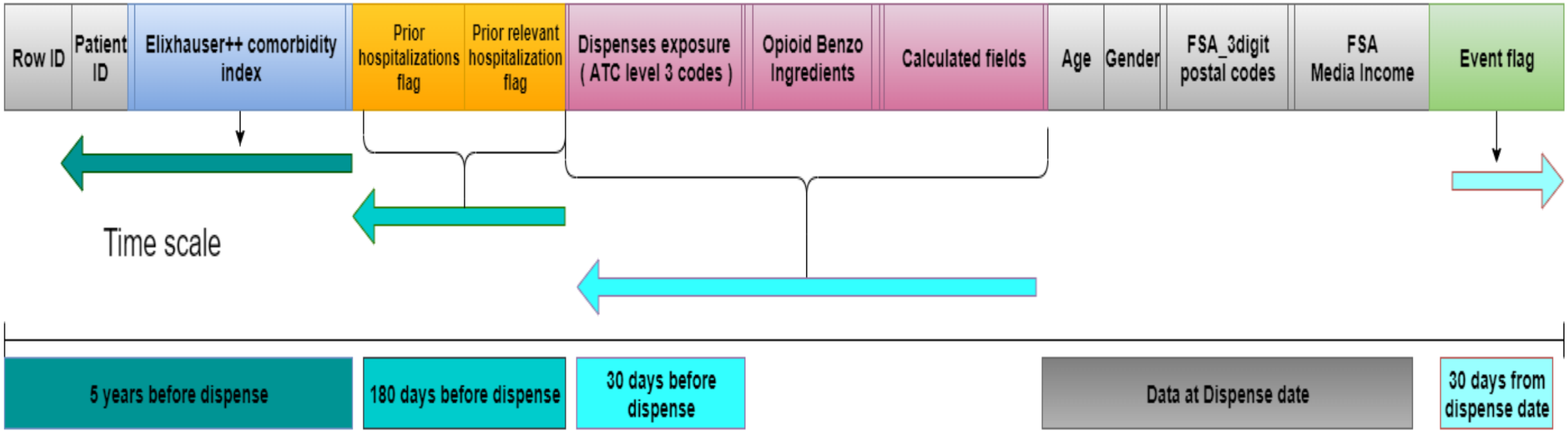
"Prophesy is a good line of business but it is full of risks." – Mark Twain

Project Objective

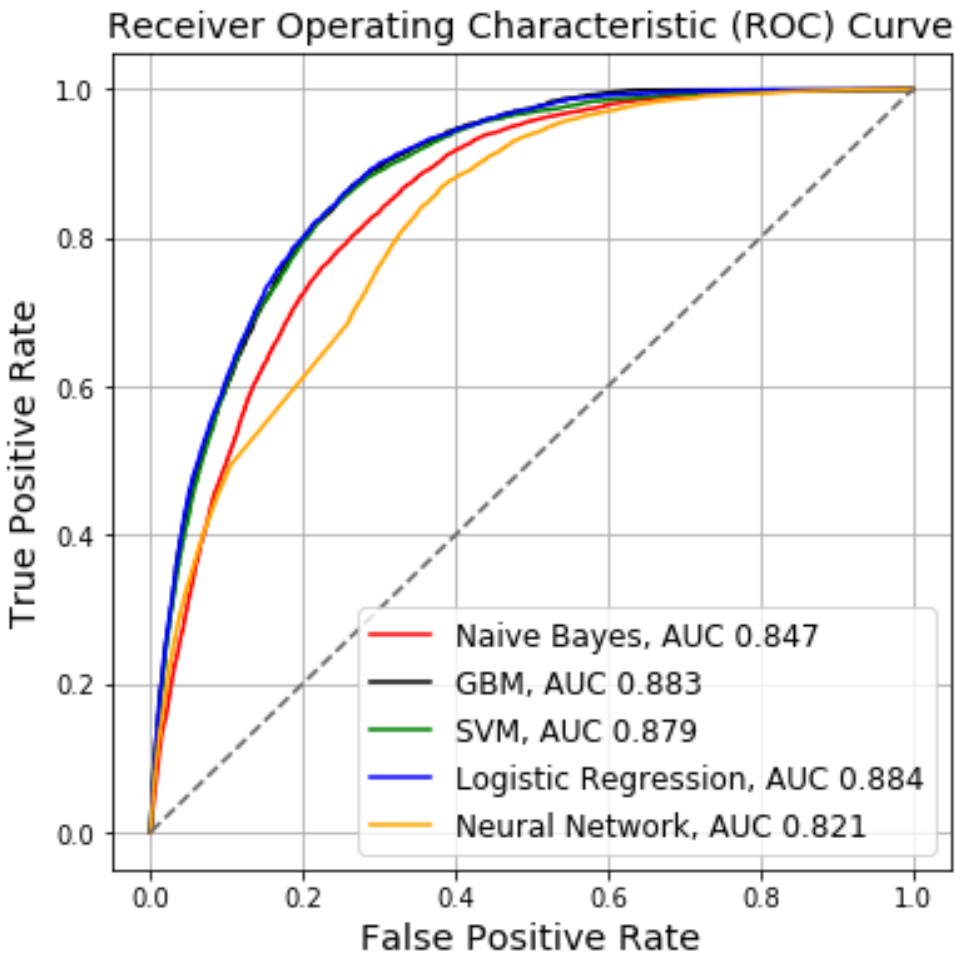
- Apply ML methods to AB's healthcare administrative databases to develop a population-based model to predict 30-day risk of drug poisoning related emergency visit, hospitalization, or death at the time of an opioid dispense.
- Explore potential predictive factors ('features') from MD claims, Rx dispensations, hospitalizations, emergency department visits and death data.

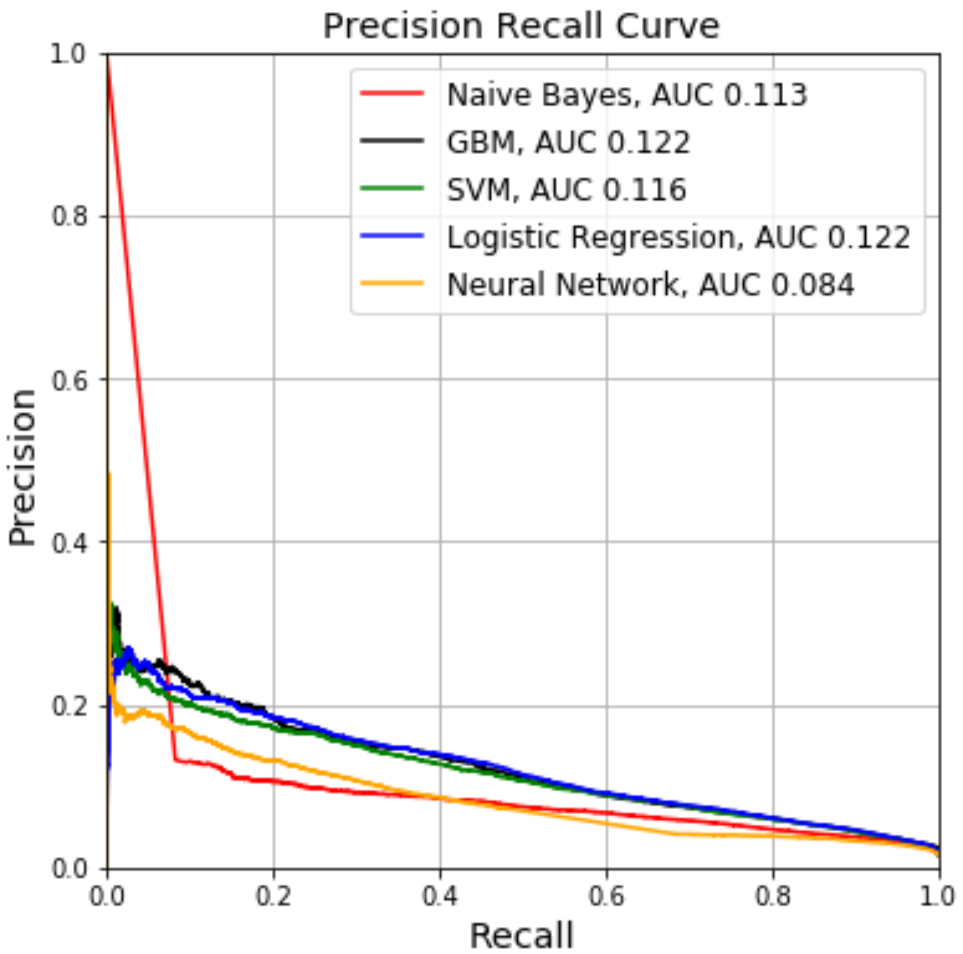
Database	Records
Patients who received at least 1 opioid 2012-2018	1,794,606
Pharmaceutical Information Network (PIN)	255,446,107
Practitioner Claims (Claims)	164,221,577
National Ambulatory Care Reporting System (NACRS)	34,360,160
Discharge Abstract Database (DAD)	1,657,230
Vital statistics (VS)	93,098

Predictive Features in Relation to Outcomes



ROC vs PR curves





2018 Model Performance Using Centers for Medicare & Medicaid Services (CMS) Guidelines

Condition	Sensitivity	Specificity	AUC
High dose and Multiple doctors and multiple pharmacies and concurrency	0.001	0.999	0.500
High dose or Multiple doctors and multiple pharmacies or concurrency	0.472	0.681	0.583
High dose or Multiple doctor or multiple pharmacies or concurrency	0.607	0.636	0.622
>120 OME/day for >90 days - Highdosage	0.057	0.950	0.504
(>4 doctors) and (>4 pharmacies)	0.085	0.972	0.529
Concurrency (Opioid with BDZ over 30 days)	0.407	0.733	0.570
Multiple pharmacies	0.120	0.956	0.538
Multiple doctors	0.291	0.889	0.590
(>4 doctors) or (>4 pharmacies)	0.326	0.872	0.599

2018 Model Performance using Canadian Practice Guidelines

Guideline	Sensitivity	Specificity	AUC
Hx of mental disorder only	0.92	0.32	0.626
Substance abuse only	0.99	0.38	0.688
OME/day >90 only	0.14	0.88	0.517
(Mental disorder and substance abuse) OR OME/day >90	0.92	0.48	0.702
Mental disorder and substance abuse AND OME/day >90	0.14	0.93	0.534
Mental disorder OR substance abuse OR OME/day >90	0.99	0.18	0.589

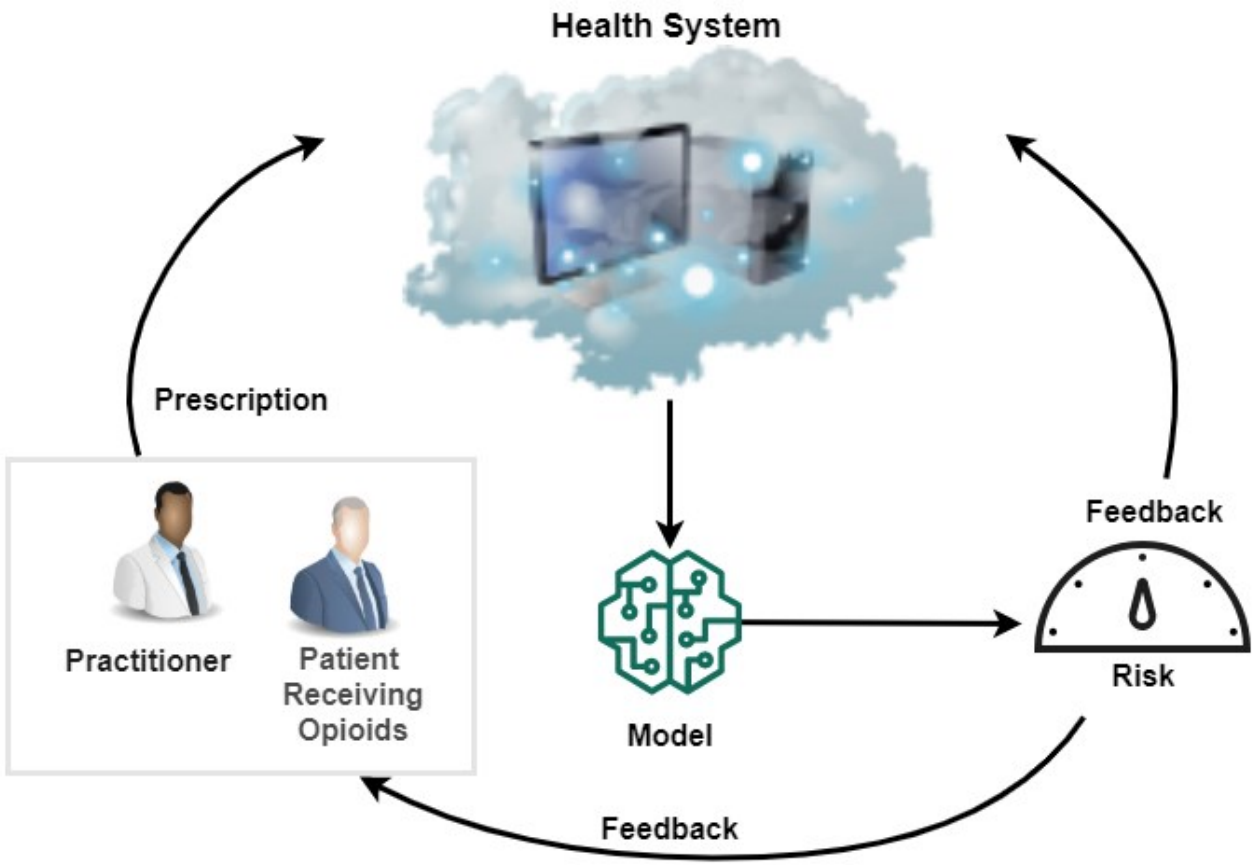
The Results

- "Machine learning classifiers, especially incorporating hospitalization and physician claims data, have better predictive performance compared with guideline or prescription history only approaches when predicting 30-day risk of adverse outcomes. Prescription monitoring programs and health departments with access to administrative data can use machine learning classifiers to effectively identify those at higher risk compared with current guideline-based approaches.“

- Sharma V, Kulkarni V, Eurich DT, Kumar L, Samanani S. Safe opioid prescribing: a prognostic machine learning approach to predicting 30-day risk after an opioid dispensation in Alberta, Canada. BMJ open. 2021 May 1;11(5):e043964.

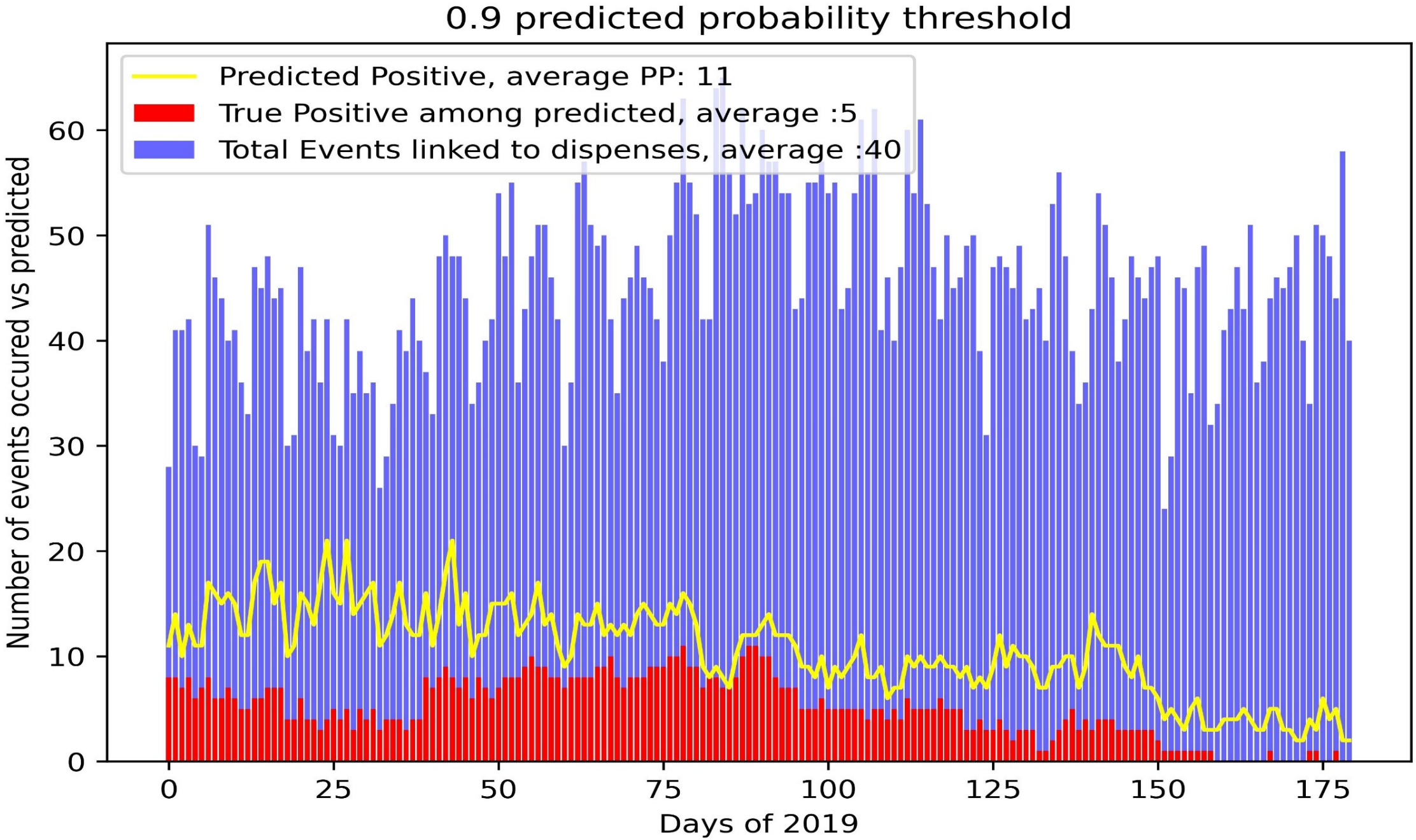
How would we apply this model in practice?

- As part of practice feedback?
- As part of population-based high risk case management?
- As part of clinical decision support?

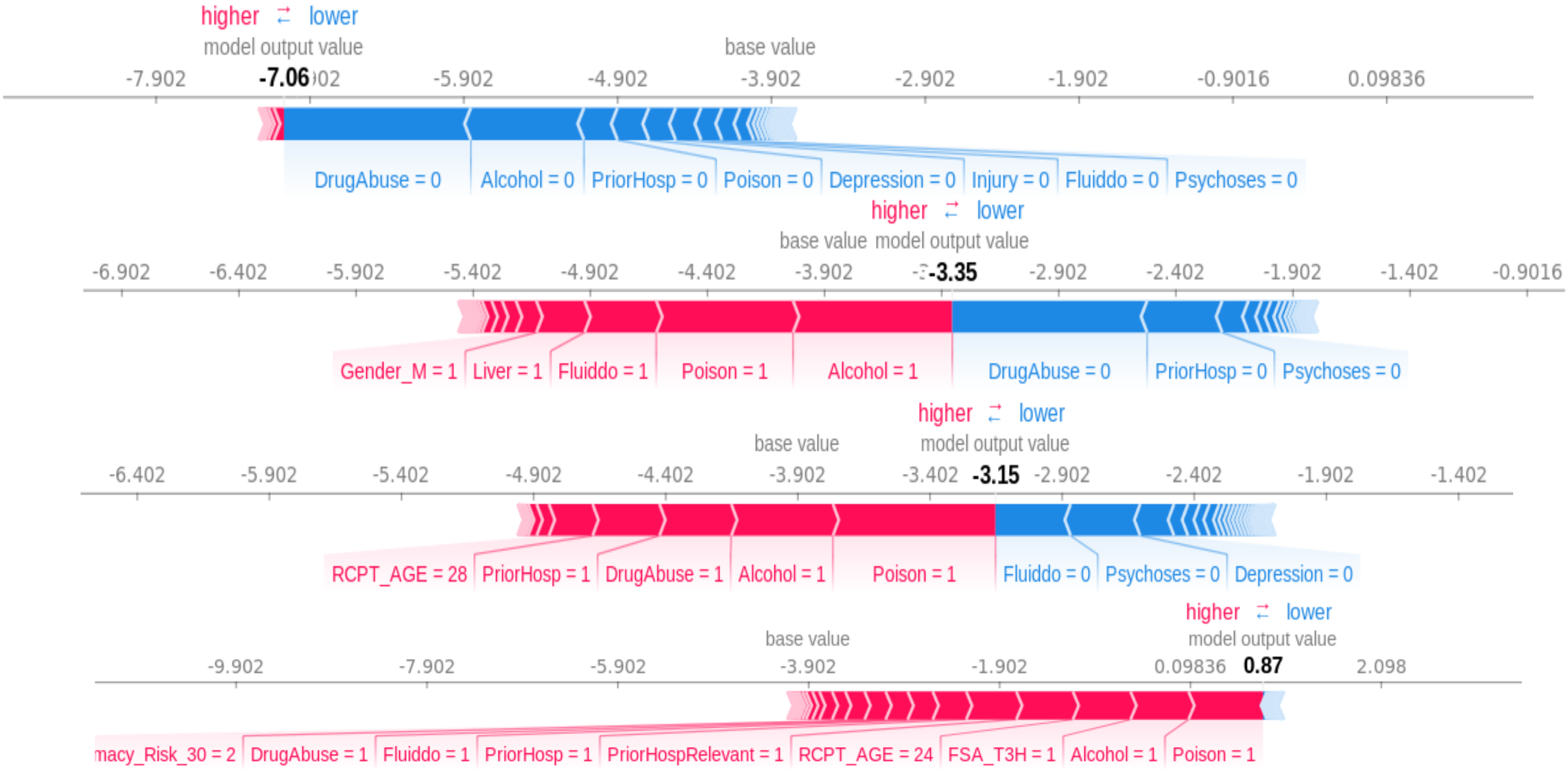


Daily identification of patients with new starts based on high-risk threshold

Threshold	PP	TP	FN	FP	TN	PPV	NPV	Sensitivity	Specificity	LR+
0	2098.81	39.93	0	2058.88	0	0.02		1	0	1
0.1	1508.97	39.37	0.56	1469.60	589.28	0.03	1.00	0.99	0.28	1.38
0.2	1015.76	38.30	1.63	977.46	1081.43	0.04	1.00	0.96	0.51	2.00
0.3	761.54	37.09	2.83	724.45	1334.43	0.05	1.00	0.93	0.63	2.60
0.4	604.34	35.45	4.48	568.89	1489.99	0.06	1.00	0.89	0.70	3.16
0.5	460.43	32.00	7.93	428.43	1630.46	0.07	0.99	0.81	0.78	3.82
0.6	300.12	26.64	13.29	273.48	1785.41	0.09	0.99	0.68	0.86	5.10
0.7	154.31	19.84	20.08	134.46	1924.42	0.14	0.99	0.51	0.93	7.74
0.8	56.89	11.94	27.99	44.95	2013.93	0.22	0.99	0.31	0.98	14.28
0.85	28.56	8.34	31.58	20.22	2038.67	0.29	0.98	0.22	0.99	22.69
0.9	10.60	5.05	34.88	5.55	2053.33	0.44	0.98	0.13	1.00	
0.95	1.88	1.28	38.64	0.60	2058.28	0.70	0.98	0.03	1.00	
1	0	0	39.93	0	2058.88		0.98	0	1	


0.9 predicted probability threshold
Predicted Positive, average PP: 11
True Positive among predicted, average :5
Total Events linked to dispenses, average :40
Number of events occured vs predicted
0
10
20
30
40
50
60
0
25
50
75
100
125
150
175
Days of 2019

Explaining Individual Predictions



Questions and Discussion

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