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Exploring Opportunities for RWE Generation Within a Hybrid Data Ecosystem

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Disclosures

Paul Reuscher and Seth Kuranz are both employees of Forian, Inc.

Introductions

Paul Reuscher

VP, Product Innovation

Seth Kuranz, PhD

RWE Principal

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Agenda

Background

RWE Generation Using Hybrid Claims Data

- Example 1: Progression to ESRD among Diabetic Kidney Disease Patients
- Example 2: Dialysis Treatment among Hospitalized COVID-19 Patients

Discussion and Questions

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Introduction to Forian

The Challenge	The Solution
A single RWD source provides a limited and incomplete view of a patient's healthcare journey	CHRONOS is a hybrid data ecosystem that combines RWD in a HIPAA-compliant manner to answer a range of life sciences-related questions.

CHRONOS

Forian's health system and healthcare provider solutions are enabled by Forian's proprietary data product, CHRONOS, which captures data for over 98% of all providers in the US

CHRONOS is a hybrid data ecosystem comprising medical and pharmacy claims including full provider details across clinicians, facilities, and pharmacies.

- Fully-integrated, proprietary, and privacy-compliant data
- 2.2M+ US healthcare providers
- Inclusive of all physician specialties, as well as PAs and NPs
- 6,000+ US hospitals and 100,000+ US healthcare facilities
- 9+ years of longitudinal patient data
- Integrated provider contact details (address, phone numbers, and email)

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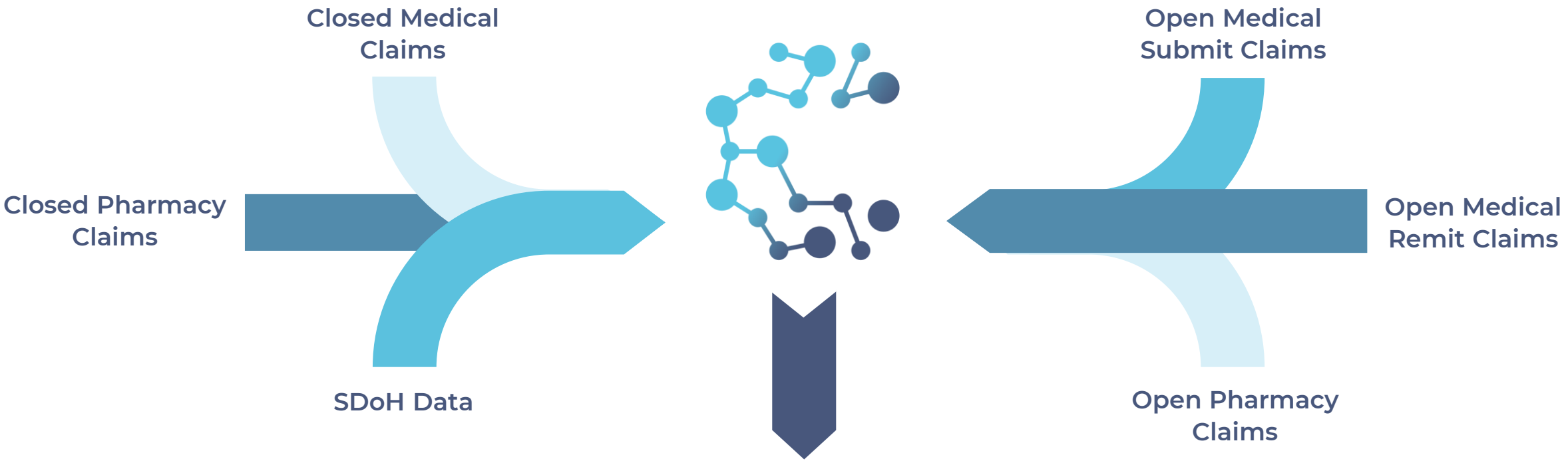
Forian's Data Ecosystem



CHRONOS Hybrid Data Model

Demographics	Diagnoses	Provider details for clinicians, facilities, and pharmacies
Socioeconomic status	Prescriptions	Payer mix
Purchasing behavior	Place of service	Insurance plan enrollment
Procedures	Health care expenditures	

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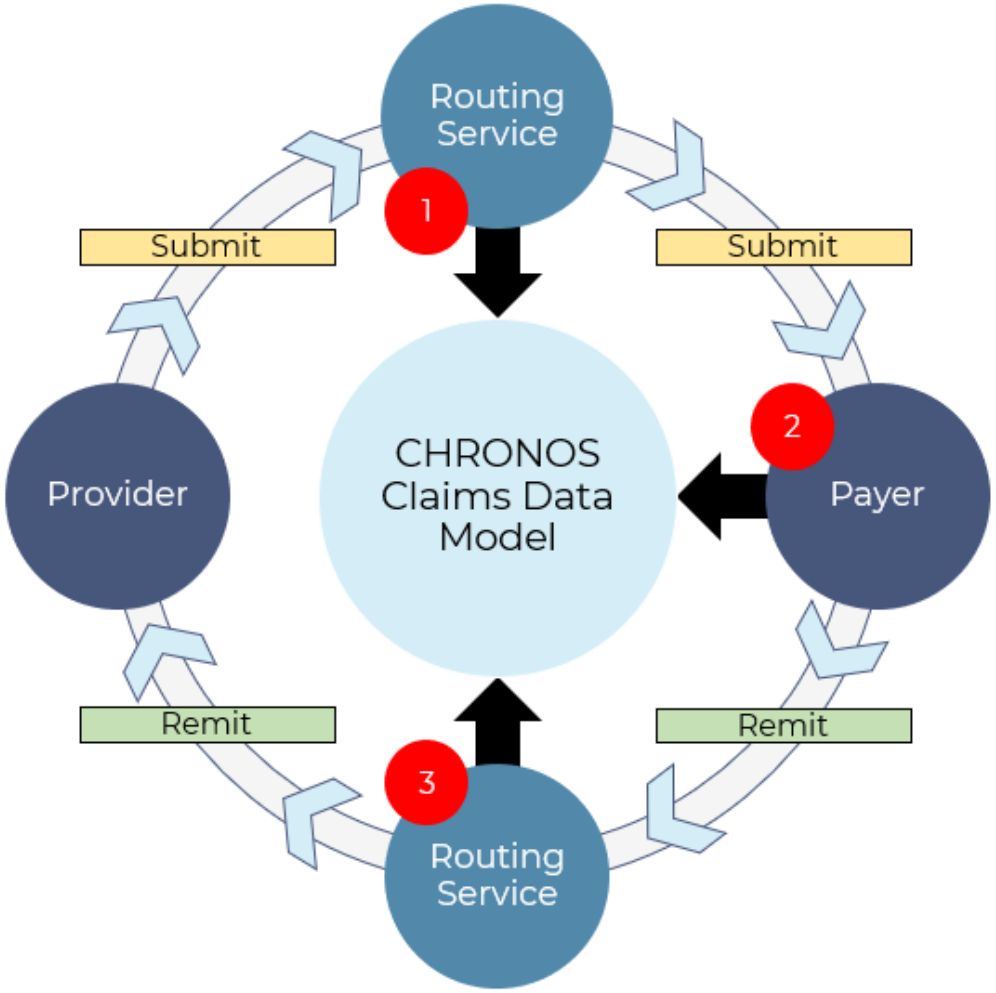
Claims Data Integration in CHRONOS

The revenue cycle for medical billing and the CHRONOS claims data model



Open and closed claims data flow into CHRONOS at different revenue cycle stages for medical billing.

1. Open claims data is sourced from clearinghouses and switches that manage submitted claims from providers to payers.

2. Payers receive submitted claims and return remitted claims to the provider following adjudication. Closed claims data is sourced following the adjudication process, which summarizes the submitted and remitted data and may include multiple revenue cycles.

3. Open claims data is sourced from clearinghouses and switches that manage remitted claims from payers to providers.

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CHRONOS Patient Population

Counts for unique patients between 2017 and 2023 YTD

Total CHRONOS Patient Count	N = 358,947,787

Closed Claims Patients — **N = 70,600,957**

98% Medical claims

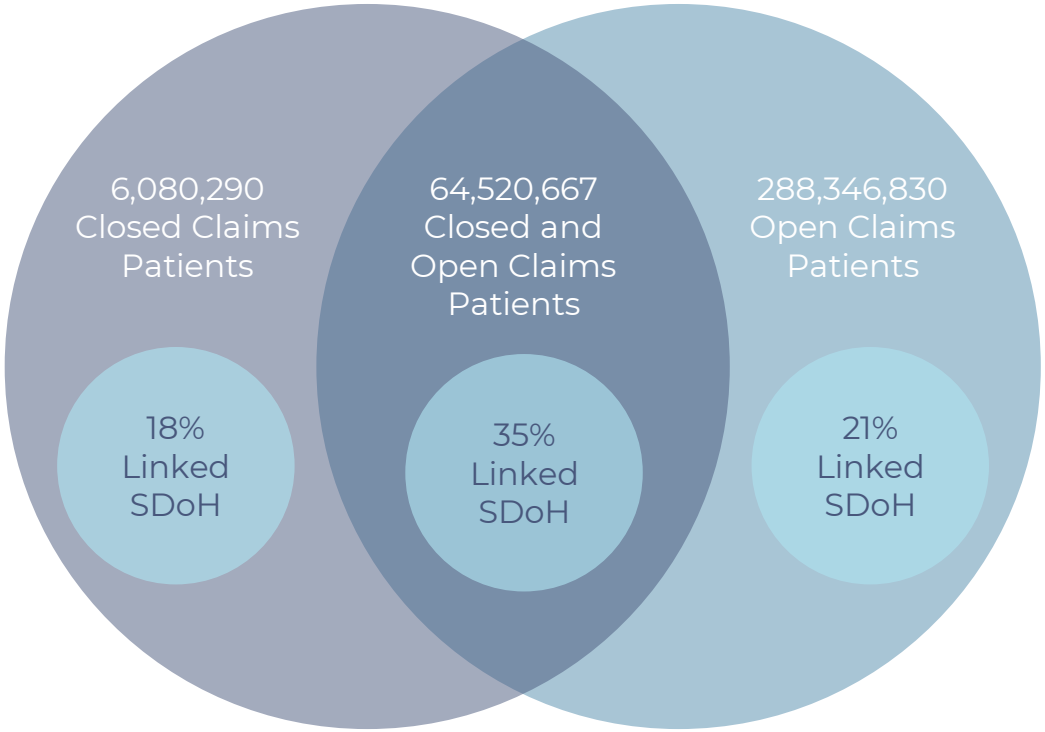
61% Pharmacy claims

Open Claims Patients — **N = 352,867,497**

90% Medical claims

57% Pharmacy claims

SDoH Patients — **N = 96,175,806**



Value of a Hybrid Data Ecosystem

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Strengths and Limitations of RWD

A hybrid RWD ecosystem combines the strengths and mitigates limitations of each individual data sources

	Closed Claims Data	Open Claims Data
Source	Healthcare insurers/payers.	Routing systems (i.e., claims clearinghouses and pharmacy switches)
Strengths	• Near complete capture of care while the patient is enrolled in an insurance plan. • Inclusion of institutional, professional, and pharmacy claims.	• Length of a patient's record is unrestricted by enrollment in an insurance plan. • Geographic representation is not limited by the location of the payer. • Lag between the current date and the date of the most recent available claim is less than two weeks.
Limitations	• Average length of enrollment in an insurance plan is 1-2 years. • Lag between the current date and the date of the most recent available claim is 3-6 months.	• Clearinghouses and pharmacy switches vary by provider. • Medical billing cycle may be unresolved (i.e., submitted claims without remitted claims).

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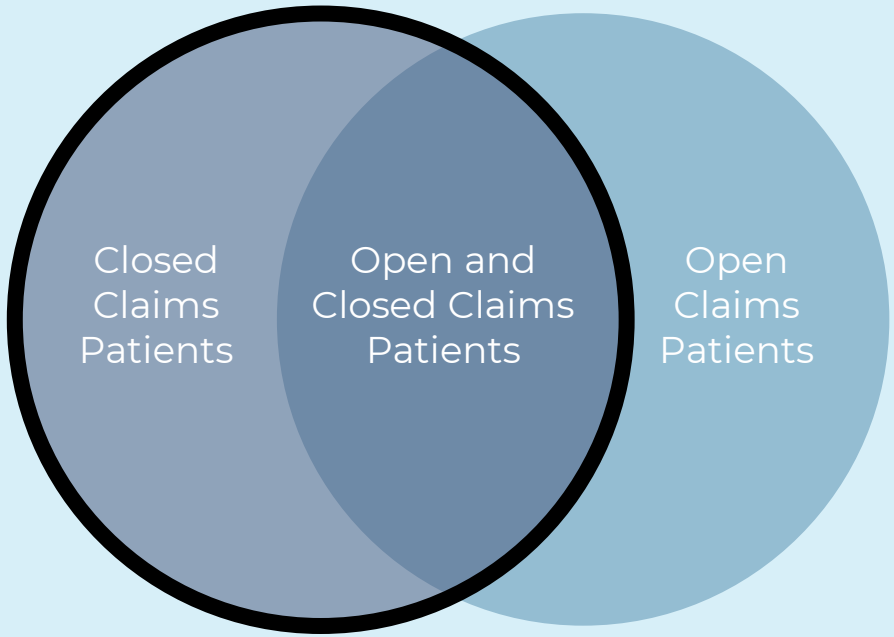
Outcomes Analysis Using Hybrid Claims

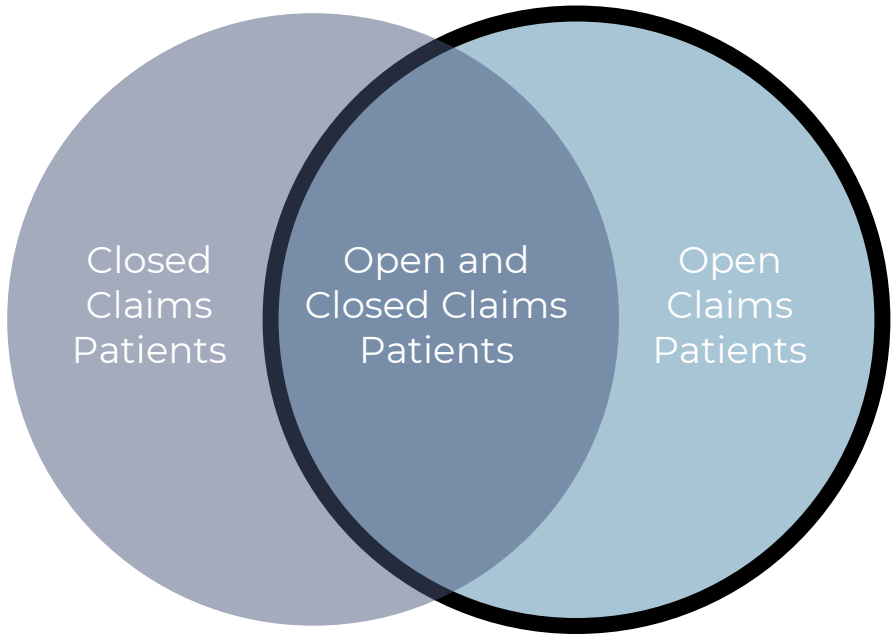
Example 1:

Progression to ESRD among Diabetic Kidney Disease Patients



Example 2:

Dialysis Treatment among Hospitalized COVID-19 Patients



RWE Example: Progression to ESRD

647,694 patients with a claim for stage 3 or stage 4 CKD in CHRONOS between 2017 and 2022

Exclude patients with prevalent CKD, **less than 12 months of continuous enrollment,** or no link to SDoH data.

112,858 eligible patients

Exclude patients with stage 3 or 4 CKD recorded in the open claims **before a first claim for CKD in the closed claims data.**

105,214 eligible patients

CKD Progression in Patients With and Without Diabetes in the Closed and Hybrid Claims Data

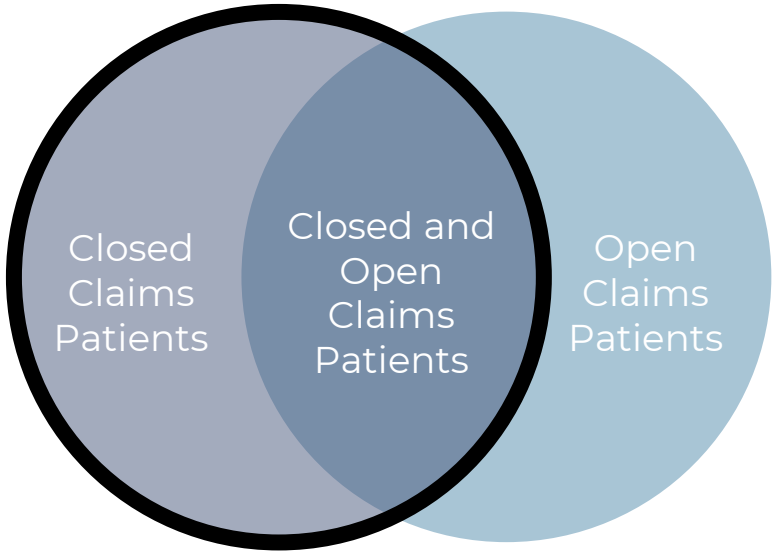
Of the eligible patients, 32,638 patients with diabetes were matched one-to-one to patients without diabetes using propensity scores.

Rates of Progression in Matched Cohorts

Rates and 95% Confidence Intervals per 100,000 person-years

Considerations

Open Claims data linked to Closed Claims data



Why is patient care missing in the closed claims data?

- Out-of-pocket payments
- Changes in health care insurance plans
- Medicare or support from other public payers
- Payers may strip information from closed claims

Further Analytic Considerations and Calibration

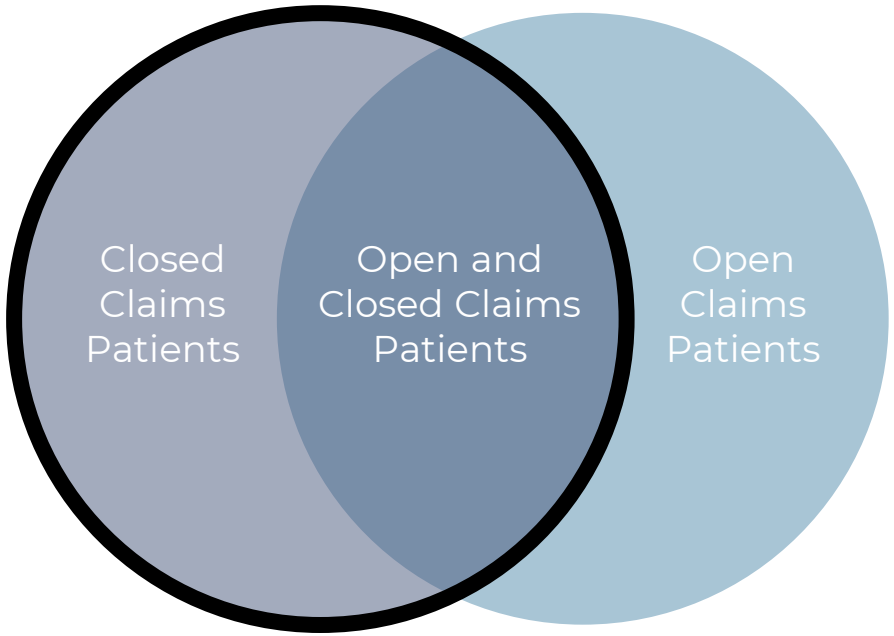
- Complete case analysis
- Missing data and imputation
- External distributions for confounder adjustment
- Quantitative bias analyses

(See Reference Slide)

Outcomes Analysis Using Hybrid Claims

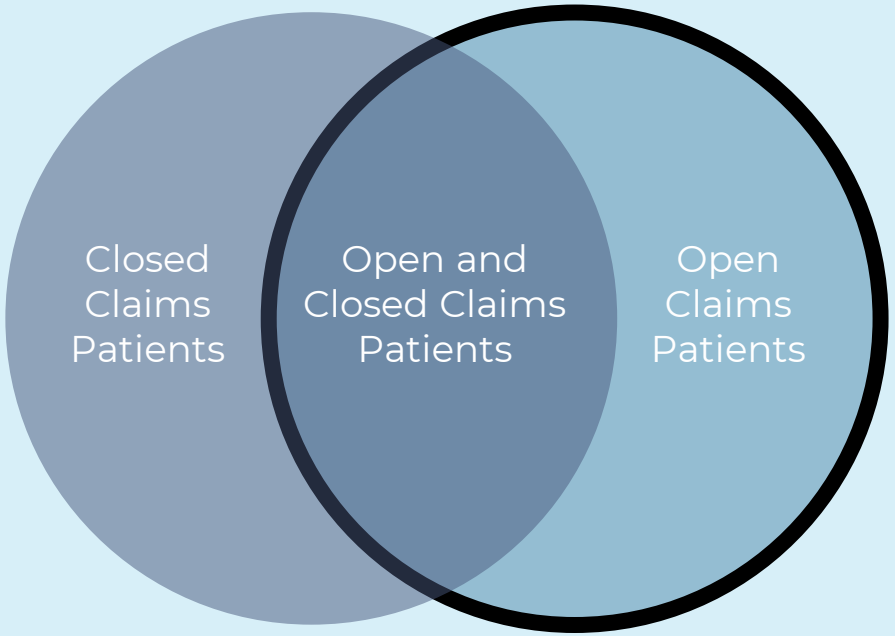
Example 1:

Progression to ESRD among Diabetic Kidney Disease Patients



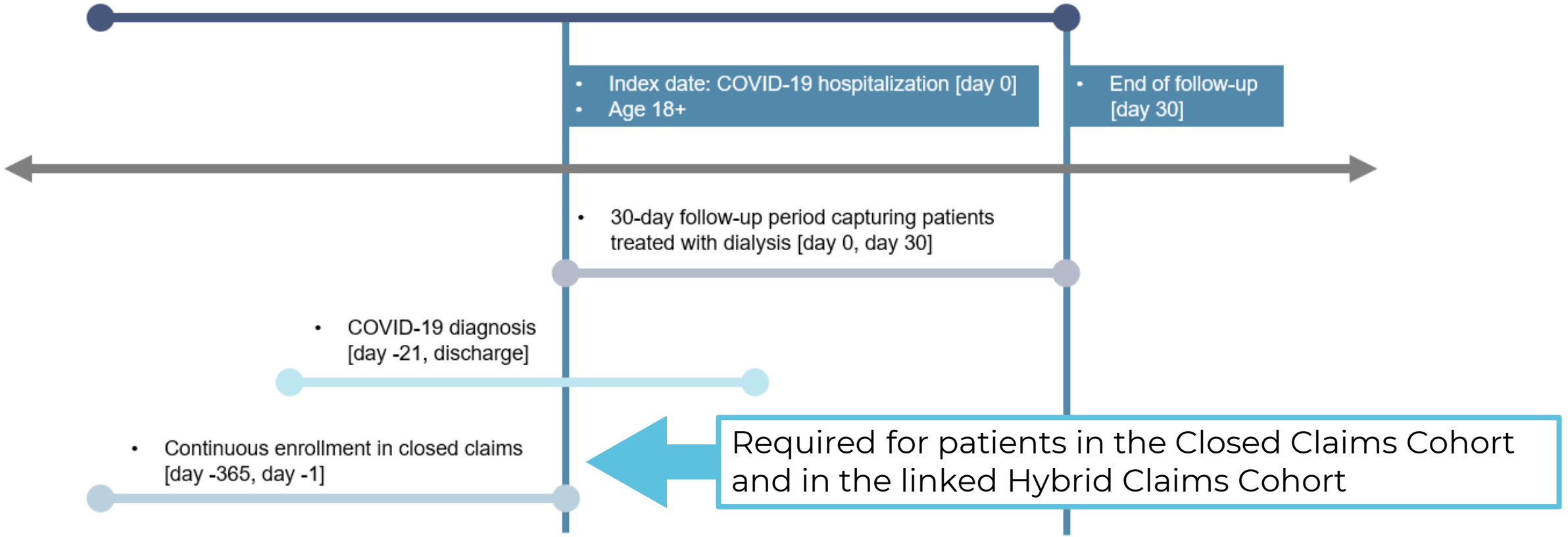
Example 2:

Dialysis Treatment among Hospitalized COVID-19 Patients



Example 2: Hospitalized COVID-19 Patients

- Study Period: April 1, 2019, through June 30, 2022. Study period is inclusive of 12 months of continuous enrollment for patients in the closed claims cohort.
- Identification Period: April 1, 2020, through May 31, 2022.



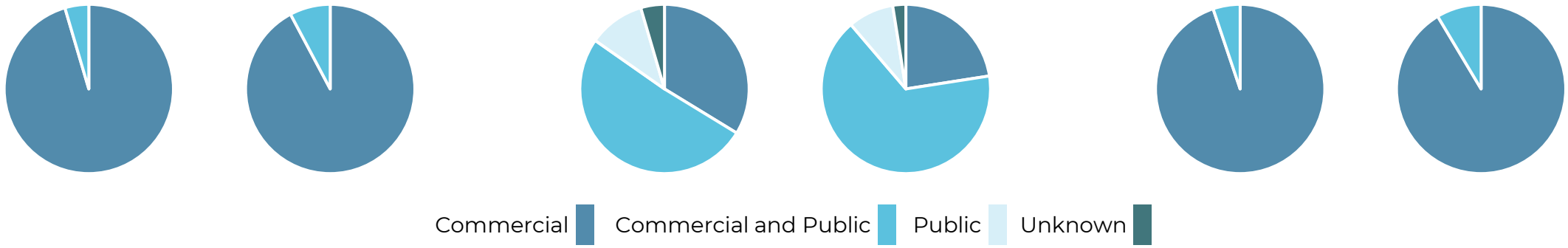
Inclusion/exclusion criteria followed the logic published by Burn E, et al. (2021). Use of dialysis, tracheostomy, and extracorporeal membrane oxygenation among 842,928 patients hospitalized with COVID-19 in the United States. *MedRxiv: The Preprint Server for Health Sciences*, 2020.

Hospitalized COVID-19 Patients by Source

Patient characteristics stratified by patients with and without diabetes

	Closed Claims Cohort		Open Claims Cohort		Hybrid Claims Cohort	
	No Diabetes	Diabetes	No Diabetes	Diabetes	No Diabetes	Diabetes
	N = 153,135 84% Linked	N = 69,453 88% Linked	N = 1,085,274 12% Linked	N = 693,508 9% Linked	N = 128,285 100% Linked	N = 60,846 100% Linked
Cohort Characteristics [Mean (SD)]						
Age	52.3 (11.8)	56.6 (9.2)	63.3 (17)	67.6 (13.2)	52.7 (11.6)	56.7 (9.2)
LOS	7.9 (9.1)	9.2 (9.6)	4.2 (10.4)	4.7 (12.9)	8.2 (9.4)	9.4 (9.7)
#RX	14.1 (22.8)	27.2 (35)	10.4 (24.8)	19.1 (39.1)	14.8 (23.4)	27.8 (35.4)
#IP	24.9 (50)	39.2 (71.9)	9.8 (29.4)	17.5 (43.5)	26.6 (52.5)	41.2 (74.8)
#OP	101.7 (100.3)	139.4 (128)	30.4 (62.1)	42.1 (76.3)	107.3 (103.7)	145 (130.7)
CCI	0.9 (1.5)	2.9 (2.2)	1.5 (2)	4.2 (2.7)	0.9 (1.5)	2.9 (2.2)

Payer Type



Abbreviations: LOS, Length of stay; Rx, Prescriptions; IP, Inpatient claims; OP, Outpatient claims; CCI, Charlson Comorbidity Index

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Propensity Score Matching

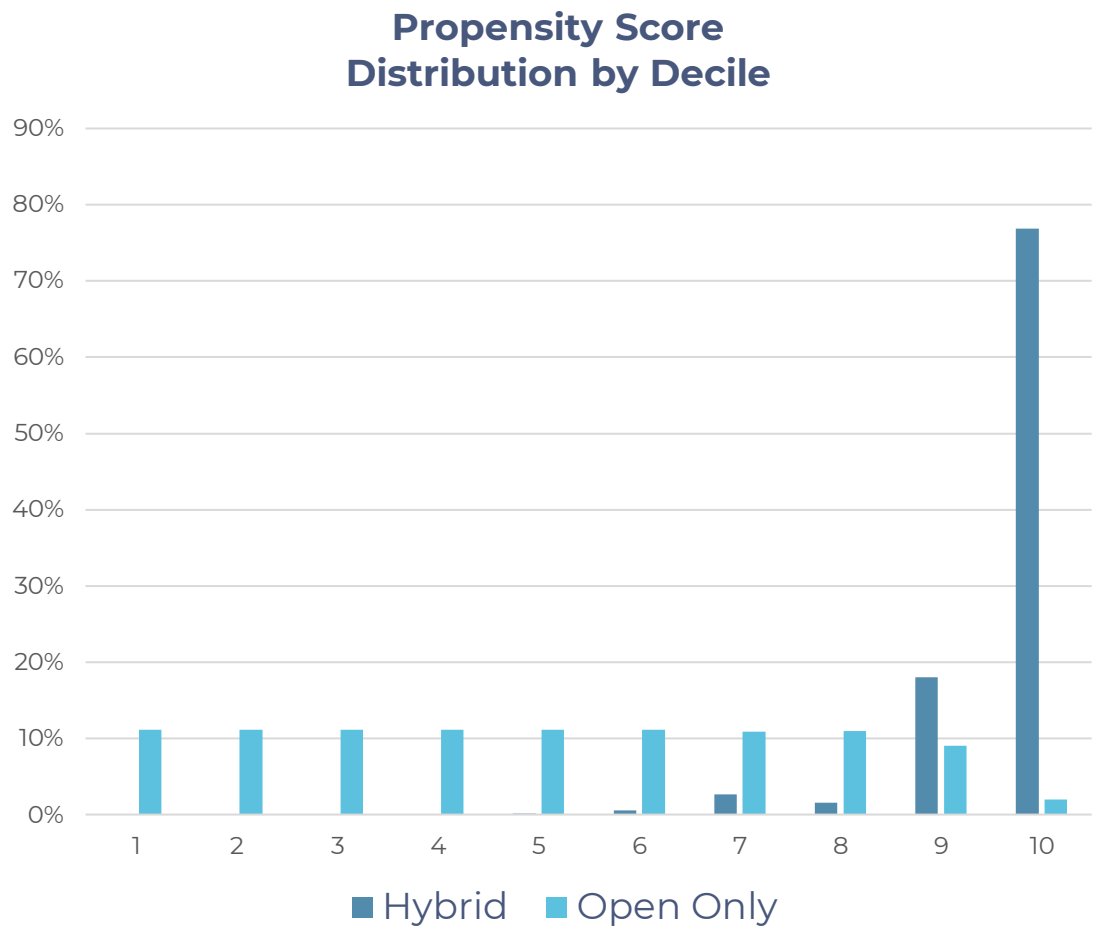
Using the closed claims as the standard, we use a logistic regression model to predict the probability that an open patient meets the definition of the hybrid claims cohort, including 12 months of continuous enrollment before hospitalization.

Method

Define an open-only patient cohort and a hybrid patient cohort (i.e., Open Claims with linked Closed Claims)

Generate propensity scores predicting patients' status in the Hybrid claims cohort

Match patients 1-to-1 using greedy nearest neighbor matching and 0.25 times the pooled standard deviation as a caliper.

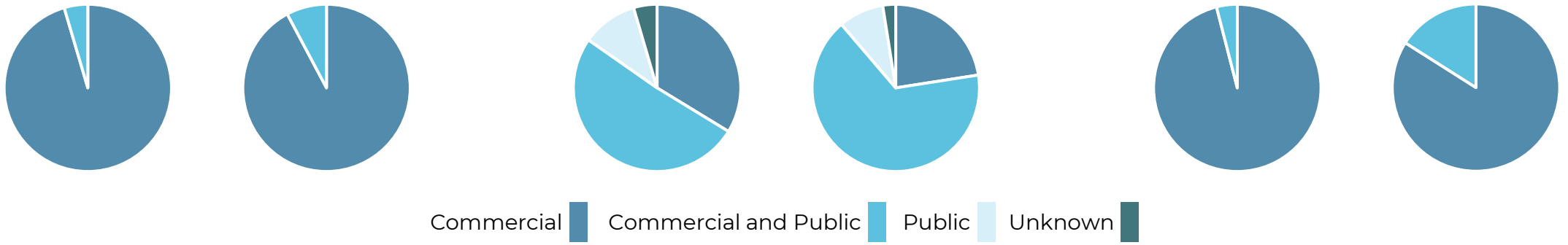


Closed, Open, and Matched Patients

Patient characteristics stratified by patients with and without diabetes

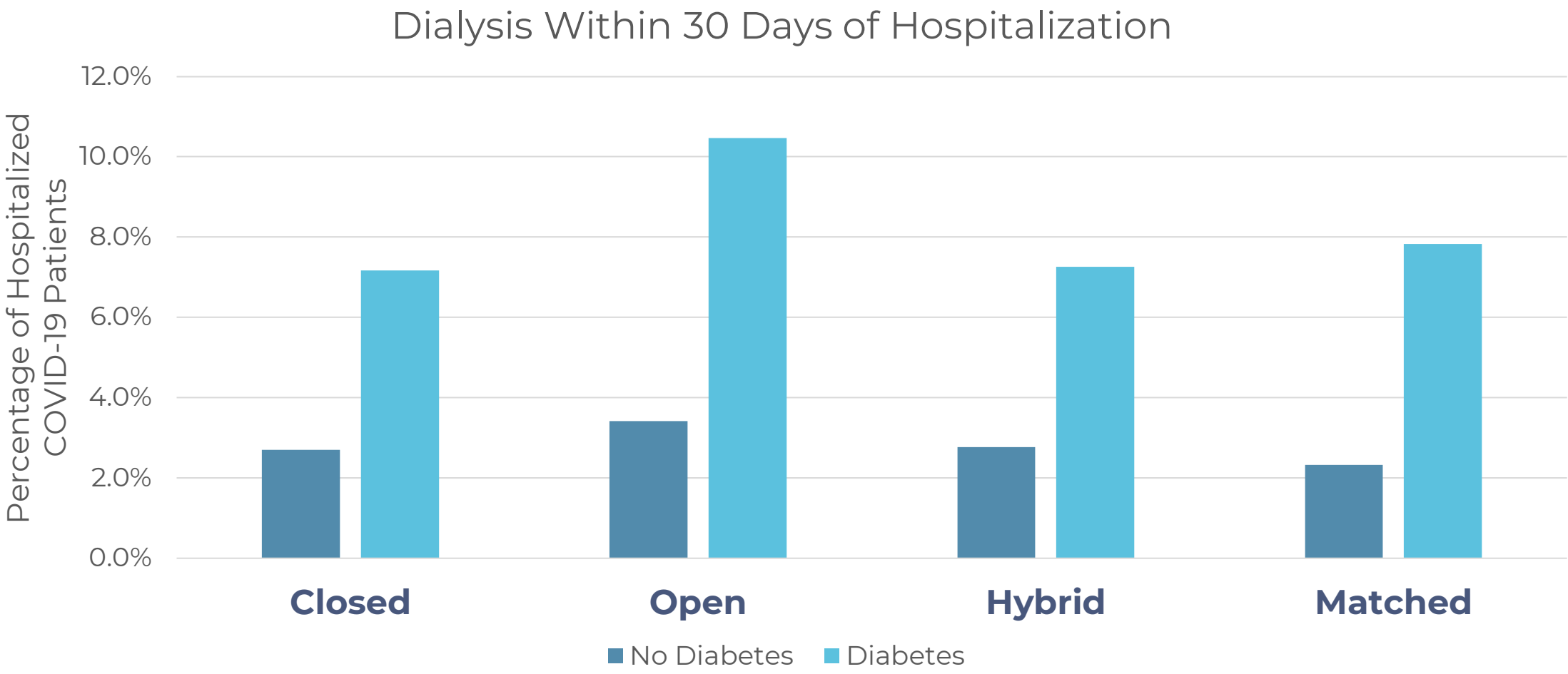
	Closed Claims Cohort		Open Claims Cohort		Matched Open Claims Cohort	
	No Diabetes	Diabetes	No Diabetes	Diabetes	No Diabetes	Diabetes
	N = 153,135	N = 69,453	N = 1,085,274	N = 693,508	N = 47,180	N = 15,303
Cohort Characteristics [Mean (SD)]						
Age	52.3 (11.8)	56.6 (9.2)	63.3 (17)	67.6 (13.2)	51.2 (14.9)	58.7 (12.3)
LOS	7.9 (9.1)	9.2 (9.6)	4.2 (10.4)	4.7 (12.9)	8.9 (14.2)	8.7 (14.9)
#RX	14.1 (22.8)	27.2 (35)	10.4 (24.8)	19.1 (39.1)	9.8 (25.1)	23.0 (45.2)
#IP	24.9 (50)	39.2 (71.9)	9.8 (29.4)	17.5 (43.5)	8.6 (35.8)	27.6 (77.3)
#OP	101.7 (100.3)	139.4 (128)	30.4 (62.1)	42.1 (76.3)	45.0 (66,5)	101.1 (110.9)
CCI	0.9 (1.5)	2.9 (2.2)	1.5 (2)	4.2 (2.7)	0.7 (1.3)	3.0 (2.4)

Payer Type



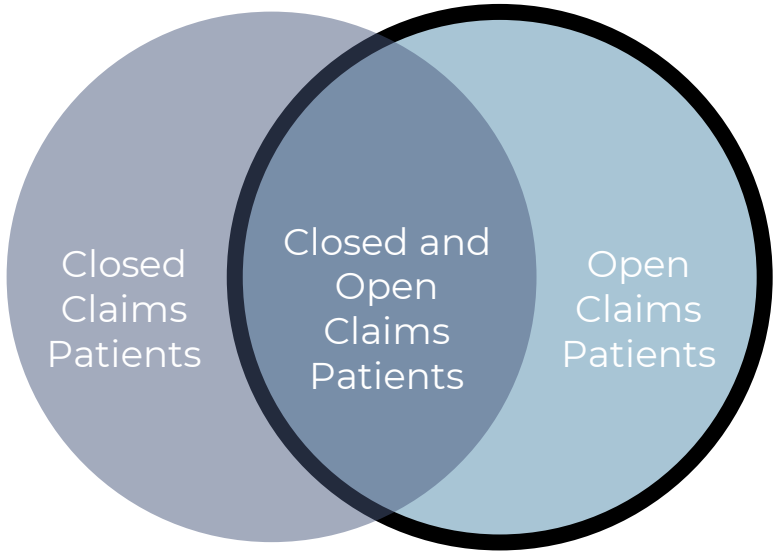
Abbreviations: LOS, Length of stay; Rx, Prescriptions; IP, Inpatient claims; OP, Outpatient claims; CCI, Charlson Comorbidity Index

Dialysis Treatment by Data Source



Considerations

Closed Claims data linked to Open Claims data



Using Propensity Scores to stabilize an open claims cohort

- Patients are more similar to closed claims patients because of continuous enrollment criteria
- Increased sample size

Analytic Considerations

- Matching strategies
- Same considerations when using Closed Claims
  - Missing data and imputation
  - External distributions for confounder adjustment
  - Quantitative bias analyses

Value of Hybrid Claims

The CHRONOS data ecosystem includes research-ready, linked open and closed claims data

Source population: Patients with closed claims and overlapping open claims

Fit-for-purpose examples:

- Burden of illness and cost of care
- Unmet need
- Adherence, persistence, and treatment pathways
- Outcomes and comparative effectiveness research

Value added by linking:

- Open claims data fill gaps when insurance coverage changes or care is paid out-of-pocket
- Open claims extend the longitudinal view of patient cohorts
- Open claims can substantially increase the sample size for rare diseases and newly launched therapeutics

Source population: Patients with open claims and overlapping closed claims

Fit-for-purpose examples:

- Incidence and prevalence metrics stratified by US region, payer, and/or provider
- Commercial targeting, market sizing, and patient profiling
- Study of rare diseases
- Uptake and treatment patterns of newly approved therapies

Value added by linking:

- Closed claims data provide enrollment periods during which complete capture is assumed
- Supports defining inclusion/exclusion criteria to capture meaningful study populations.

References

Methodological References

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Questions?

Thank you!