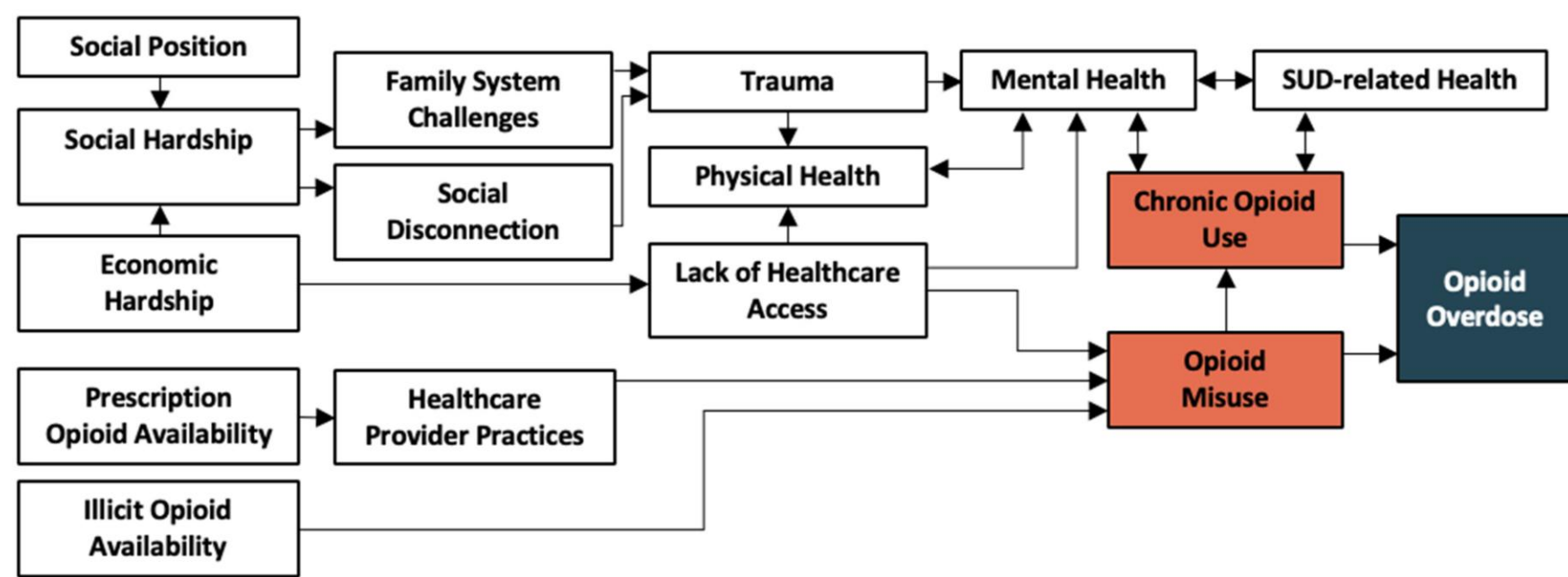


Introduction

Endoscopic pituitary surgery is a minimally invasive approach widely used for pituitary adenomas, with over 5,000 cases annually in the U.S.. Effective postoperative pain management is essential to ensure patient recovery while minimizing opioid-related adverse effects such as dependency, respiratory depression, and gastrointestinal complications.

- Opioid prescriptions are common post-surgery (~75% of patients receive opioids), but ~20% develop long-term use, increasing the risk of dependency.
- Recent guidelines promote multimodal pain management, emphasizing NSAIDs and acetaminophen to reduce opioid reliance.
- Racial and gender disparities in opioid prescribing have been documented, but limited research exists on trends specific to neurosurgical patients.
- Objective:** This study analyzes temporal prescription trends, demographic disparities, and regional differences in opioid and NSAID prescribing patterns following endoscopic pituitary surgery.



Methods

Data Source & Study Design

- Dataset:** TriNetX Research Network (161M+ patients, 139 healthcare organizations).
- Study Period:** 2011-2023.
- Cohort Definition:** Patients who underwent endoscopic pituitary surgery (CPT: 62165) in a given year.

Medications Analyzed

- Opioids:** Tramadol (RxNorm: 10689), Hydrocodone (RxNorm: 5489), Oxycodone (RxNorm: 7804), Morphine (RxNorm: 7052).
- Non-Opioids:** NSAIDs.

Statistical Analysis

1. Descriptive Statistics

- Mean, age, gender, racial distribution** analyzed.
- Prescription frequencies calculated for each drug.

2. Time Series Analysis

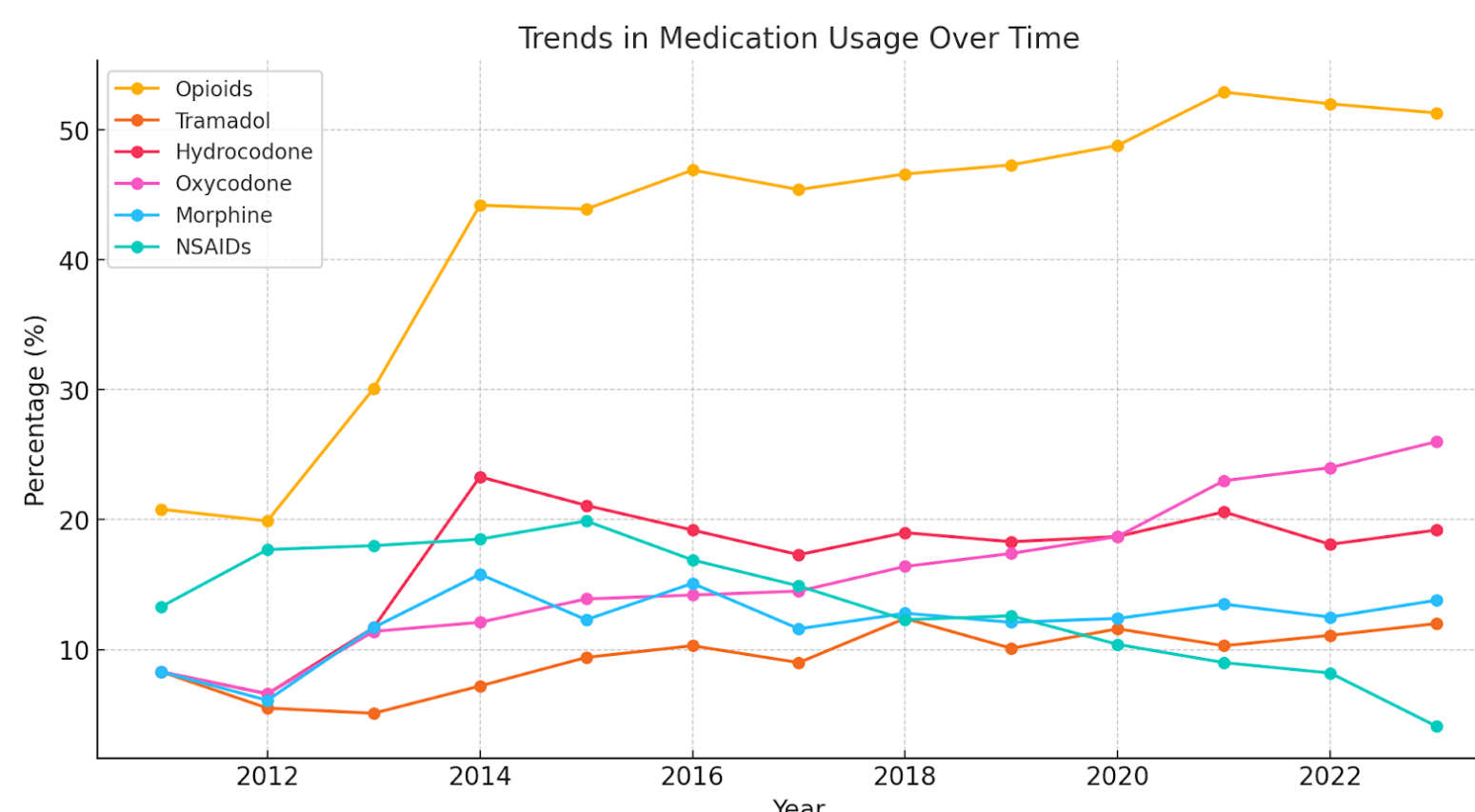
- Linear Regression:** Assessed annual percentage changes in opioid and NSAID prescriptions.
- Poisson Regression:** Modeled annual prescription counts, adjusting for cohort size.

3. Multivariable Analysis

- Beta Regression:** Investigated the influence of demographics (age, gender, race, region) on prescription trends.
- Adjusted for multicollinearity (VIF < 10)** and removed near-zero variance predictors.
- Sequential model selection based on **AIC reduction criteria** to identify the best-fit model.

Results

Fig 1. Trends in Opioid Usage over Time



Drug	Intercept	Year	p-value (Year)	Residual Deviance	AIC
Opioids	-72.75	0.04	<0.001	31.85	125
Tramadol	-91.27	0.04	<0.001	13.98	88.73
Hydrocodone	-30.25	0.01	0.072	33.96	116.1
Oxycodone	-186	0.09	<0.001	4.69	85.75
Morphine	-19.9	0.01	0.377	14.9	93.06
NSAIDs	234.2	-0.1	<0.001	28.32	106.8

Table 1. Poisson Regression for Count Data

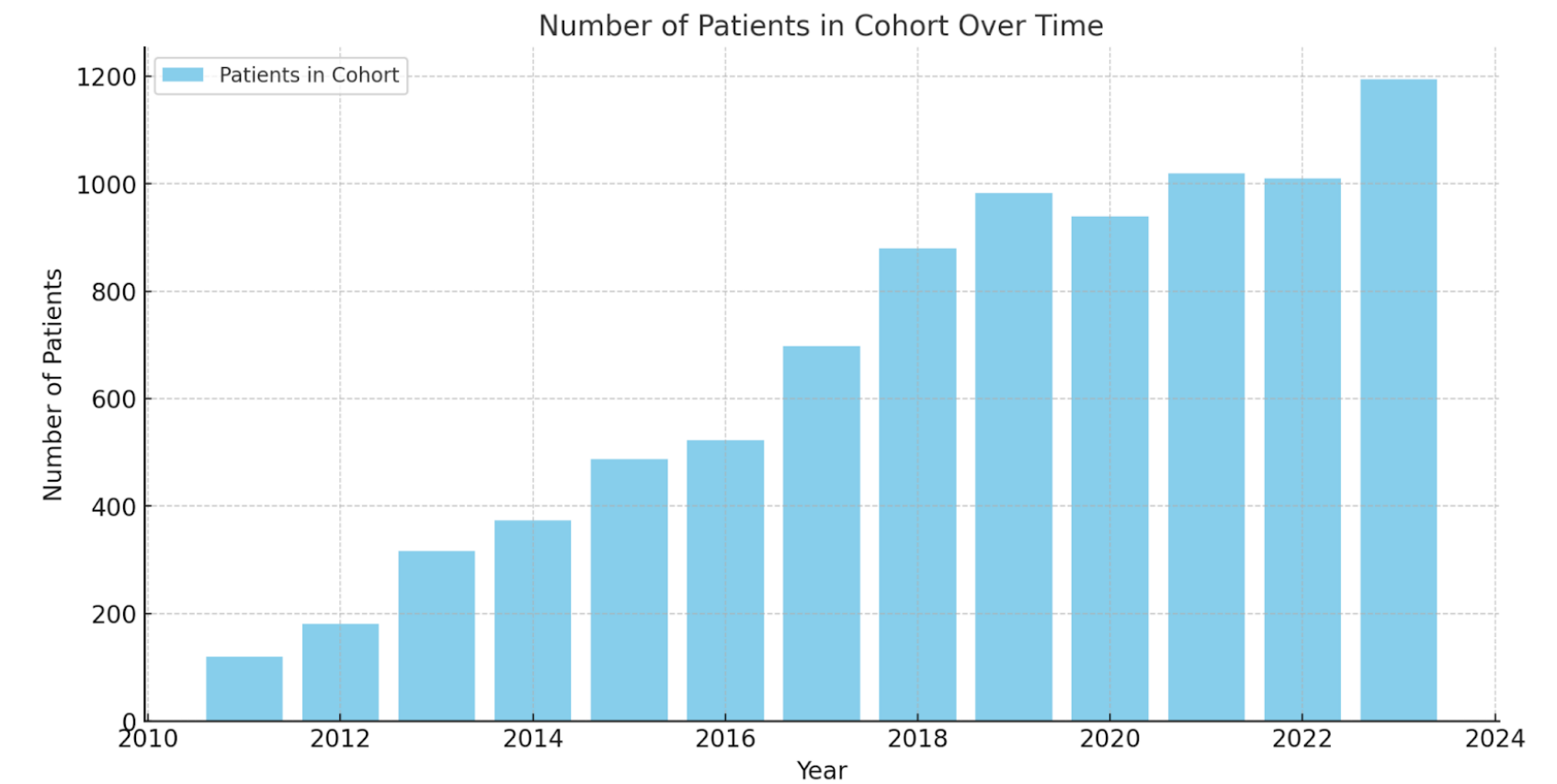
Predictor	Estimate	Std. Error	z value	Pr(> z)	VIF
Intercept	-53.400	120.800	-0.442	0.658	
Year	0.025	0.060	0.416	0.677	57.590
Male	0.001	0.001	0.991	0.322	42.808
Female	0.000	0.002	0.000	1.000	142.616
Other Race	-0.021	0.006	-3.610	0.000	
Northeast	0.004	0.001	2.593	0.010	

Table 3. Optimized Model for Tramadol Prescription Counts

Predictor	Estimate	Std. Error	z value	Pr(> z)	VIF
Intercept	868.000	89.270	9.722	< 2e-16	
Year	-0.433	0.044	-9.750	< 2e-16	57.590
Male	0.001	0.001	1.490	0.136	42.808
Female	0.011	0.001	9.461	< 2e-16	142.616
Other Race	-0.070	0.004	-15.616	< 2e-16	
Northeast	0.010	0.001	13.217	< 2e-16	
South	-0.004	0.001	-7.028	< 0.001	
West	0.022	0.002	10.651	< 2e-16	

Table 5. Optimized Model for Hydrocodone Prescription Counts

Fig 2. Number of Patients per Annual Cohort



Predictor	Estimate	Std. Error	z value	Pr(> z)	VIF
Intercept	152.900	194.500	0.786	0.432	
Year	-0.077	0.097	-0.792	0.428	57.590
Male	-0.002	0.001	-1.236	0.216	42.808
Female	0.005	0.002	2.134	0.033	142.616
Asian	-0.023	0.007	-3.025	0.002	
Midwest	-0.005	0.002	-2.706	0.007	

Table 2. Optimized Model for NSAID Prescription Counts

Predictor	Estimate	Std. Error	z value	Pr(> z)	VIF
Intercept	1.023	119.600	0.009	0.993	
Year	-0.002	0.059	-0.030	0.976	57.590
Male	-0.001	0.001	-1.009	0.313	42.808
Female	0.003	0.002	2.081	0.037	142.616
Other Race	-0.016	0.005	-2.980	0.003	
West	0.008	0.003	2.542	0.011	

Table 4. Optimized Model for Oxycodone Prescription Counts

Predictor	Estimate	Std. Error	z value	Pr(> z)	VIF
Intercept	79.390	216.800	0.366	0.714	
Year	-0.041	0.108	-0.380	0.704	57.590
Male	-0.025	0.005	-4.562	0.000	42.808
Female	-0.015	0.005	-3.286	0.001	142.616
Caucasian/White	0.028	0.006	4.529	0.000	
Northeast	0.007	0.002	3.326	0.001	
West	0.018	0.006	2.962	0.003	

Table 6. Optimized Model for Morphine Prescription Counts

Results (cont.)

1. Trends in Opioid and NSAID Prescriptions

- Opioid prescriptions increased from 19.9% (2012) to 52.9% (2021) ($B = 2.21$, $p = 0.0042$).
- Oxycodone (+1.53% per year, $p = 0.0042$) and tramadol (+0.56% per year, $p = 0.0042$) increased significantly.
- Hydrocodone (-0.43% per year, $p < 0.001$) and NSAIDs (-1.28% per year, $p = 0.0015$) declined significantly.
- Morphine showed no significant trend ($p = 0.70$).

2. Gender Disparities

- Females had higher opioid ($B = 0.0086$, $p < 0.001$) and hydrocodone ($B = 0.0114$, $p < 0.001$) prescriptions.
- NSAIDs were also prescribed more to females ($B = 0.0046$, $p = 0.033$).
- Males were less likely to receive morphine ($B = -0.0246$, $p < 0.001$).
- No gender difference for tramadol ($p = 0.999$).

3. Racial Disparities

- Minority patients received fewer opioids, especially hydrocodone ($B = -0.0699$, $p < 0.001$) and tramadol ($B = -0.0207$, $p = 0.0003$).
- White patients had higher morphine prescriptions ($B = 0.0278$, $p < 0.001$).
- NSAID prescriptions were lower in Asian patients ($B = -0.0227$, $p = 0.0025$).

4. Regional Differences

- Opioid prescriptions were higher in the Northeast ($B = 0.0074$, $p < 0.001$) and West ($B = 0.0111$, $p = 0.0001$).
- Hydrocodone prescriptions were lower in the South ($B = -0.0045$, $p < 0.001$).
- NSAIDs were prescribed less in the Midwest ($B = -0.0055$, $p = 0.007$).

Conclusions

- Opioid prescriptions have increased significantly post-surgery, with oxycodone and tramadol rising while NSAID use declines, despite evidence supporting multimodal pain management.
- Females receive more opioids and NSAIDs, while males are prescribed fewer morphine-based medications, reflecting potential provider biases.
- Minority patients receive fewer opioids, particularly hydrocodone, suggesting systemic disparities in pain management.
- Regional differences indicate prescribing patterns are shaped by policy, provider preferences, and access to care, with higher opioid use in the Northeast and West.
- Reducing opioid reliance may require promoting NSAIDs and acetaminophen