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POMS-HK 2019

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Curbing the Opioid Crisis:
The Value of a Second Opinion in the Primary Care Setting

Joint work with:
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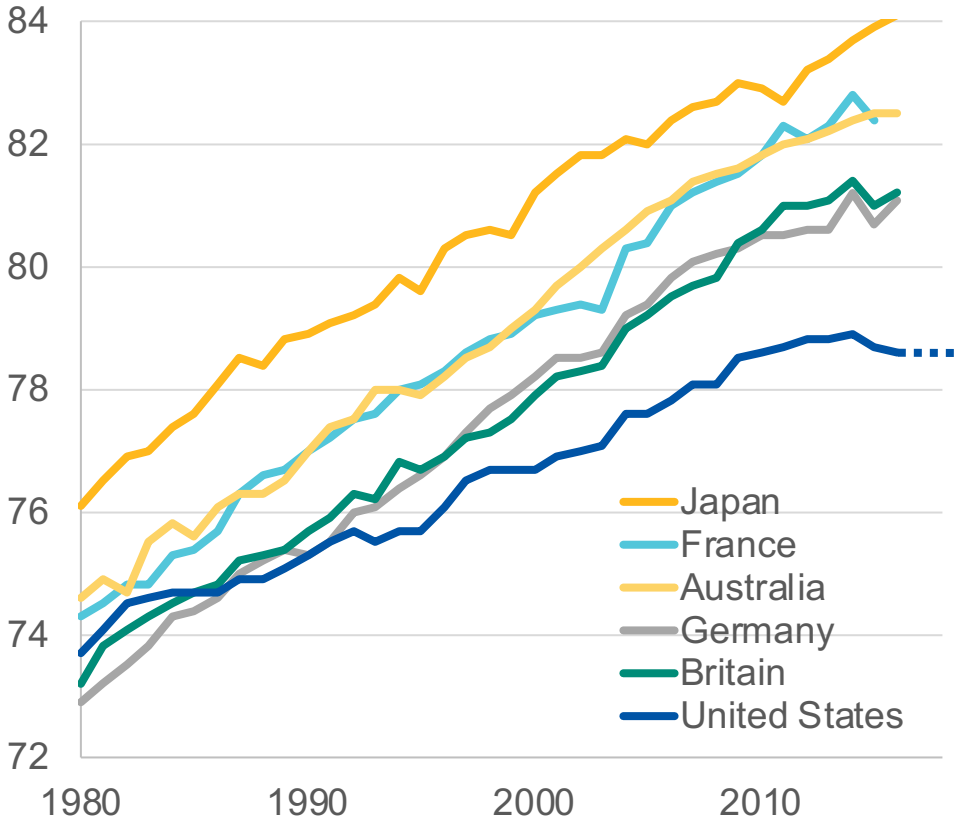
Lawrence Huan, MD

Life expectancy in the US has been declining for the past three years

Average Life Expectancy at Birth



Between 2000 and 2015:

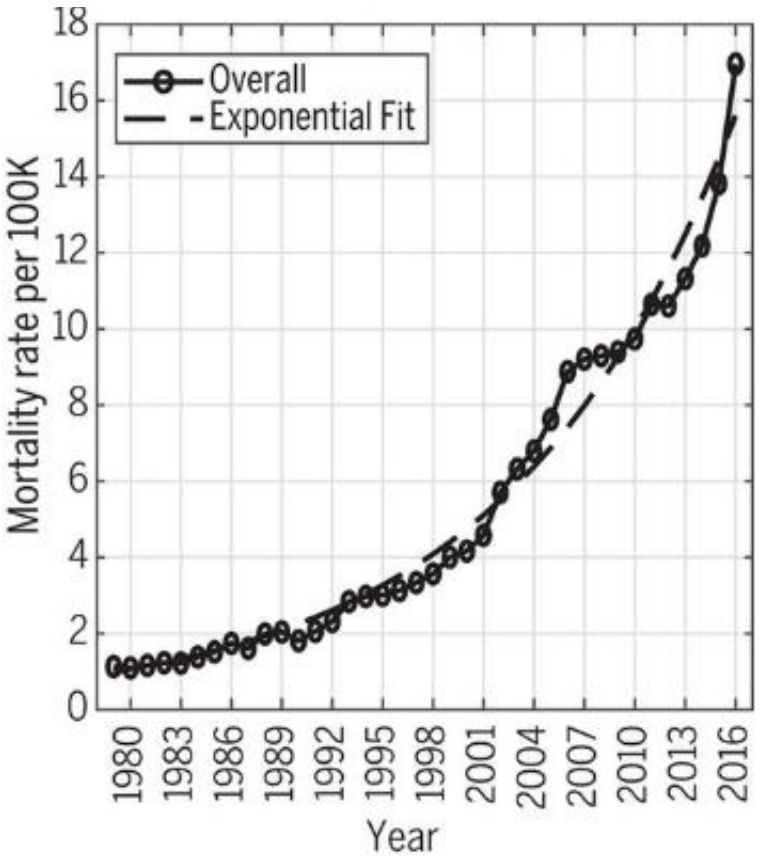
Increases in opioid-related deaths shortened life expectancy by 0.21 years (49,000 deaths in 2015 alone)

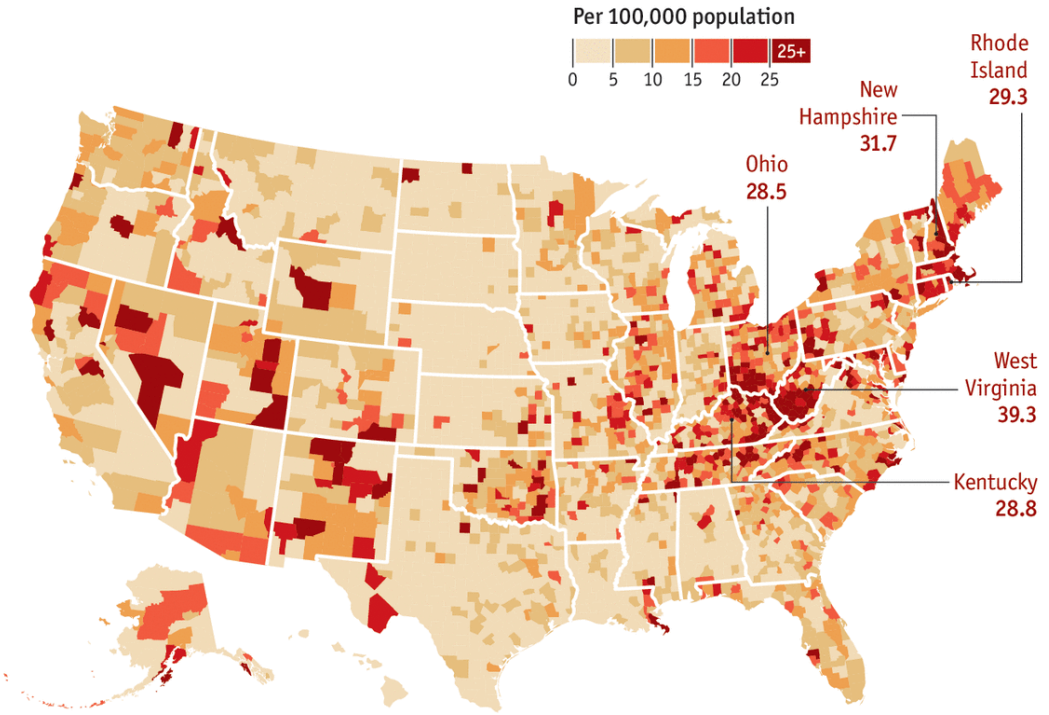
Advances in heart disease, cancer, diabetes, etc. have increased life expectancy by 2.25 years

OECD.org; Dowell et al. 2017 (JAMA)
https://amp.economist.com/
https://www.drugabuse.gov/

The majority of opioid literature focuses primarily on segmentation

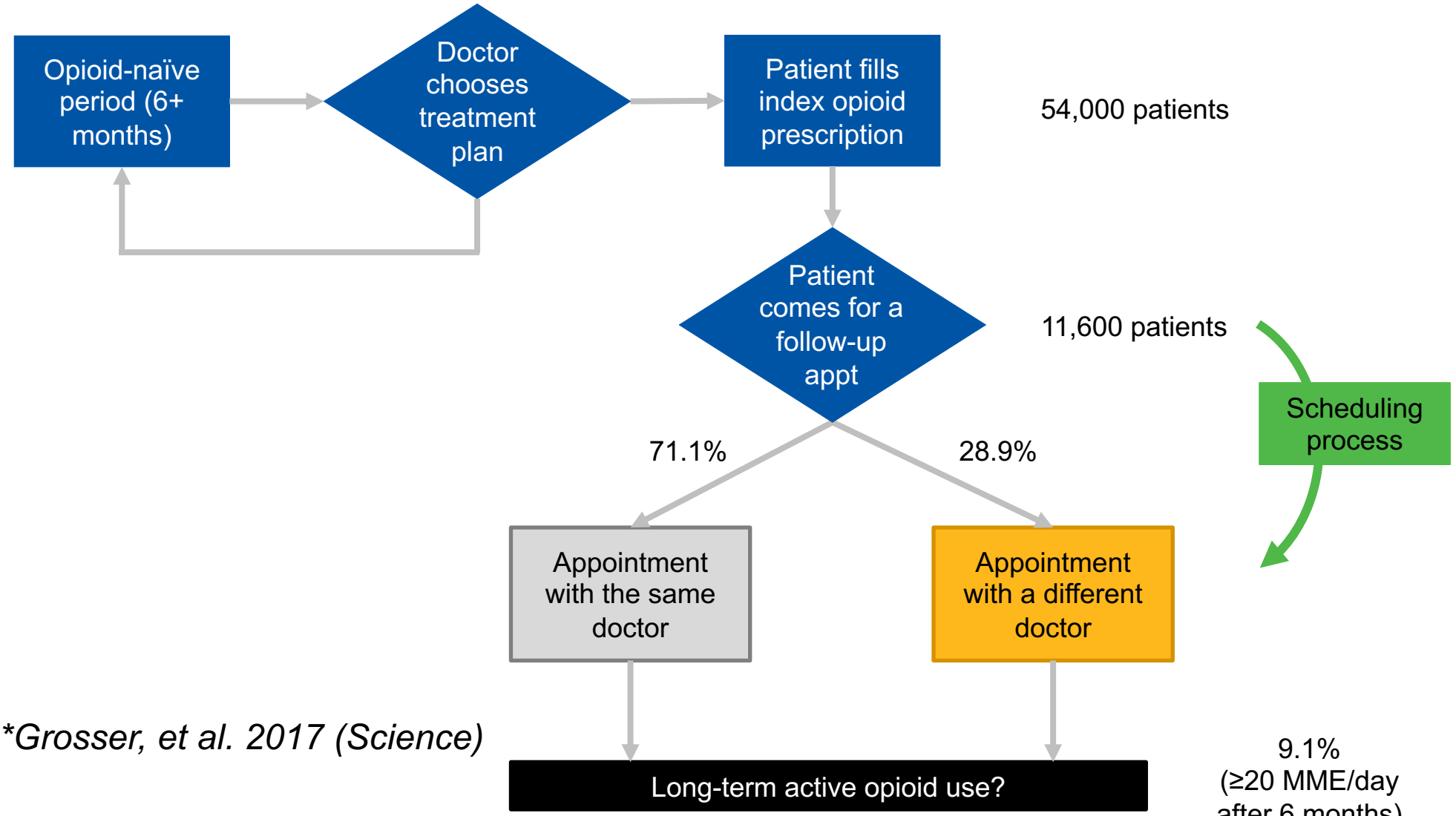
Opioid mortality rates across time and geography:





Images: Jalal et al. 2018 – Science; Economist.com sourced from Centres for Disease Control and Prevention

Many first-time opioid prescriptions are given in the primary care setting for non-malignant pain*



Grosser, et al. 2017 (Science)

How might the follow-up appointment impact a patient's long-term opioid use?

	Continuity of Care	Second Opinion
Definition	The **same** general care provider will diagnose, treat, and oversee the complete care of a patient.	After the primary treatment, the patient is referred to or seeks care from a **different** doctor.

We leverage a complex database of medical and pharmaceutical claims to abstract the patient journey

Pharma Claims

MEMBER_ID	PRESCRIBER_ID	FILLED_DATE	DRUG_GPI	DRUG_NAME	QUANTITY	MME_DOSE_UNIT
1002	MD01	7/19/2015	GPI01	TRAMADOL HCL TABLET	20	5
1002	MD02	8/1/2015	GPI01	TRAMADOL HCL TABLET	180	5
1002	MD02	10/14/2015	GPI02	HYDROCODONE-ACETAMINOPHEN TABLET	10	5
1002	MD03	10/21/2015	GPI03	OXYCODONE W/ ACETAMINOPHEN TABLET	30	11.25
1004	MD02	5/4/2015	GPI04	MORPHINE SULFATE TABLET EXTENDED RELEASE	90	15
1004	MD05	8/11/2015	GPI06	HYDROCODONE-ACETAMINOPHEN TABLET	20	5
1006	MD02	7/19/2015	GPI01	TRAMADOL HCL TABLET	90	5
1006	MD04	12/16/2015	GPI02	HYDROCODONE-ACETAMINOPHEN TABLET	18	5
1006	MD01	6/5/2016	GPI07	OXYCODONE W/ ACETAMINOPHEN TABLET	30	7.5
1006	MD05	10/27/2016	GPI05	METHADONE HCL TABLET	60	5
1007	MD06	11/2/2015	GPI02	HYDROCODONE-ACETAMINOPHEN TABLET	24	7.5
...	...	...	...	...	...	...

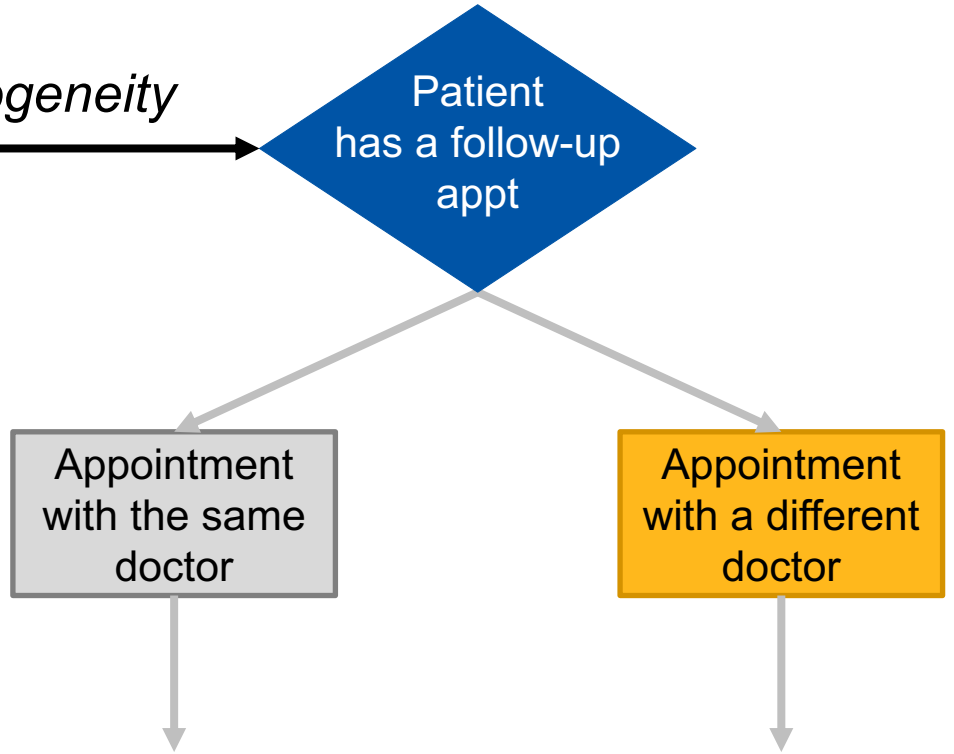
Medical Claims

MEMBER_ID	PROVIDER_ID	SERVICE_START_DATE	LOCATION	PRIMARY_DIAGNOSIS_CATEGORY
1002	MD01	2/20/2015	OFFICE	RESPIRATORY SYSTEM
1002	MD02	10/13/2015	OFFICE	NERVOUS SYSTEM
1002	MD07	4/7/2016	INPATIENT	RESPIRATORY SYSTEM
1002	MD07	4/8/2016	INPATIENT	RESPIRATORY SYSTEM
1002	MD02	4/13/2016	SNF	RESPIRATORY SYSTEM
1002	MD01	4/27/2016	SNF	RESPIRATORY SYSTEM
1002	MD03	5/11/2015	SNF	RESPIRATORY SYSTEM
1004	MD02	3/10/2015	OFFICE	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1004	MD02	4/3/2015	OUTPATIENT	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1004	MD02	5/2/2015	OFFICE	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1004	MD02	5/11/2015	OFFICE	NERVOUS SYSTEM
1004	MD05	8/11/2015	OFFICE	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1006	MD04	5/4/2016	OUTPATIENT	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1006	MD01	6/1/2016	OFFICE	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1007	MD06	3/14/2015	OFFICE	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1007	MD06	11/2/2015	OFFICE	MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE
1007	MD07	11/20/2015	ER	DIGESTIVE SYSTEM
1007	MD08	11/20/2015	OUTPATIENT	DIGESTIVE SYSTEM
...	...	...	...	...

After data cleaning, we find a difference in opioid usage rates

Potential sources of endogeneity

- *Doctor shopping*
- *Acuity or pain level*
- *Etc.*



	Appointment with the same doctor	Appointment with a different doctor
Raw opioid usage	*10.4%*	*5.3%*
Controlled for observables	*9.6%*	*8.0%*

Why might we be concerned about endogeneity?

There are multiple reasons why a patient that has a second opinion may be predisposed to becoming more or less likely a chronic opioid user based on unobservable factors:

More likely

- Intentional **doctor shopping**: a patient may seek out multiple doctors to obtain a higher quantity of opioids
- A patient that is referred to a different doctor may have **more complex** needs
- **Scheduling**: patients with high levels of pain may be more willing to see a different doctor if their original doctor is unavailable

Less likely

- A patient who changes provider maybe intentionally **seeking an alternative** to opioids
- **Scheduling**: patients who have a bad reaction to opioids may return quickly, and the original doctor may be unavailable

A simultaneous equation model can resolve endogeneity issues

First stage:

$$\boldsymbol{DiffDoctorFlag} = \boldsymbol{\alpha_0} + \boldsymbol{InstrVariable}\,\boldsymbol{\alpha_1} + \boldsymbol{Controls}\,\boldsymbol{\alpha_2} + \boldsymbol{\epsilon_1}$$

Second stage:

$$\boldsymbol{LongTermOpioidUsage} = \boldsymbol{\beta_0} + \boldsymbol{DiffDoctorFlag}\,\boldsymbol{\beta_1} + \boldsymbol{Controls}\,\boldsymbol{\beta_2} + \boldsymbol{\epsilon_2}$$

Errors jointly distributed according to a bivariate normal distribution with correlation coefficient rho, i.e.,

$$\begin{pmatrix} \epsilon_2 \\ \epsilon_2 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \quad \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right]$$

Angrist and Pischke, 2009

Instrumental variables improve reliability of coefficient estimates

Instrumental Variable
Likelihood that the prescribing doctor's other patients* switch doctors for their follow-up appointment. **In the 12 months prior to the start of the episode*

- ✓ **Relevance Criteria**: correlated with the causal variable of interest
- ✓ **Exclusion Restriction**: uncorrelated with the dependent variable

After data cleaning, we find a difference in opioid usage rates

Potential sources of endogeneity

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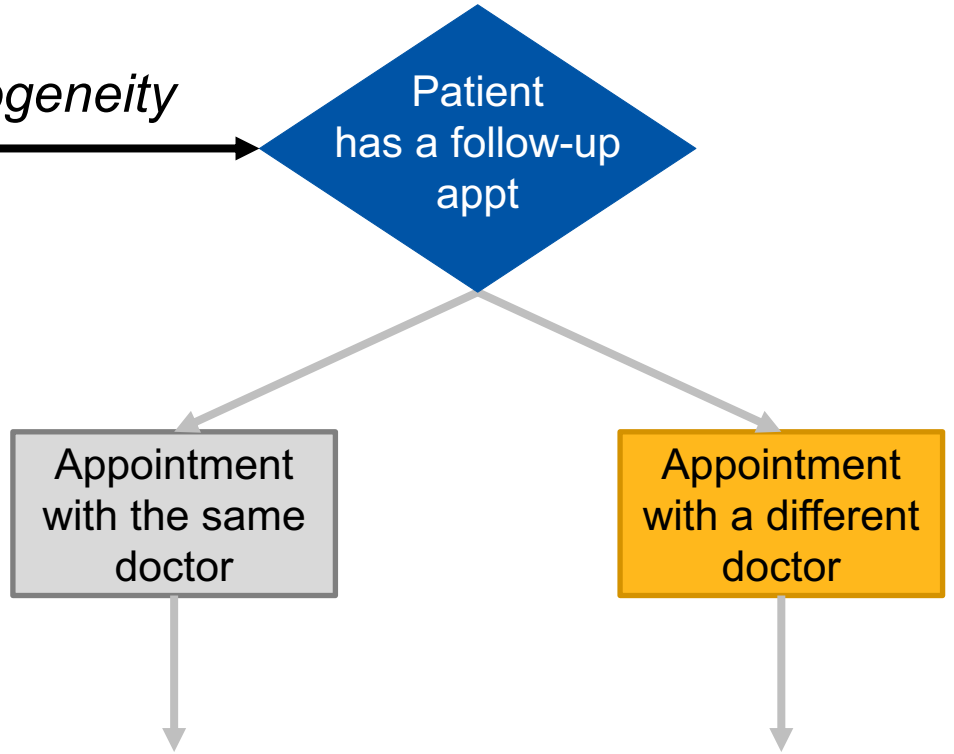
- *Etc.*

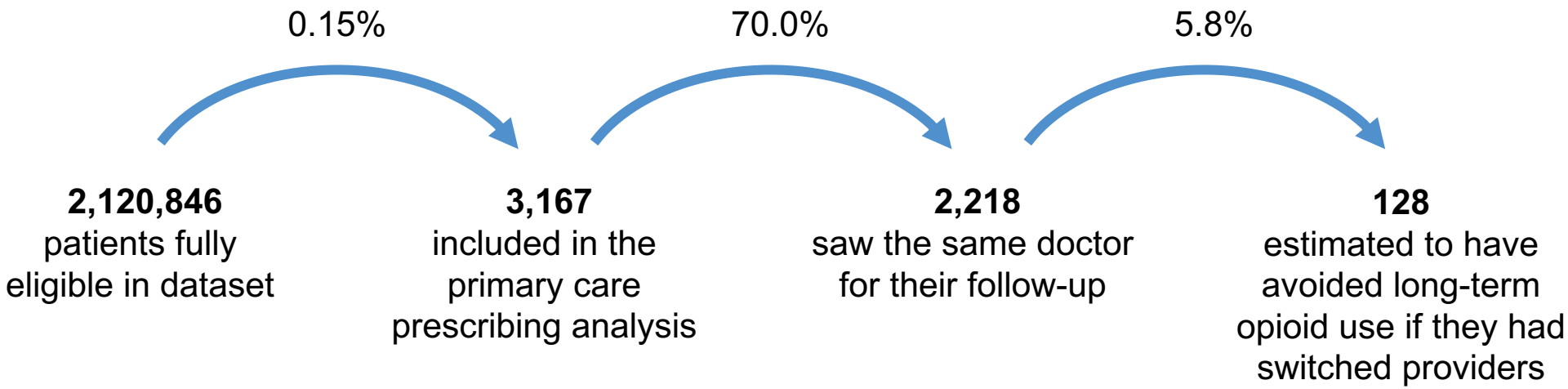


	Appointment with the same doctor	Appointment with a different doctor
Raw opioid usage	*10.4%*	*5.3%*
Controlled for observables	*9.6%*	*8.0%*
Corrected for endogeneity	*10.8%*	*5.0%*

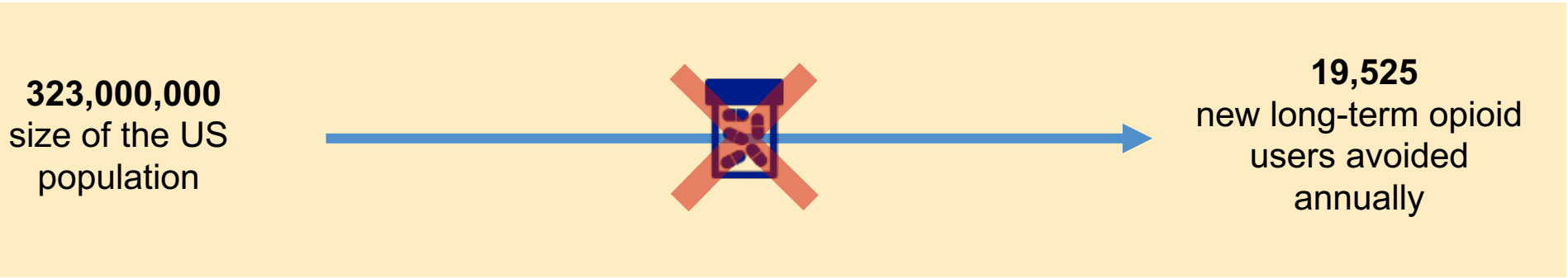
5.8 pct pts; 45% relative reduction

Scheduling all first-prescription opioid patients with a different provider could have large implications for long-term opioid use

In 2016, **287** new patients started long-term opioid use:



If we extrapolate to the United States:



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Thank you!

Questions?

Appendix

Instrumental variables should satisfy both the relevance criteria and exclusion restriction

Proposed IV	Relevance Criteria	Exclusion Restriction
PAST_SWITCH_PROP: Proportion of **other patients** (patients in who saw the doctor in the 12 months prior to the index appointment) who visit the same first doctor and who switch to a different doctor for their next appointment	If other patients are switching from the first provider (for any reason including: scheduling issues in the practice, a culture of fragmented care in the region, etc.) then the patient of interest is also more likely to switch doctors. (0.37 correlation)	Other patients' switching behaviour should not directly affect the patient of interest's likelihood of becoming opioid dependent
DOCTOR_PREV_SEEN: An indicator that flags whether the patient of interest has had an appointment with their first opioid-prescribing provider in the 6 months **prior** to the index appointment	If the patient of interest has already established a relationship with the prescribing doctor, he/she will be less likely to switch doctors during the next appointment. (-0.21 correlation)	Whether or not the patient of interest has seen their first prescribing doctor in the opioid-free 6 month period should not directly affect the patient's likelihood of becoming opioid dependent

Regression Output: Stage 1 Matched Dataset

> Stage 1: DIFF_PROVIDER_FLAG ~ PROV_PAST_CHANGE_PROP + PROV_PAST_APPT_RARE + ALL_CONTROLS

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-1.214004553	0.317386841	-3.825	0.000131	***
PROV_PAST_CHANGE_PROP	4.086169239	0.179436128	22.772	< 0.0000000000000002	***
PROV_PAST_APPT_RARE	0.497872483	0.073179554	6.803	0.0000000000102	***
FP_SPECIALTY_CATGENERAL	0.342690834	0.303752467	1.128	0.259239	
FP_SPECIALTY_CATINTERNAL	0.196103002	0.069316756	2.829	0.004668	**
FP_SPECIALTY_CATNP	-0.341569773	0.115663389	-2.953	0.003146	**
FP_SPECIALTY_CATPA	-0.492488749	0.100126731	-4.919	0.0000008714134	***
GENDERM	0.053872342	0.058643699	0.919	0.358285	
OBS_HISTORY_OF_RX	0.014724922	0.058243746	0.253	0.800411	
PROV_IN_PRIOR_6MO	-0.101428195	0.079989331	-1.268	0.204790	
APPT_IN_PRIOR_6MO	0.009232194	0.024154562	0.382	0.702303	
TOTAL_INITIAL_MME_SQRT	0.004389126	0.005057539	0.868	0.385483	
FP_SHARED_OFFICE_CT_LOG	-0.054312412	0.021648347	-2.509	0.012113	*
FP_RX_CLASSIFICATIONHIGH	0.137602180	0.083014364	1.658	0.097404	.
FP_RX_CLASSIFICATIONLOW	-0.025384411	0.067607794	-0.375	0.707314	
FP_SMALL_RX_CT	-0.205313416	0.114808455	-1.788	0.073726	.

Additional Controls:

AGE_BUCKET
LOB_CATEGORY
SOCIO_ECONOMIC
COMORBIDITIES
MONTHS_SINCE_LAST_APPT
PRIMARY_ICD_CHAPTER_KEY
FIRST_OPIOID_DRUG_BASE
PATIENT_STATE

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Regression Output: Stage 2 Matched Dataset

> Stage 2: LONG_TERM_OPIOID_USAGE ~ PREDICT(DIFF_PROVIDER_FLAG) + PROV_PAST_APPT_RARE + ALL_CONTROLS

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-3.2516035473	0.7947247531	-4.091	0.0000429	***
DIFF_PROVIDER_FLAG	-1.4067865689	0.3987816679	-3.528	0.000419	***
PROV_PAST_APPT_RARE	0.3246261738	0.1761171595	1.843	0.065294	.
FP_SPECIALTY_CATGENERAL	0.2515352659	0.6459806737	0.389	0.696991	
FP_SPECIALTY_CATINTERNAL	0.1212145727	0.1618635598	0.749	0.453936	
FP_SPECIALTY_CATNP	0.3051785188	0.2444848841	1.248	0.211939	
FP_SPECIALTY_CATPA	-0.1193653379	0.2452174708	-0.487	0.626419	
GENDERM	0.0798937563	0.1331725557	0.600	0.548555	
OBS_HISTORY_OF_RX	-0.1777068444	0.1364320461	-1.303	0.192735	
PROV_IN_PRIOR_6MO	-0.1047401473	0.1699245020	-0.616	0.537636	
APPT_IN_PRIOR_6MO	0.0058181815	0.0425649193	0.137	0.891276	
TOTAL_INITIAL_MME_SQRT	0.1129241293	0.0088290337	12.790	< 0.0000000000000002	***
FP_SHARED_OFFICE_CT_LOG	-0.0082442516	0.0493418806	-0.167	0.867304	
FP_RX_CLASSIFICATIONHIGH	0.2976924870	0.1698439336	1.753	0.079646	.
FP_RX_CLASSIFICATIONLOW	-0.2195976888	0.1859653110	-1.181	0.237661	
FP_SMALL_RX_CT	0.0362768863	0.2417575324	0.150	0.880721	

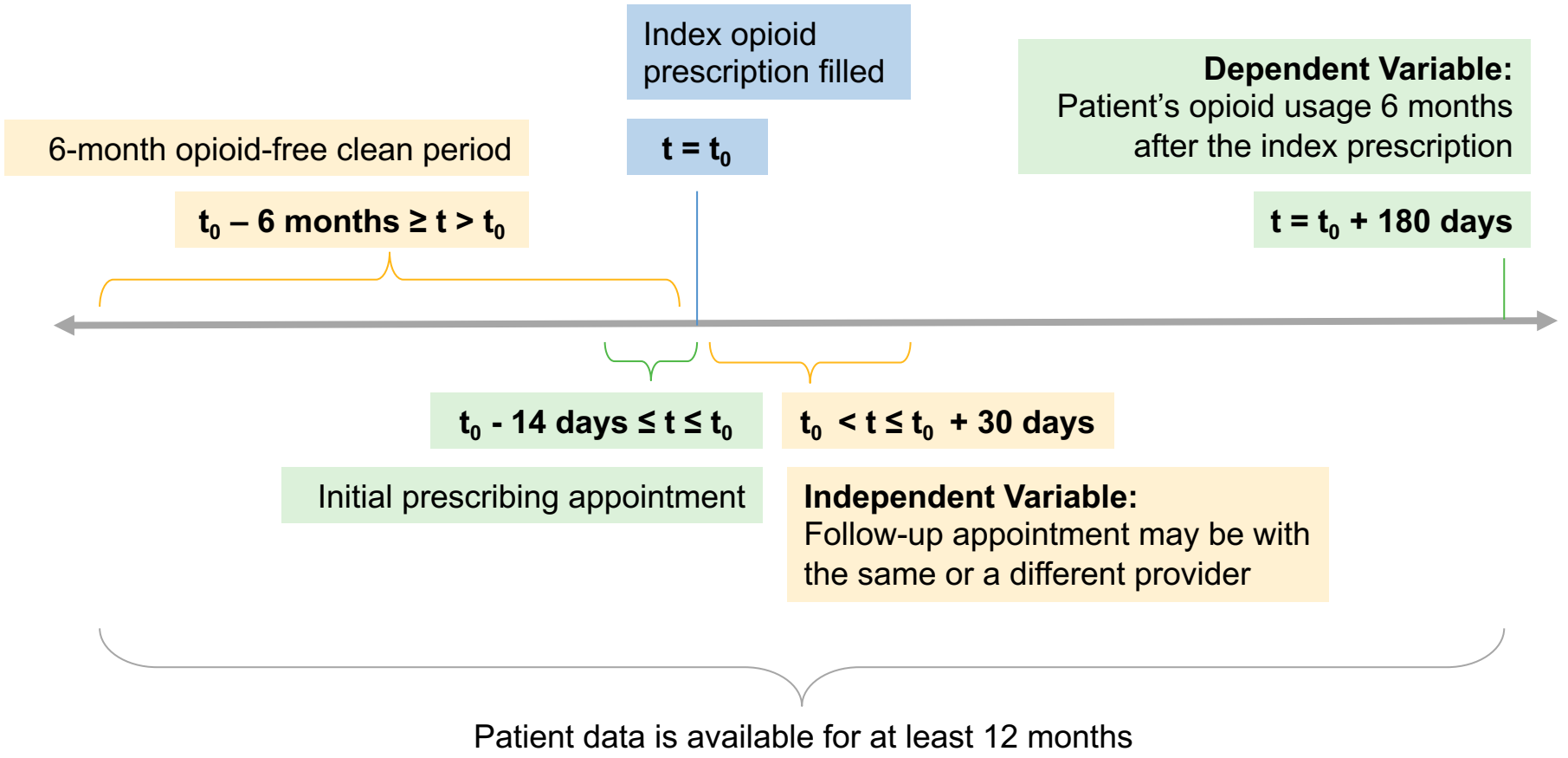
Additional Controls:
AGE_BUCKET
LOB_CATEGORY
SOCIO_ECONOMIC
COMORBIDITIES
MONTHS_SINCE_LAST_APPT
PRIMARY_ICD_CHAPTER_KEY
FIRST_OPIOID_DRUG_BASE
PATIENT_STATE

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

The average treatment effect of seeing a different doctor for the follow-up appointment is (95% confidence interval):

- 5.78 percentage points (- 10.39 pct pts, -2.81 pct pts)

The study focuses on the beginning of the patient's opioid journey



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