

# Supplemental Tables and Figures

eTable 1: Table of ICD9 Codes of Pre-Operative Abuse and Post-Operative Abuse

eTable 2: All Events Cox Model

eFigure 1: CONSORT Protocol

eFigure 2: Prescribing Changes by Surgery Category

eFigure 3: Sensitivity Analysis with One-Year Events

eFigure 4: Sensitivity Analysis with No Intervening Surgery

## eTable 1: ICD Code Tables Used in the Study

### 1A: All Observed Outcome Codes

ICD	LONG DESCRIPTION	N in sample
304.00	Opioid type dependence, unspecified	2,203
304.01	Opioid type dependence, continuous	1,311
305.50	Opioid abuse, unspecified	484
965.09	Poisoning by other opiates and related narcotics	409
E935.2	Other opiates and related narcotics causing adverse effects in therapeutic use	384
965.00	Poisoning by opium (alkaloids), unspecified	190
304.70	Combinations of opioid type drug with any other drug dependence, unspecified	113
305.51	Opioid abuse, continuous	77
304.71	Combinations of opioid type drug with any other drug dependence, continuous	72
E850.2	Accidental poisoning by other opiates and related narcotics	63
304.02	Opioid type dependence, episodic	39
305.53	Opioid abuse, in remission	35
305.52	Opioid abuse, episodic	30
304.72	Combinations of opioid type drug with any other drug dependence, episodic	11

### 1B: All Abuse Codes Used for Exclusion Criteria

ICD	LONG DESCRIPTION	N in sample
304.00	Opioid type dependence, unspecified	2,240
305.90	Other, mixed, or unspecified drug abuse, unspecified	1,625
304.01	Opioid type dependence, continuous	1,486
304.90	Unspecified drug dependence, unspecified	1,417
977.9	Poisoning by unspecified drug or medicinal substance	1,076
292.0	Drug withdrawal	956
305.50	Opioid abuse, unspecified	589
304.03	Opioid type dependence, in remission	283

E935.2	Other opiates and related narcotics causing adverse effects in therapeutic use	256
965.09	Poisoning by other opiates and related narcotics	229
304.91	Unspecified drug dependence, continuous	226
977.8	Poisoning by other specified drugs and medicinal substances	222
304.70	Combinations of opioid type drug with any other drug dependence, unspecified	177
305.93	Other, mixed, or unspecified drug abuse, in remission	160
965.00	Poisoning by opium (alkaloids), unspecified	145
305.51	Opioid abuse, continuous	134
304.71	Combinations of opioid type drug with any other drug dependence, continuous	121
305.91	Other, mixed, or unspecified drug abuse, continuous	120
305.53	Opioid abuse, in remission	90
305.53	Opioid abuse, in remission	90
304.02	Opioid type dependence, episodic	67
E980.0	Poisoning by analgesics, antipyretics, and antirheumatics, undetermined whether accidentally or purposely inflicted	48
304.93	Unspecified drug dependence, in remission	47
E850.2	Accidental poisoning by other opiates and related narcotics	44
965.01	Poisoning by heroin	43
305.92	Other, mixed, or unspecified drug abuse, episodic	42
305.52	Opioid abuse, episodic	36
304.73	Combinations of opioid type drug with any other drug dependence, in remission	32
965.02	Poisoning by methadone	25
292.12	Drug-induced psychotic disorder with hallucinations	24
304.72	Combinations of opioid type drug with any other drug dependence, episodic	18
304.92	Unspecified drug dependence, episodic	14

E850.0	Accidental poisoning by heroin	10
292.11	Drug-induced psychotic disorder with delusions	7
E850.1	Accidental poisoning by methadone	4
E935.0	Heroin causing adverse effects in therapeutic use	3

eTable 2: Comprehensive Adjusted Cox Regression Effects Model.

Covariate	Hazard ratio	Confidence interval, low	Confidence interval, high	p-value
Duration in weeks	1.199	1.185	1.214	< 1e-04
Dose in 10 MME/day	1.008	1.003	1.013	0.00126
Age 15-25 vs. <15	5.149	3.904	6.791	< 1e-04
Age 25-35 vs. <15	2.434	1.829	3.24	< 1e-04
Age 35-45 vs. <15	1.89	1.425	2.506	< 1e-04
Age 45-55 vs. <15	1.512	1.141	2.004	0.00404
Age 55-65 vs. <15	1.331	1.001	1.77	0.04908
Age 65+ vs. <15	1.179	0.877	1.586	0.27438
Benzodiazepine use	1.774	1.635	1.926	< 1e-04
Male	1.293	1.203	1.391	< 1e-04
Hydrocodone vs. Codeine	1.067	0.894	1.274	0.47152
Hydromorphone vs. Codeine	1.76	1.37	2.26	< 1e-04
Mixed types vs. Codeine	1.468	1.198	1.799	0.00022
Morphine vs. Codeine	2.247	1.38	3.658	0.00113
Oxycodone vs. Codeine	1.236	1.034	1.477	0.01965
Oxymorphone vs. Codeine	2.039	0.281	14.8	0.48121
Tramadol vs. Codeine	0.956	0.713	1.281	0.76216
State: AK	0.827	0.5	1.367	0.45767
State: AL	0.827	0.494	1.384	0.46909
State: AR	0.725	0.453	1.16	0.18023
State: AZ	1.004	0.77	1.309	0.97464
State: CA	0.901	0.717	1.133	0.37235
State: CO	0.936	0.688	1.273	0.67416
State: CT	0.968	0.752	1.246	0.80141
State: DC	0.907	0.556	1.481	0.69672
State: DE	0.749	0.42	1.334	0.32578
State: FL	0.86	0.683	1.083	0.19980
State: GA	0.844	0.64	1.111	0.22664
State: HI	0	0	1.224e+259	0.97004
State: IA	0.487	0.214	1.109	0.08659
State: ID	1.18	0.744	1.872	0.48210
State: IL	0.684	0.506	0.924	0.01326

State: IN	0.686	0.457	1.031	0.07004
State: KS	0.433	0.256	0.734	0.00186
State: KY	0.896	0.593	1.353	0.60011
State: LA	1.09	0.797	1.489	0.58992
State: MA	0.831	0.561	1.231	0.35659
State: MD	0.898	0.698	1.156	0.40474
State: ME	0.788	0.559	1.111	0.17471
State: MI	0.58	0.409	0.821	0.00215
State: MN	0.875	0.517	1.482	0.61963
State: MO	0.628	0.434	0.909	0.01376
State: MS	1.457	1.017	2.087	0.04002
State: MT	0.505	0.16	1.592	0.24366
State: NC	0.501	0.336	0.749	0.00075
State: ND	0.358	0.05	2.566	0.30650
State: NE	0.516	0.251	1.059	0.07142
State: NH	0.941	0.546	1.622	0.82753
State: NJ	1.016	0.81	1.275	0.89146
State: NM	1.384	0.607	3.153	0.43927
State: NV	1.531	1.116	2.102	0.00838
State: NY	1.206	0.96	1.515	0.10790
State: OH	0.674	0.519	0.877	0.00323
State: OK	1.125	0.843	1.503	0.42380
State: OR	0.835	0.531	1.312	0.43430
State: PA	0.871	0.691	1.099	0.24500
State: RI	1.356	0.66	2.788	0.40689
State: SC	0.717	0.453	1.137	0.15719
State: SD	1.256	0.31	5.092	0.74962
State: TN	1.176	0.863	1.602	0.30351
State: TX	0.966	0.781	1.196	0.75417
State: UT	1.008	0.712	1.428	0.96332
State: VA	0.571	0.434	0.751	< 1e-04
State: VT	1.393	0.567	3.42	0.46966
State: WA	1.198	0.929	1.545	0.16375
State: WI	0.674	0.429	1.059	0.08735
State: WV	0.618	0.331	1.151	0.12920

State: WY	1.783	0.566	5.624	0.32350
Surgery year: 2009	1.041	0.933	1.16	0.47499
Surgery year: 2010	1.082	0.964	1.214	0.17946
Surgery year: 2011	1.077	0.952	1.218	0.23670
Surgery year: 2012	1.258	1.106	1.431	0.00048
Surgery year: 2013	1.273	1.107	1.465	0.00072
Surgery year: 2014	1.795	1.536	2.097	< 1e-04
Surgery year: 2015	2.464	1.744	3.48	< 1e-04
Surgery type: Auditory.system	1.109	0.662	1.857	0.69404
Surgery type: Cardiovascular.system	0.979	0.775	1.237	0.85951
Surgery type: Digestive.system	1.059	0.911	1.23	0.45481
Surgery type: Endocrine.system	1.281	0.968	1.696	0.08331
Surgery type: Female.genital.system	1.084	0.911	1.29	0.36224
Surgery type: Hernic.and.lymphatic.systems	1.032	0.756	1.409	0.84401
Surgery type: Integumentary.system	1.109	0.936	1.313	0.23051
Surgery type: Male.genital.system	0.831	0.618	1.118	0.22145
Surgery type: Maternity.care.and.delivery	1.048	0.555	1.978	0.88447
Surgery type: Mediastinum.and.diaphragm	1.675	0.923	3.042	0.08989
Surgery type: Musculoskeletal.system	1.099	0.951	1.271	0.20134
Surgery type: Nervous.system	0.717	0.607	0.848	0.00010
Surgery type: Reproductive.system	0	0	Inf	0.99714
Surgery type: Respiratory.system	0.901	0.622	1.304	0.57901
Surgery type: Urinary.system	0.875	0.671	1.142	0.32593
038.9: Septicemia NOS	1.481	1.073	2.044	0.01701
276.51: Dehydration	1.076	0.876	1.322	0.48577
276.8: Hypopotassemia	1.148	0.942	1.4	0.17161
296.32: Major depressive disorder, recurrent episode, moderate degree	1.505	1.218	1.86	0.00015
300.00: Anxiety state unspecified	1.47	1.319	1.637	< 1e-04

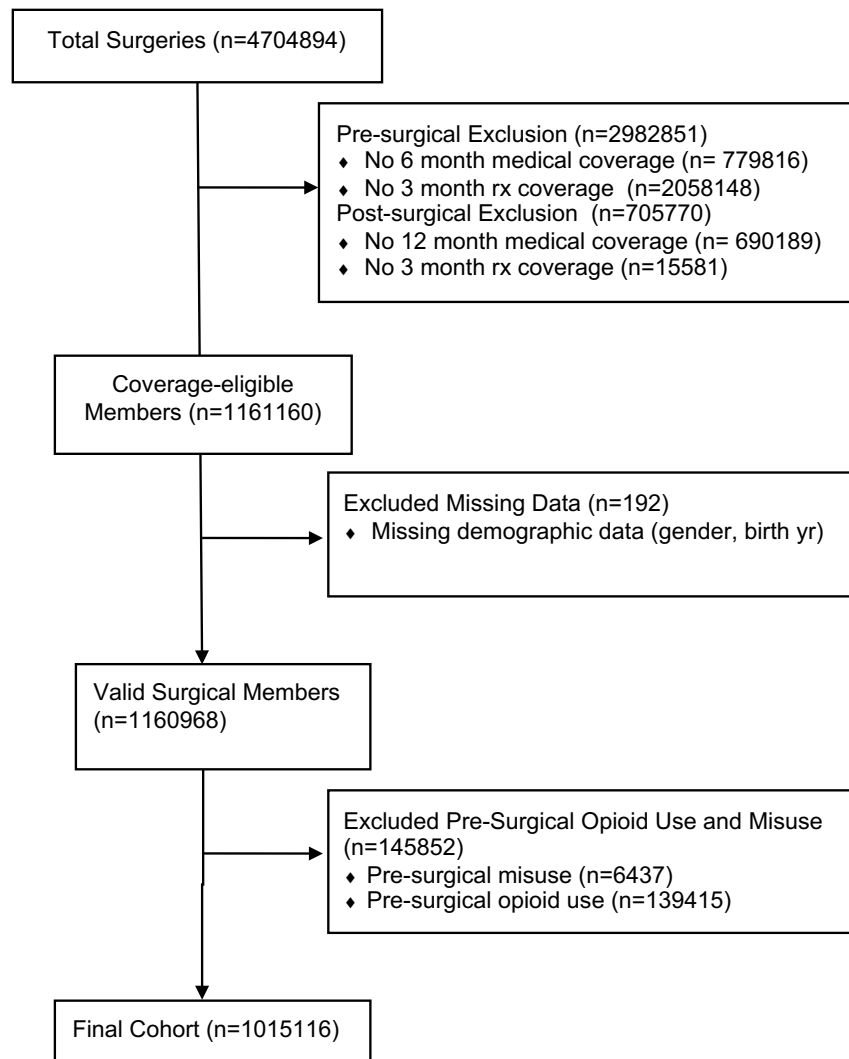
300.02: Generalized anxiety disorder	1.119	0.936	1.339	0.21656
300.4: Dysthymic disorder	1.489	1.265	1.751	< 1e-04
305.1: Tobacco use disorder	2.157	1.973	2.359	< 1e-04
309.28: Adjustment disorder with mixed anxiety and depressed mood	1.32	1.049	1.662	0.01779
311: Depressive disorder NEC	1.601	1.439	1.781	< 1e-04
314.00: Attention deficit disorder of childhood without mention of hyperactivity	1.516	1.221	1.883	0.00017
314.01: Attention deficit disorder of childhood with hyperactivity	1.504	1.207	1.873	0.00027
338.29: Other chronic pain	2.017	1.682	2.418	< 1e-04
346.90: Migraine, unspecified, without mention of intractable migraine without mention of status migrainosus	1.326	1.121	1.57	0.00101
356.9: Unspecified idiopathic peripheral neuropathy	1.343	1.017	1.773	0.03776
462: Acute pharyngitis	1.153	1.024	1.298	0.01905
466.0: Acute bronchitis	1.258	1.101	1.436	0.00072
473.9: Chronic sinusitis NOS	1.103	0.922	1.318	0.28329
493.90: Asthma, unspecified type, without mention of status asthmaticus	1.217	1.089	1.36	0.00052
518.81: Acute respiratory failure	1.08	0.813	1.433	0.59610
535.10: Atrophic gastritis, without mention of hemorrhage	1.135	0.894	1.44	0.29861
535.40: Other specified gastritis, without mention of hemorrhage	1.23	0.967	1.565	0.09174
535.50: Unspecified gastritis and gastroduodenitis, without mention of hemorrhage	1.067	0.888	1.283	0.48863
558.9: Other and unspecified noninfectious gastroenteritis and colitis	1.095	0.907	1.321	0.34494
564.00: Constipation NOS	1.229	1.049	1.438	0.01047
682.6: Cellulitis and abscess of leg,	1.475	1.102	1.974	0.00892



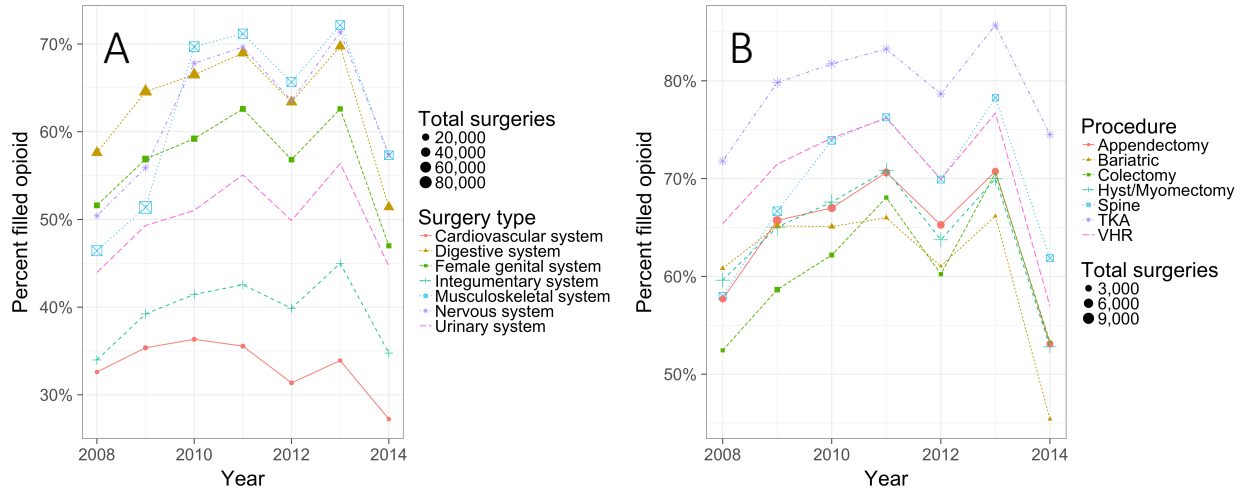
except foot

714.0: Rheumatoid arthritis	1.417	1.104	1.819	0.00613
721.3: Lumbosacral spondylosis without myelopathy	1.339	1.129	1.588	0.00082
722.4: Degeneration of cervical intervertebral disc	1.269	1.043	1.545	0.01747
722.52: Degeneration of lumbar or lumbosacral intervertebral disc	1.055	0.896	1.242	0.52376
723.1: Cervicalgia	1.079	0.95	1.226	0.24348
723.4: Brachial neuritis or radiculitis NOS	1.178	0.977	1.421	0.08622
724.2: Lumbago	1.287	1.154	1.436	< 1e-04
724.4: Thoracic or lumbosacral neuritis or radiculitis, unspecified	1.364	1.172	1.587	< 1e-04
724.5: Backache unspecified	1.265	1.118	1.43	0.00018
724.8: Other symptoms referable to back	1.04	0.787	1.374	0.78263
729.1: Myalgia and myositis unspecified	1.164	1.014	1.336	0.03083
780.52: Insomnia, unspecified	1.661	1.441	1.914	< 1e-04
780.53: Hypersomnia with sleep apnea, unspecified	1.131	0.9	1.419	0.29070
780.79: Other malaise and fatigue	1.252	1.139	1.375	< 1e-04
780.97: Altered mental status	1.271	0.923	1.749	0.14119
783.21: Loss of weight	1.252	0.999	1.569	0.05132
784.0: Headache	1.157	1.028	1.302	0.01537
785.0: Tachycardia NOS	1.022	0.823	1.27	0.84102
786.09: Other dyspnea and respiratory abnormality	1.081	0.942	1.241	0.26638
786.2: Cough	1.035	0.919	1.166	0.56788
786.50: Unspecified chest pain	1.034	0.932	1.148	0.52593
787.01: Nausea with vomiting	1.173	1.02	1.349	0.02515
787.03: Vomiting alone	1.349	1.126	1.616	0.00118
787.3: Flatulence, eructation, and gas pain	1.142	0.915	1.425	0.24016
787.91: Diarrhea	1.192	1.023	1.389	0.02403
789.00: Abdominal pain,	1.122	1.018	1.237	0.02002

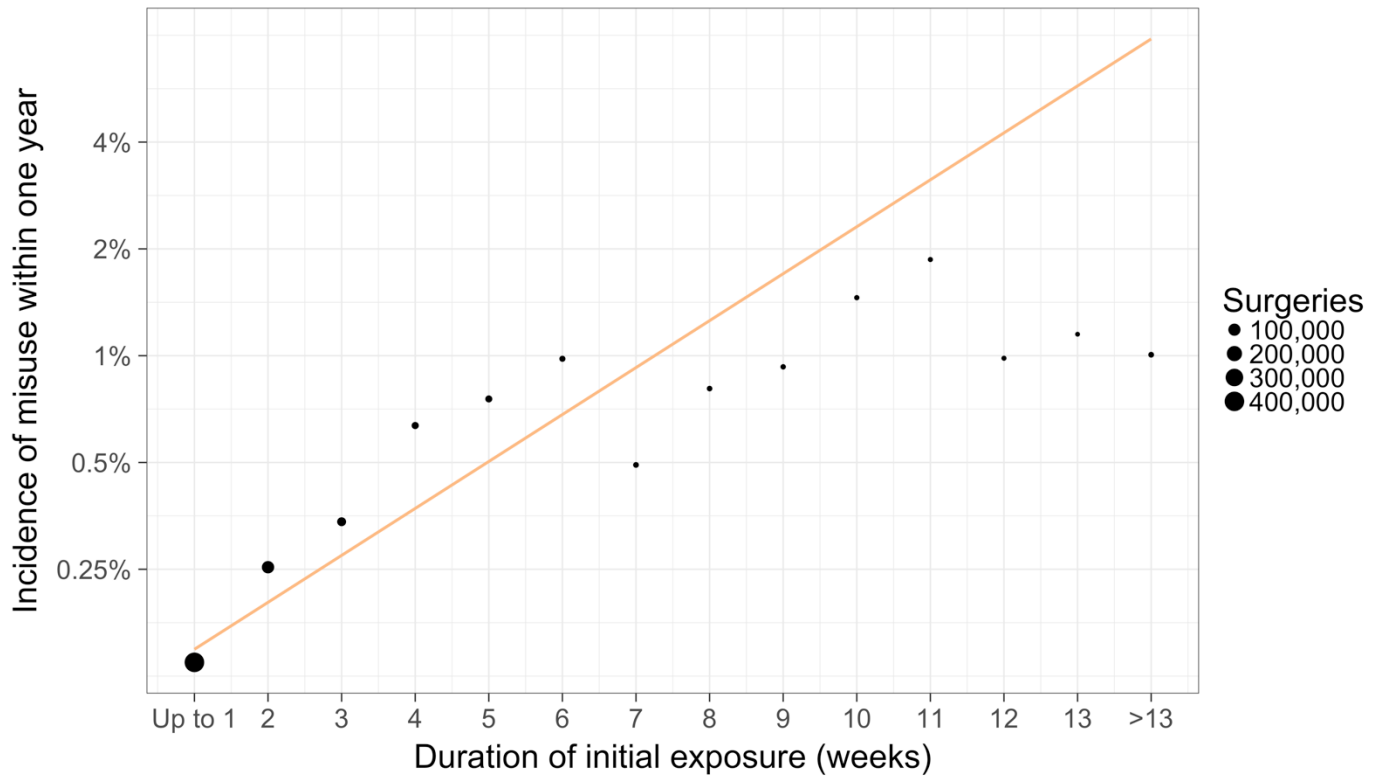
unspecified site				
789.07: Abdominal pain, generalized	1.288	1.124	1.476	0.00026
789.09: Abdominal pain, other specified site; multiple sites	1.169	1.031	1.326	0.01491
789.59: Other ascites	1.037	0.778	1.382	0.80394
847.0: Neck sprain	1.543	1.28	1.86	< 1e-04
959.09: Injury of face and neck	1.487	1.165	1.899	0.00146
959.11: Other injury of chest wall	1.253	0.944	1.664	0.11821
V45.4: Postsurgical arthrodesis status	1.27	1.025	1.572	0.02847
V45.86: Bariatric surgery status	2.195	1.77	2.724	< 1e-04
V58.81: Encounter for fitting and adjustment of vascular catheter	1.046	0.847	1.294	0.67452
V58.82: Encounter for fitting and adjustment of non-vascular catheter NEC	1.168	0.91	1.5	0.22360
V70.0: Routine general medical examination at a health care facility	0.769	0.691	0.855	< 1e-04
V71.89: Observation for other specified suspected conditions	1.191	0.902	1.573	0.21687
V76.12: Other screening mammogram	0.928	0.813	1.059	0.26826
V85.4: Body Mass Index 40 and over, adult	1.278	0.989	1.65	0.06078



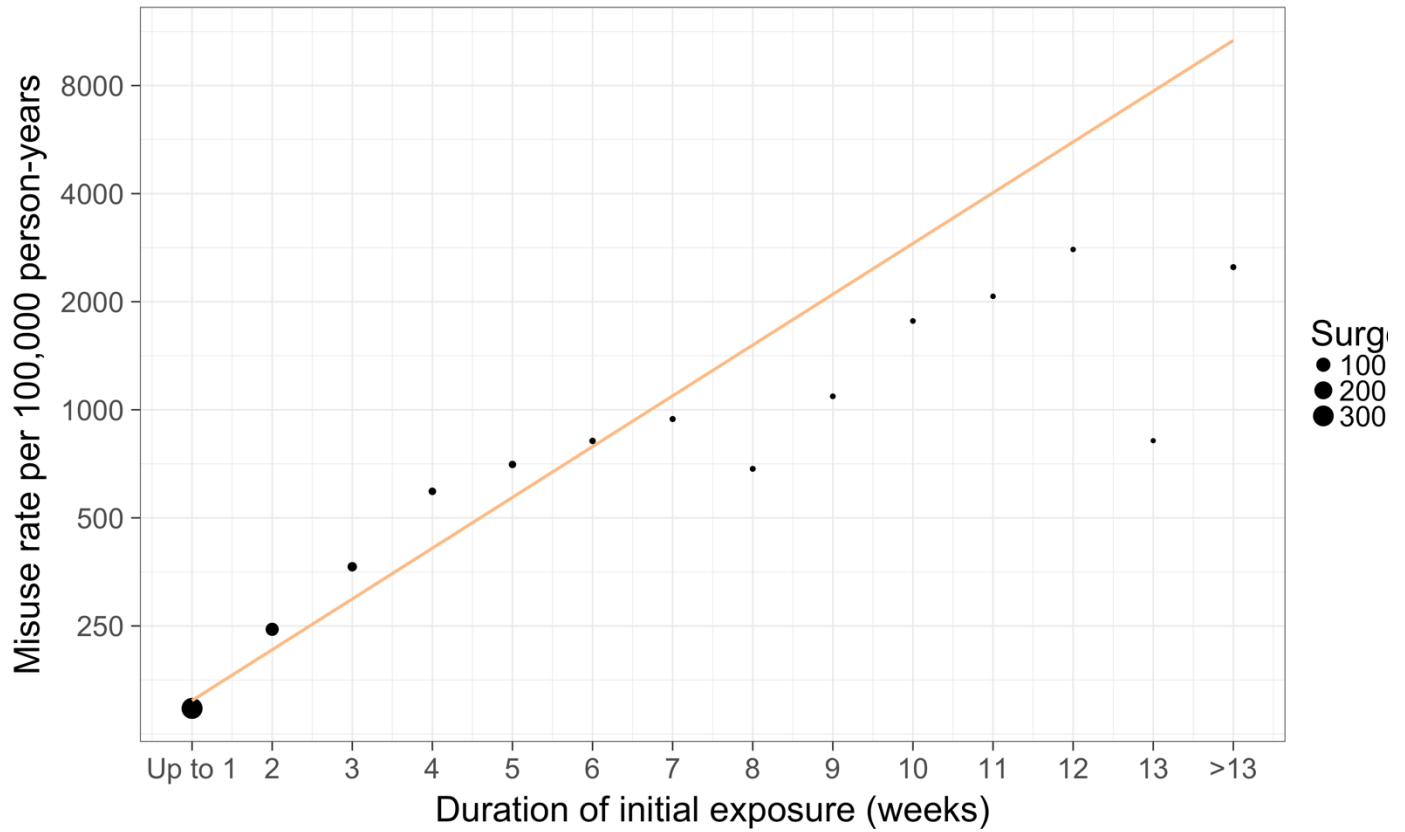
eFigure 1: CONSORT Diagram of Cohort Derivation.



eFigure 2: Rate of Post-Discharge Opioid Prescriptions During the Years of the Study. The graphs are arranged by (A) surgery type and (B) select representative surgeries. The size of each data point represents the number of surgical events.



eFigure 3: Incidence of Opioid Abuse and Overdose Within One Year After Surgery by Week of Exposure. The relationship between rates of opioid abuse and weeks of post-surgical opioid prescription. The size of each data point represents the number of surgical events. Y axis is represented on a log scale.



eFigure 4: Rate of Opioid Abuse and Overdose Among Those with No Subsequent Surgery by Week of Exposure. The relationship between rates of overdose and weeks of post-surgical opioid prescription duration for patients who did not have subsequent surgeries after the index surgery. The size of each data point represents the number of surgical events. Y axis is represented on a log scale.