**Supplementary Materials**

**Changes in Opioid Dispensing by Medical Specialties after Release of the 2016 CDC Guideline for Prescribing Opioids for Chronic Pain**

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**Figure S1. Flow Chart for Dispensed Prescriptions Included for Analysis – United States, 2015-2019.**

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**\***A full list of clinician specialties which were excluded is included in Supplementary Table SX.

† 654,986,729 dispensed prescriptions met minimum data completeness for inclusion and are analyzed in Table 1. An additional 998,482 dispensed prescriptions (<0.1% of included data) for which dosage, quantity, and/or dispensing date were missing were excluded from the interrupted time-series analysis.

**Table S1. Medical Specialty Group Categorization for IQVIA Clinician Specialties.**

|  |  |
| --- | --- |
| **Clinician Specialty Description** | **Specialty Group** |
| Addiction Medicine | Addiction Medicine |
| Addiction Psychiatry | Addiction Medicine |
| Allergy | Allergy & Immunology |
| Allergy & Immunology | Allergy & Immunology |
| Clinical & Laboratory Immunology (Internal Medicine) | Allergy & Immunology |
| Clinical Laboratory Immunology (Allergy & Immunology) | Allergy & Immunology |
| Immunology | Allergy & Immunology |
| Adult Cardiothoracic Anesthesiology | Anesthesiology |
| Anesthesiology | Anesthesiology |
| Certified Nurse Anesthetist | Anesthesiology |
| Internal Medicine/Anesthesiology | Anesthesiology |
| Obstetric Anesthesiology | Anesthesiology |
| Pediatric Anesthesiology | Anesthesiology |
| Pediatrics/Anesthesiology | Anesthesiology |
| Adult Congenital Heart Disease (Internal Medicine) | Cardiology |
| Advanced Heart Failure & Transplant Cardiology | Cardiology |
| Cardiovascular Disease | Cardiology |
| Clinical Cardiac Electrophysiology | Cardiology |
| Interventional Cardiology | Cardiology |
| Dental Hygienist | Dentist |
| Dentist | Dentist |
| Dentistry/Anesthesiology | Dentist |
| Dentistry/Endodontics | Dentist |
| Dentistry/Orthodontics | Dentist |
| Dentistry/Pedodontics | Dentist |
| Dentistry/Periodontics | Dentist |
| Dentistry/Prosthodontics | Dentist |
| Clinical Informatics (Emergency Medicine) | Emergency Medicine |
| Critical Care Medicine (Emergency Medicine) | Emergency Medicine |
| Emergency Medical Services | Emergency Medicine |
| Emergency Medical Services | Emergency Medicine |
| Emergency Medicine | Emergency Medicine |
| Internal Medicine/Emergency Medicine | Emergency Medicine |
| Medical Toxicology (Emergency Medicine) | Emergency Medicine |
| Medical Toxicology (Preventive Medicine) | Emergency Medicine |
| Pediatric Emergency Medicine | Emergency Medicine |
| Pediatric Emergency Medicine (Pediatrics) | Emergency Medicine |
| Pediatrics/Emergency Medicine | Emergency Medicine |
|  |  |
| **Clinician Specialty Description** | **Specialty Group** |
| Sports Medicine (Emergency Medicine) | Emergency Medicine |
| Underseas Medicine (Emergency Medicine) | Emergency Medicine |
| Diabetes | Endocrinology |
| Endocrinology, Diabetes & Metabolism | Endocrinology |
| Clinical Informatics (Family Medicine) | Family Medicine |
| Family Medicine | Family Medicine |
| General Practice | Family Medicine |
| Geriatric Medicine (Family Medicine) | Family Medicine |
| Internal Medicine/Family Medicine | Family Medicine |
| Sports Medicine (Family Medicine) | Family Medicine |
| Gastroenterology | Gastroenterology/Hepatology |
| Hepatology | Gastroenterology/Hepatology |
| Transplant Hepatology (Internal Medicine) | Gastroenterology/Hepatology |
| Infectious Disease | Infectious Disease |
| Clinical Informatics (Internal Medicine) | Internal Medicine |
| Geriatric Medicine (Internal Medicine) | Internal Medicine |
| Hospitalist | Internal Medicine |
| Internal Medicine | Internal Medicine |
| Internal Medicine/Preventive Medicine | Internal Medicine |
| Osteopathic Manipulative Medicine | Internal Medicine |
| Sports Medicine (Internal Medicine) | Internal Medicine |
| Nephrology | Nephrology |
| Sleep Medicine | Neurology |
| Critical Care Medicine (Obstetrics & Gynecology) | OB/GYN |
| Female Pelvic Medicine & Reconstructive Surgery | OB/GYN |
| Gynecology | OB/GYN |
| Maternal & Fetal Medicine | OB/GYN |
| Obstetrics | OB/GYN |
| Obstetrics & Gynecology | OB/GYN |
| Reproductive Endocrinology & Infertility | OB/GYN |
| Aerospace Medicine | Occupational Medicine |
| General Preventive Medicine | Occupational Medicine |
| Occupational Medicine | Occupational Medicine |
| Public Health & General Preventive Medicine | Occupational Medicine |
| Underseas Medicine (Preventive Medicine) | Occupational Medicine |
| Gynecological Oncology | Oncology and/or Hematology |
| Hematology (Internal Medicine) | Oncology and/or Hematology |
| Hematology/Oncology | Oncology and/or Hematology |
| **Clinician Specialty Description** | **Specialty Group** |
| Medical Oncology | Oncology and/or Hematology |
| Musculoskeletal Oncology | Oncology and/or Hematology |
| Radiation Oncology | Oncology and/or Hematology |
| Ophthalmology | Ophthalmology |
| Retinal Specialist | Ophthalmology |
| Abdominal Radiology | Other |
| Acupuncturist | Other |
| Anatomic Pathology | Other |
| Anatomic/Clinical Pathology | Other |
| Behavioral Health & Social Services | Other |
| Blood Banking/Transfusion Medicine | Other |
| Cardiothoracic Radiology | Other |
| Chemical Pathology | Other |
| Clinical Biochemical Genetics | Other |
| Clinical Cytogenetics | Other |
| Clinical Genetics | Other |
| Clinical Informatics (Pathology) | Other |
| Clinical Molecular Genetics | Other |
| Clinical Neurophysiology | Other |
| Clinical Pathology | Other |
| Cytopathology | Other |
| Dermatologic Surgery | Other |
| Dermatology | Other |
| Dermatopathology | Other |
| Diagnostic Radiology | Other |
| Diagnostic Radiology/Nuclear Medicine | Other |
| Epilepsy | Other |
| Forensic Pathology | Other |
| Hematology (Pathology) | Other |
| Interventional Radiology-Integrated | Other |
| Medical Genetics | Other |
| Molecular Genetic Pathology (Pathology) | Other |
| Musculoskeletal Radiology | Other |
| Neurology | Other |
| Neuromuscular Medicine (Neurology) | Other |
| Neuropathology | Other |
| Neuroradiology | Other |
| Nuclear Cardiology | Other |
| Nuclear Medicine | Other |
| Nuclear Radiology | Other |
| Pediatric Pathology | Other |
| Pharmaceutical Medicine | Other |
| **Clinician Specialty Description** | **Specialty Group** |
| Procedural Dermatology | Other |
| Radiology | Other |
| Selective Pathology | Other |
| Therapeutic Radiology | Other |
| Vascular & Interventional Radiology | Other |
| Vascular Medicine | Other |
| Vascular Neurology | Other |
| Pain Medicine | Pain Medicine |
| Pain Medicine (Anesthesiology) | Pain Medicine |
| Pain Medicine (Neurology) | Pain Medicine |
| Pain Medicine (Physical Medicine & Rehabilitation) | Pain Medicine |
| Pain Medicine (Psychiatry) | Pain Medicine |
| Regional Anesthesiology And Acute Pain Medicine (Anesthesia) | Pain Medicine |
| Hospice & Palliative Medicine | Palliative Care |
| Hospice & Palliative Medicine (Anesthesiology) | Palliative Care |
| Hospice & Palliative Medicine (Emergency Medicine) | Palliative Care |
| Hospice & Palliative Medicine (Family Medicine) | Palliative Care |
| Hospice & Palliative Medicine (Internal Medicine) | Palliative Care |
| Hospice & Palliative Medicine (Obstetrics & Gynecology) | Palliative Care |
| Hospice & Palliative Medicine (Pediatrics) | Palliative Care |
| Hospice & Palliative Medicine (Physical Medicine & Rehabilitation) | Palliative Care |
| Hospice & Palliative Medicine (Psychiatry & Neurology) | Palliative Care |
| Hospice & Palliative Medicine (Radiology) | Palliative Care |
| Palliative Medicine | Palliative Care |
| Pediatric Hematology/Oncology | Pediatric Hematology/Oncology |
| Child & Adolescent Psychiatry | Pediatric Subspecialties (Other) |
| Child Neurology | Pediatric Subspecialties (Other) |
| Clinical & Laboratory Immunology (Pediatrics) | Pediatric Subspecialties (Other) |
| Pediatric Allergy | Pediatric Subspecialties (Other) |
| Pediatric Cardiology | Pediatric Subspecialties (Other) |
| Pediatric Cardiothoracic Surgery | Pediatric Subspecialties (Other) |
| Pediatric Critical Care Medicine | Pediatric Subspecialties (Other) |
| Pediatric Dermatology | Pediatric Subspecialties (Other) |
| Pediatric Endocrinology | Pediatric Subspecialties (Other) |
| Pediatric Gastroenterology | Pediatric Subspecialties (Other) |
| Pediatric Infectious Disease | Pediatric Subspecialties (Other) |
| Pediatric Nephrology | Pediatric Subspecialties (Other) |
| Pediatric Ophthalmology | Pediatric Subspecialties (Other) |
| Pediatric Orthopedics | Pediatric Subspecialties (Other) |
| Pediatric Otolaryngology | Pediatric Subspecialties (Other) |
| **Clinician Specialty Description** | **Specialty Group** |
| Pediatric Pulmonology | Pediatric Subspecialties (Other) |
| Pediatric Radiology | Pediatric Subspecialties (Other) |
| Pediatric Rheumatology | Pediatric Subspecialties (Other) |
| Pediatric Surgery | Pediatric Subspecialties (Other) |
| Pediatric Surgery (Neurology) | Pediatric Subspecialties (Other) |
| Pediatric Transplant Hepatology | Pediatric Subspecialties (Other) |
| Pediatrics/Psychiatry/Child & Adolescent Psychiatry | Pediatric Subspecialties (Other) |
| Sports Medicine (Pediatrics) | Pediatric Subspecialties (Other) |
| Adolescent Medicine (Internal Medicine) | Pediatrics |
| Adolescent Medicine (Pediatrics) | Pediatrics |
| Child Abuse Pediatrics | Pediatrics |
| Clinical Informatics (Pediatrics) | Pediatrics |
| Developmental/Behavioral Pediatrics | Pediatrics |
| Internal Medicine/Pediatrics | Pediatrics |
| Neonatal-Perinatal Medicine | Pediatrics |
| Neurodevelopmental Disabilities (Pediatrics) | Pediatrics |
| Pediatrics | Pediatrics |
| Brain Injury Medicine (Physical Medicine & Rehabilitation | Physical Medicine & Rehabilitation |
| Neuromuscular Medicine (Physical Medicine & Rehabilitation) | Physical Medicine & Rehabilitation |
| Pediatric Rehabilitation Medicine | Physical Medicine & Rehabilitation |
| Physical Medicine & Rehabilitation | Physical Medicine & Rehabilitation |
| Sports Medicine (Physical Medicine & Rehabilitation) | Physical Medicine & Rehabilitation |
| Podiatrist | Podiatry |
| Brain Injury Medicine (Psychiatry & Neurology) | Psychiatry |
| Forensic Psychiatry | Psychiatry |
| Geriatric Psychiatry | Psychiatry |
| Internal Medicine/Psychiatry | Psychiatry |
| Neurodevelopmental Disabilities (Psychiatry & Neurology) | Psychiatry |
| Psychiatry | Psychiatry |
| Psychiatry/Family Medicine | Psychiatry |
| Psychiatry/Neurology | Psychiatry |
| Anesthesiology Critical Care Medicine (Emergency Medicine | Pulmonary/Critical Care Medicine |
| Critical Care Medicine (Anesthesiology) | Pulmonary/Critical Care Medicine |
| Critical Care Medicine (Internal Medicine) | Pulmonary/Critical Care Medicine |
| Neurocritical Care (Psych & Neuro) | Pulmonary/Critical Care Medicine |
| Pulmonary Critical Care Medicine | Pulmonary/Critical Care Medicine |
| Pulmonary Disease | Pulmonary/Critical Care Medicine |
| Rheumatology | Rheumatology |
| Abdominal Surgery | Surgery |
| **Clinician Specialty Description** | **Specialty Group** |
| Adult Reconstructive Orthopedics | Surgery |
| Cardiothoracic Surgery | Surgery |
| Cardiovascular Surgery | Surgery |
| Colon & Rectal Surgery | Surgery |
| Congenital Cardiac Surgery (Thoracic Surgery) | Surgery |
| Craniofacial Surgery | Surgery |
| Critical Care Medicine (Neurological Surgery) | Surgery |
| Endovascular Surgical Neuroradiology (Neurological Surgery) | Surgery |
| Endovascular Surgical Neuroradiology (Neurology) | Surgery |
| Endovascular Surgical Neuroradiology (Radiology) | Surgery |
| Facial Plastic Surgery | Surgery |
| Female Pelvic Medicine & Reconstructive Surgery (Urology) | Surgery |
| Foot & Ankle, Orthopedics | Surgery |
| General Surgery | Surgery |
| Hand Surgery | Surgery |
| Hand Surgery (Orthopedics) | Surgery |
| Hand Surgery (Plastic Surgery) | Surgery |
| Hand Surgery (Surgery) | Surgery |
| Head & Neck Surgery | Surgery |
| Neurological Surgery | Surgery |
| Neurotology (Otolaryngology) | Surgery |
| Oral & Maxillofacial Surgery | Surgery |
| Orthopedic Surgery | Surgery |
| Orthopedic Surgery Of The Spine | Surgery |
| Orthopedic Trauma | Surgery |
| Otolaryngology | Surgery |
| Otology | Surgery |
| Pediatric Urology | Surgery |
| Plastic Surgery | Surgery |
| Plastic Surgery Within The Head & Neck | Surgery |
| Plastic Surgery Within The Head & Neck (Otolaryngology) | Surgery |
| Proctology | Surgery |
| Spinal Cord Injury Medicine | Surgery |
| Sports Medicine (Orthopedic Surgery) | Surgery |
| Surgical Critical Care (Surgery) | Surgery |
| Surgical Oncology | Surgery |
| Thoracic Surgery | Surgery |
| Transplant Surgery | Surgery |
| Trauma Surgery | Surgery |
| Urology | Surgery |
| Vascular Surgery | Surgery |
| **Clinician Specialty Description** | **Specialty Group** |
| Advanced Registered Nurse | EXCLUDED |
| Alternate Therapy | EXCLUDED |
| Ancillary Services | EXCLUDED |
| Anesthesia Assistant | EXCLUDED |
| Audiology | EXCLUDED |
| Chiropractic | EXCLUDED |
| Clinical Nurse Specialist | EXCLUDED |
| Clinical Pharmacology | EXCLUDED |
| Clinical Social Worker | EXCLUDED |
| Epidemiology | EXCLUDED |
| Home Health/Personal Care | EXCLUDED |
| Legal Medicine | EXCLUDED |
| Licensed Practical Nurse | EXCLUDED |
| Licensed Vocational Nurse | EXCLUDED |
| Massage Therapy | EXCLUDED |
| Medical Management | EXCLUDED |
| Medical Microbiology | EXCLUDED |
| Military Health Care Provider | EXCLUDED |
| Naturopathic Doctor | EXCLUDED |
| Not Applicable | EXCLUDED |
| Nurse Midwife | EXCLUDED |
| Nurse Practitioner | EXCLUDED |
| Nutrition | EXCLUDED |
| Nutritionist | EXCLUDED |
| Occupational Therapy | EXCLUDED |
| Occupational Therapy - Assistant | EXCLUDED |
| Optometrist | EXCLUDED |
| Orthotics | EXCLUDED |
| **Clinician Specialty Description** | **Specialty Group** |
| Other Specialty | EXCLUDED |
| Perfusionist | EXCLUDED |
| Pharmacist | EXCLUDED |
| Pharmacist Intern | EXCLUDED |
| Pharmacy Technician | EXCLUDED |
| Phlebology | EXCLUDED |
| Physical Therapy | EXCLUDED |
| Physical Therapy - Assistant | EXCLUDED |
| Physician Assistant | EXCLUDED |
| Podiatrist - Assistant | EXCLUDED |
| Psychoanalysis | EXCLUDED |
| Psychology | EXCLUDED |
| Radiological Physics | EXCLUDED |
| Registered Dietician | EXCLUDED |
| Registered Nurse | EXCLUDED |
| Respiratory Therapist | EXCLUDED |
| Specialist/Technologist/Technician-Other | EXCLUDED |
| Student, Health Care | EXCLUDED |
| Surgical Assistant | EXCLUDED |
| Technologist - Audiology/Speech/Language | EXCLUDED |
| Technologist - Dental | EXCLUDED |
| Technologist - Health Information | EXCLUDED |
| Technologist - Pathology | EXCLUDED |
| Technologist - Radiologic | EXCLUDED |
| Technologist - Vision | EXCLUDED |
| Transitional Year | EXCLUDED |
| Unspecified | EXCLUDED |
| Veterinarian | EXCLUDED |

**Table S2. Changes in Prescription Dispensing Level After Release of the 2016 CDC *Guideline for Prescribing Opioids for Chronic Pain* – United States, 2015-2019.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Total****Prescriptions** | **High-****Dosage Prescriptions** | **Total****Monthly****MME** | **Average****MME per Prescription** | **Average****Prescription Duration** |
|  | Δβ0\* | p-value | Δβ0\* | p-value | Δβ0\* | p-value | Δβ0\* | p-value | Δβ0\* | p-value |
| Addiction Medicine | -0.35 | 0.002 | 0.04 | 0.219 | <0.001 | 0.432 | 15.81 | <0.001 | -0.10 | 0.534 |
| Allergy & Immunology | 0.10 | <0.001 | 0.04 | 0.003 | <0.001 | 0.002 | 2.80 | 0.225 | 0.83 | 0.298 |
| Anesthesiology | 8.04 | <0.001 | 3.29 | <0.001 | 0.21 | <0.001 | 1.58 | 0.087 | 0.39 | <0.001 |
| Cardiology | 0.48 | 0.122 | 0.07 | 0.145 | 0.01 | 0.018 | 1.52 | 0.158 | 0.63 | 0.121 |
| Dentist | 34.69 | <0.001 | 0.61 | 0.004 | 0.04 | <0.001 | 1.13 | 0.021 | 0.09 | <0.001 |
| Emergency Medicine | 19.30 | 0.233 | -0.41 | 0.403 | <0.001 | 0.930 | -0.12 | 0.592 | 0.04 | 0.557 |
| Endocrinology | 0.02 | 0.839 | -0.04 | 0.032 | <0.001 | 0.431 | -1.54 | 0.225 | 1.33 | 0.012 |
| Family Medicine | 67.8 | <0.001 | 11.3 | <0.001 | 1.02 | <0.001 | 1.29 | <0.001 | 0.65 | 0.034 |
| Gastroenterology/Hepatology | -0.10 | 0.490 | -0.01 | 0.863 | <0.001 | 0.674 | 0.64 | 0.451 | 0.92 | 0.022 |
| Infectious Disease | -0.13 | 0.410 | -0.01 | 0.593 | <0.001 | 0.252 | 0.38 | 0.462 | 0.65 | 0.010 |
| Internal Medicine | 36.9 | <0.001 | 6.51 | <0.001 | 0.56 | <0.001 | 1.18 | <0.001 | 0.76 | 0.036 |
| Nephrology | 0.72 | 0.002 | 0.10 | <0.001 | 0.01 | <0.001 | 0.41 | 0.552 | 1.10 | 0.081 |
| Neurology | -0.12 | <0.001 | -0.01 | 0.003 | 0.00 | <0.001 | -2.51 | 0.081 | 1.38 | <0.001 |
| OB/GYN | 7.38 | <0.001 | 0.91 | <0.001 | 0.04 | <0.001 | 2.36 | 0.007 | 0.48 | 0.002 |
| Occupational Medicine | -0.89 | <0.001 | -0.11 | 0.151 | -0.01 | 0.004 | 2.02 | 0.428 | -0.54 | 0.322 |
| Oncology and/or Hematology | 3.86 | <0.001 | 1.74 | <0.001 | 0.10 | <0.001 | 1.46 | 0.027 | 0.54 | 0.007 |
| Ophthalmology | 0.53 | 0.003 | -0.01 | 0.813 | 0.00 | 0.513 | 0.70 | 0.562 | -0.10 | 0.428 |
| Other | 3.43 | 0.008 | -0.08 | 0.787 | 0.02 | 0.251 | 0.01 | 0.970 | 0.42 | 0.001 |
| Pain Medicine | 39.3 | <0.001 | 12.3 | <0.001 | 0.82 | <0.001 | 1.44 | 0.122 | 0.45 | <0.001 |
| Palliative Care | -0.49 | 0.001 | -0.06 | 0.322 | -0.01 | 0.023 | 2.71 | 0.321 | -0.22 | 0.273 |
| Pediatric Hematology/ Oncology | 0.01 | 0.532 | -0.01 | 0.230 | 0.00 | 0.072 | -0.07 | 0.930 | 0.04 | 0.834 |
| Pediatric Subspecialties (Other) | 0.16 | 0.339 | -0.01 | 0.846 | 0.00 | 0.867 | -0.34 | 0.800 | 0.74 | 0.027 |
| Pediatrics | 0.77 | 0.107 | 0.00 | 0.979 | 0.01 | 0.153 | -0.61 | 0.225 | 0.36 | 0.196 |
| Physical Medicine & Rehabilitation | 12.9 | <0.001 | 5.46 | <0.001 | 0.35 | <0.001 | 3.10 | <0.001 | 0.53 | <0.001 |
| Podiatry | 3.58 | 0.008 | 0.51 | 0.002 | 0.02 | <0.001 | 1.68 | 0.077 | 0.91 | <0.001 |
| Psychiatry | -0.18 | 0.272 | 0.14 | 0.168 | 0.00 | 0.802 | 4.88 | 0.065 | 0.22 | 0.348 |
| Pulmonary/ Critical Care Medicine | 0.81 | 0.012 | 0.39 | <0.001 | 0.02 | 0.002 | 5.33 | 0.001 | 0.56 | 0.135 |
| Rheumatology | 3.08 | 0.001 | 0.20 | 0.050 | 0.04 | 0.001 | 0.93 | 0.016 | 0.89 | 0.042 |
| Surgery | 42.03 | <0.001 | 10.93 | <0.001 | 0.36 | <0.001 | 2.56 | 0.008 | 0.90 | <0.001 |

Abbreviations: MME – Morphine Milligram Equivalents

\*Δβ0denotes the change in intercept (level) of each outcome immediately following introduction of the 2016 CDC Guideline. Units for each outcome are: total prescriptions – prescriptions per 100,000; high-dosage prescriptions – prescriptions per 100,000; total monthly MME – MME; average MME per prescription – MME; average prescription duration – days.

**Figure S2. Total Monthly Opioid Prescriptions Dispensed per 100,000 by Clinician Specialty – United States, 2015-2019.**



Monthly trends in numbers of dispensed opioid prescriptions are illustrated for 29 clinician specialties. Data are drawn from the IQVIA Longitudinal Prescription (LRx) database from 2015 through 2019. Each point represents prescriptions dispensed for one calendar month, standardized to a 30-day month length. All numbers of monthly prescriptions dispensed are presented per 100,000 population. Modeled monthly trendlines are depicted prior to the release (blue lines) and after release (red lines) of the CDC Guideline (denoted by the dotted line), accompanied by slopes estimated for each trendline. Asterisks (\*) indicate statistically significant (p<0.05) coefficients for slope (prior to release, blue) or change in slope (after release, red) for each statistic reported. †For display purposes, some clinician specialty titles have been abbreviated here; see Supplementary Table SX for details of all specialty groups.