**Supplemental Content 4:**

**Table S2.** Definitions of opioid naïve, persistent opioid use, as well as the type and formulation of opioid used in each study.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author** | **Year** | **Article Title** | **Study Design** | **Location** | **Definition of Chronic Opioid Use (Post-operatively)** | **Definition of Opioid Naive** | **Opioids Used** |
| Lee1 | 2017 | New Persistent Opioid Use Among Patients With Cancer After Curative-Intent Surgery | Retrospective Cohort Study | United States | 1) Filled prescription within 30 days before surgery and 14 days after discharge; 2) Filled at least one additional opioid prescription between 90 and 180 days after surgery | No opioid prescriptions between 12 months and 31 days before surgery | Not specified |
| Marcusa2 | 2017 | Prescription Opioid Use among Opioid-Naive Women Undergoing Immediate Breast Reconstruction | Retrospective Cohort Study | United States | 1) Filled prescription within 30 days before surgery and 30 days after discharge; 2) Filled at least one additional opioid prescription between 90 and 120 days after surgery | No opioid prescriptions between 12 months and 31 days before surgery | Not Specified |
| Hansen3 | 2017 | Chronic Use of Opioids Before and After Total Knee Arthroplasty: A Retrospective Cohort Study | Retrospective Cohort Study | Australia | 90 days of continuous use or at least 120 days of noncontinuous use (within 275 days, excluding the first 90 days) | No opioid use in the year prior to surgery | Weak (codeine, dextropropoxyphene,tramadol) and Strong (buprenorphine, fentanyl, hydromorphone,hydrocodone, morphine, oxycodone, oxycodoneþnaloxone,pethidine hydrochloride). |
| Ladha4 | 2016 | Impact of Perioperative Epidural Placement on Postdischarge Opioid Use in Patients Undergoing Abdominal Surgery | Retrospective Cohort Study | United States | Outcome 1: Filled more than two opioid prescriptions within 90 days after dischargeOutcome 2: Filled at least one opioid prescription between 90 and 180 days after surgery | No Opioid in the 6-months prior to surgery | Not Specified |
| Schoenfeld5 | 2017 | Risk Factors for Prolonged Opioid Use Following Spine Surgery, and the Association with Surgical Intensity, Among Opioid-Naive Patients | Retrospective Cohort Study | United States | Authors used "Time to Discontinuation". Sustained opioid use was defined as a consistently filled prescription beginning within 30 days of hospital discharge and continuing with no more than 30 days elapsing between prescription refills until 6 months post-operatively. | No Opioid in the 6-months prior to surgery | All medications defined by the U.S. Drug Enforcement Agency as opioid combinations, opioid partial agonists, or opioidagonists in categories II (high abuse potential) or III (moderate risk of dependence) |
| Mueller6 | 2017 | Lack of Association Between the Use of Nerve Blockade and the Risk of Persistent Opioid Use Among Patients Undergoing Shoulder Arthroplasty: Evidence From the Marketscan Database | Retrospective Cohort Study | United States | Filled at least one opioid prescription between 90 and 365 days after surgery | No opioid use in the year prior to surgery | Prescriptions for fentanyl (patch or oral form), hydrocodone, hydromorphone (oral form), methadone, morphine, oxymorphone, and oxycodone, and excluded prescriptions containing hydrocodone in cough/cold formulation |
| Sun7 | 2017 | Lack of Association Between the Use of Nerve Blockade and the Risk of Postoperative Chronic Opioid Use Among Patients Undergoing Total Knee Arthroplasty: Evidence From the Marketscan Database | Retrospective Cohort Study | United States | 1) 10 or more prescriptions; or 2) >120 days’ supply within the first year of surgery (excluding the first 90 postoperative days) | No opioid use in the year prior to surgery | Prescriptions for fentanyl (patch or oral form), hydrocodone, hydromorphone (oral form), methadone, morphine, oxymorphone, and oxycodone and excluded prescriptions containing hydro-codone in cough/cold formulations |
| Brummett8 | 2017 | New Persistent Opioid Use After Minor and Major Surgical Procedures in US Adults | Retrospective Cohort Study | United States | (1) ≥1 Opioid prescription 30 d before procedure date through 2 wk after discharge. (2) Filled at least one opioid prescription between 90 and 180 days after surgery | No Prescription 11mo prior to index date (365 days - 31 days) | Not Specified |
| Sun9 | 2016 | Incidence of and Risk Factors for Chronic Opioid Use Among Opioid-Naive Patients in the Postoperative Period | Retrospective Cohort Study | United States | 1) 10 or more prescriptions; or 2) >120 days’ supply within the first year of surgery (excluding the first 90 postoperative days) | No opioid use in the year prior to surgery | Prescriptions for fentanyl (patch or oral form), hydrocodone, hydromorphone (oralform), methadone, morphine, oxymorphone, and oxyco-done and excluded prescriptions containing hydrocodone in cough/cold formulation. |
| Inacio10 | 2016 | Risk factors for persistent and new chronic opioid use in patients undergoing total hip arthroplasty: a retrospective cohort study | Retrospective Cohort Study | Australia | 90 days of continuous use or at least 120 days of noncontinuous use (within 275 days, excluding the first 90 days) | No opioid use in the year prior to surgery | Opioids (ATC code=N02A\*, inclusive of opioid-like medications such as Tramadol) |
| Bateman11 | 2016 | Persistent opioid use following cesarean delivery: patterns and predictors among opioid-naive women | Retrospective Cohort Study | United States | Based on Trajectory of Opioid use in 12 months after Surgery: defined the group of patients with the highest probability of filling over time as persistent users |  | hydrocodone, oxycodone,codeine, meperidine, hydromorphone, morphine, fentanyl, methadone, and oxymorphone |
| Goesling12 | 2016 | Trends and predictors of opioid use after total knee and total hip arthroplasty | Prospective Cohort Study | Michigan | Opioid use at time of interview (180 days after surgery) | No opioid at time of interview (day of surgery) | Not Specified |
| Lindestrand13 | 2015 | Opioids in hip fracture patients: An analysis of mortality and post hospital opioid use | Retrospective Cohort Study | Denmark | Filled at least one opioid prescription overlapping 90 or 180 days | Unclear | Not Specified |
| Yang14 | 2015 | Surgery for Chronic Pancreatitis The Role of Early Surgery in Pain Management | Retrospective Cohort Study |  | Opioid use at 3 years follow up |  | Not Specified |
| Kulshrestha15 | 2014 | Chronic opioid analgesic usage post-kidney transplantation and clinical outcomes | Retrospective Cohort Study | Michigan, United States | Filled at 3 disctinct time points: 1) 28 to 56 days, 2) 90 to 180 days, and 3) 300 to 365 days after surgery (or first two time intervals if the patient had an event (death and/or graft loss) between three and 12 months) |  | Not Specified; "The most commonly prescribed opioid analgesic was hydrocodone (59.4%) followed by oxycodone (29.8%), hydromorphone (5.2%), fentanyl (2.9%), and others (2.7%) (Fig. 2A)." |
| Rozet16 | 2014 | Prolonged Opioid Use After Knee Arthroscopy in Military Veterans | Retrospective Cohort Study | United States | Opioids prescribed uninterrupted for 3 months after surgery | No opioid in the 3 months before surgery | Not Specified |
| Raebel17 | 2014 | Chronic opioid use emerging after bariatric surgery | Retrospective Cohort Study | United States | 1) ≥10 opioid dispensings (over ≥90 days); or 2) ≥120 total days’ supply dispensed (within 330 days, excluding the first 30 days) | No opioid in -335 to -1 pre-operatively | Not Specified; total oral and transdermal opioids dispensed |
| Holman18 | 2014 | The Effect of Preoperative Counseling on Duration of Postoperative Opiate Use in Orthopaedic Trauma Surgery: A Surgeon-Based Comparative Cohort Study | Retrospective Cohort Study | San Diego, California | Continuation of prescription opiates greater than 12 weeks postoperatively |  | Not Specified |
| Clarke19 | 2014 | Rates and risk factors for prolonged opioid use after major surgery: population based cohort study | Retrospective Cohort Study | Ontario, Canada | 1) Filled prescription within 1 to 90 days after discharge; 2) Filled at least one additional opioid prescription between 91 and 180 days after surgery | No prescription for Opioids (or analgesic drugs) within 90 of index date.  | Codeine, morphine, oxycodone, hydromorphone, meperidine, oxymorphone, methadone, and transdermal fentanyl |
| Raebel20 | 2013 | Chronic Use of Opioid Medications Before and After Bariatric Surgery | Retrospective Cohort Study | United States | 1) ≥10 opioid dispensings (over ≥90 days); or 2) ≥120 total days’ supply dispensed (within 330 days, excluding the first 30 days) | No opioid in -335 to -1 pre-operatively | Not Specified; oral and transdermal opioids |
| Holman21 | 2013 | Rates of Prescription Opiate Use Before and After Injury in Patients with Orthopaedic Trauma and the Risk Factors for Prolonged Opiate Use | Retrospective Cohort Study | Utah, United States | Continuation of prescription opiates greater than 12 weeks postoperatively | No opioid prescription in the 3 months before surgery | Not Specified; "Schedule-II through V opiate analgesics prescriptions" |
| Carroll22 | 2012 | A Pilot Cohort Study of the Determinants of Longitudinal Opioid Use After Surgery | Prospective Cohort Study | United States | Continuously filled prescriptions (with no gaps >5 days) in the 150 days after discharge | No definition | Not Specified |
| Connolly, J23 | 2017 | Predictors of Long-term Opioid Use Following Lumbar Fusion Surgery | Retrospective Cohort Study | Minnesota  | 365 days of filled opioid prescriptions (within 24 months following surgery) |  | Not specified; "Opioids belonged to schedules II, III, IV, or IV" |
| Kim S.C24 | 2017 | Patterns and predictors of persistent opioid use following hip or knee arthroplasty | Retrospective Cohort Study | United States | Having any use of opioid prescriptions in each of the 12 months continuously based on a group-based trajectory modeling (GBTM) |  | hydrocodone, codeine, oxycodone, meperidine, hydro-morphone, morphine, fentanyl, methadone, and oxymorphone |
| Johnson, S25 | 2016 |  Risk of Prolonged Opioid Use Among Opioid-Naive Patients Following Common Hand Surgery Procedures | Retrospective Cohort Study | United States | 1) Filled prescription within 30 days before surgery and 14 days after discharge; 2) Filled at least one additional opioid prescription between 90 and 180 days after surgery | no opioid exposure 11 months before the perioperative period ( perioperative period defined as 30 days before surgery and 14 days)  | Hydrocodone, Oxycodone, Tramadol, Codeine phosphate, Hydromorphone, Propoxyphene, Meperidine hydrochloride, Morphine sulfate, Fentanyl buccal or SL, Fentanyl film or oral spray, Fentanyl nasal spray, Fentanyl patch, Dihydrocodeine, Pentazocine, Oxymorphone, Tapentadol, Butorphanol, Opium, Methadone, Morphine |
| Alam26 | 2012 | Long-term analgesic use after low-risk surgery: a retrospective cohort study | Retrospective Cohort Study | Ontario, Canada | Filled within 60 days of the 1-year anniversary date (eg, 305-425 days after the index date)  | Did not fill a prescription for an opioid in the 12 months prior to their procedure  | Not specified; "The most commonly prescribed opioid was codeine. Codeine remained the most commonly used opioid at 1 year after surgery. Long-term opioid users also used more potent long-acting opioids, including transdermal fentanyl and oxycodone." |
| Cancienne27 | 2018 | Narcotic Use and Total Knee Arthroplasty | Retrospective Cohort Study | United States | Filled at least one opioid prescription between 90 and 180 days after surgery | No definition | oxycodone (with and without acetaminophen, controlled and extendedrelease, liquid and pill forms), hydrocodone (with acetaminophen,with ibuprofen, normal and extra strength), hydromorphone,oxycontin, oxymorphone (both normal and extended release),morphine (including controlled and extended release), fentanyl,and propoxyphene. |
| Hadlandsmyth28 | 2018 | Risk for Prolonged Opioid Use Following Total Knee Arthroplasty in Veterans | Retrospective Cohort Study | United States | Continuously filled prescriptions (with no gaps >14 days) in the 12 months after discharge | No opioid use in the year prior to surgery | Preoperative opioid use was defined as any outpatient prescription of noninjectable butorphanol, fentanyl, hydrocodone,hydromorphone, levorphanol, meperidine, methadone, morphine,oxycodone, oxymorphone, pentazocine, or tramadol |
| Pang29 | 2017 | Chronic Opioid Use Following Surgery for Oral Cavity Cancer | Retrospective Cohort Study | Baltimore, Maryland, United States | Filled more than 90 days after surgery | No definition | Not specified |
| Kim30 | 2017 | Preoperative Chronic Opioid Users in Total Knee Arthroplasty: Which Patients Persistently Abuse Opiates Following Surgery | Retrospective Cohort Study | New York, New York | Opioid use at 6-months (180 days) post-operatively | No definition | Not specified |
| Stafford, C31 | 2018 | What factors are associated with increased risk for prolonged postoperative opioid usage after colorectal surgery? | Retrospective Cohort Study | Massachusetts | Opioid prescription beyond 30 days after date of surgery |  | Not specified |
| Politzer32 | 2017 | Trends in Opioid Utilization Before and After Total Knee Arthroplasty | Retrospective Cohort Study | United States  | Prescribed opioids for over 6 contiguous months (followed for 24 months post-operatively) | No opioid use within one year before total knee arthroplasty  | Not specified; Drugs found in results. "Morphine extended release (ER), hydromorphone, fentanyl, oxycodone ER, morphine, and oxycodone, tramadol." |
| O'Connell33 | 2018 | Preoperative depression, lumbar fusion, and opioid use: an assessment of postoperative prescription, quality, and economic outcomes | Retrospective Cohort Study | United States | 1) 10 or more prescriptions; or 2) >120 days’ supply within the first year of surgery (excluding the first 90 postoperative days) | “Zero usage” was defined as filling 0 prescriptions for opioid medications in the 6 months prior to the index hospitalization, | Not Specified |
| Qureshi34 | 2018 | Factors Affecting Long-Term Postoperative Narcotic Use in Discectomy Patients | Retrospective Cohort Study | United States | Filled at least one opioid prescription between 90 and 180 days after surgery |  | Not specified |
| Swenson35 | 2018 | Prevalence of new persistent opioid use among opioid naive women undergoing hysterectomy. | Retrospective Cohort Study | United States | Two criteria: 1) Filled prescription within 15 to 90 days after discharge and filled at least one additional opioid prescription between 91 and 180 days after surgery; and 2) either A) 1150 OMEs total dose OR B) 39 days supplied and 2 filled prescriptions | women with any opioid fills from 243 days to 31 days prior to hysterectomy | Not specified; Opioids were identified as medications with a therapeutic class of either opioid agonist or opioid partial agonist. |
| Stark36 | 2017 | Prevalence and predictors of persistent post-surgical opioid use: a prospective observational cohort study | Prospective Cohort Study | Australia | Opioid use, based on questionnaire, between 90 and 120 days after surgery | Definition Unclear | Not Specified |
| Pugely37 | 2018 | Opioid use following cervical spine surgery: trends and factors associated with long-term use | Retrospective Cohort Study | United States | Opioid use at 12-months (365 days) post-operatively | No opioid in the 3 months before surgery | Dilaudid Hydrocodone-AcetaminophenDilaudid-5 VicodinDilaudid-HP Vicodin ESHydromorphone HCL Dosette Vicodin HPHydromorphone HCL ER NorcoPercoset FentanylPercodan Fentanyl citrateOxycodone/Acetaminophen Fentanyl citrate oral TRAOxycodone/Apap DuragesicOxycodone/Aspirin Methadone HCLOxycodone/Ibuprofen Methadone HCL DisketsOxycodone HCL Methadone HCL IntensolOxycodone HCL CR MethadoseOxycodone HCL ER Methadose sugar freeOxycodone APAP Morphine sulphateOxycontin Morphine sulphate CRHydrocodone/Acetaminophen Morphine sulphate ERHydrocodone/Ibuprofen MS CONTIN |
| Hernandez38 | 2018 | Patients at Risk: Preoperative Opioid Use Affects Opioid Prescribing, Refills, and Outcomes After Total Knee Arthroplasty | Retrospective Cohort Study | United States | Opioid use at 6 weeks post-operatively (patient interview) | Not defined | Not defined |
| Grace39 | 2018 | The influence of preoperative opioid use on inpatient opioid requirements and discharge prescriptions after primary shoulder arthroplasty | Retrospective Cohort Study | United States | Opioid use at 6 weeks post-operatively (patient interview) | No opioid identified on patient’s admission record | Not defined |

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