References on Opioid Receptor Research
Using ALZET® Osmotic Pumps

Q8394: C. A. Browne*, et al.* Behavioral effects of the kappa opioid receptor partial agonist nalmefene in tests relevant to depression. Eur J Pharmacol 2020;872(172948
Agents: Nalmefene **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2004; **Duration:** 14 days;
ALZET Comments: Dose (5 mg/kg/day); Controls received mp w/ vehicle; animal info (Male and female C57BL/6J mice, 8 weeks old); behavioral testing (forced swim test, Conditioned place aversion, Marble burying, Dark-light emergence test); Nalmefene aka NMF; neurodegenerative (Depression);

Q8391: J. M. Bossert*, et al.* In a Rat Model of Opioid Maintenance, the G Protein-Biased Mu Opioid Receptor Agonist TRV130 Decreases Relapse to Oxycodone Seeking and Taking and Prevents Oxycodone-Induced Brain Hypoxia. Biol Psychiatry 2020;88(12):935-944
Agents: Buprenophrine; TRV130 **Vehicle:** Not stated; **Route:** SC; **Species:** Rat; **Pump:** Not stated; **Duration:** 14 days;
ALZET Comments: Dose (0, 3, 6, or 9 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague Dawley rats, 250 to 350 g (males) or 175 to 225 g (females)); TRV130 aka G protein–biased mu opioid receptor agonist; dependence;

Q6131: A. Kliewer*, et al.* Phosphorylation-deficient G-protein-biased mu-opioid receptors improve analgesia and diminish tolerance but worsen opioid side effects. Nat Commun 2019;10(1):367
Agents: Fentanyl citrate; morphine sulphate salt pentahydrate **Vehicle:** PBS; water, sterile; **Route:** SC; **Species:** Mice (transgenic); **Pump:** 1007D; **Duration:** 7 days;
ALZET Comments: Dose (Fentanyl (2mg/kg/day); Morphine (17 mg/kg/day)); animal info (knock-in mice with 11S/T-A mutations (Oprm1tm3.1Shlz, MGI:6117673, 11S/T-A)); behavioral testing (hot plate test; open field locomotion test); dependence; "...we used subcutaneously implanted osmotic pumps to deliver opioids at a constant rate. This approach is a powerful means of assessing both tolerance and dependence in rodents" (p.5)

Q8596: T. Kanemasa*, et al.* Pharmacologic effects of naldemedine, a peripherally acting mu-opioid receptor antagonist, in in vitro and in vivo models of opioid-induced constipation. Neurogastroenterol Motil 2019;31(5):e13563
Agents: Morphine HCl **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 5 days;
ALZET Comments: Dose (6 mg/kg); Controls received mp w/ vehicle; animal info (6-week-old Jcl Wistar male rats); dependence;

Q7450: J. Cunningham*, et al.* F160. Samidorphan, an Opioid Receptor Antagonist, Mitigates Olanzapine-Induced Metabolic Dysfunction in Female Rats. Biological Psychiatry 2019;85(10):
Agents: Olanzapine, Samidorphan **Vehicle:** Not stated; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 2 days;
ALZET Comments: animal info (Female,); Olanzapine aka OLZ, Samidorphan aka SAM; dependence;

Q8143: K. M. Nation*, et al.* Lateralized kappa opioid receptor signaling from the amygdala central nucleus promotes stress-induced functional pain. Pain 2018;159(5):919-928
Agents: Morphine Sulfate **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Dose (7.68 mg/kg/day); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Male, Sprague Dawley, 175-200 g); post op. care (Gentamycin); neurodegenerative (Functional Pain Syndrome);

Q8073: E. S. Levitt*, et al.* Desensitization and Tolerance of Mu Opioid Receptors on Pontine Kolliker-Fuse Neurons. Mol Pharmacol 2018;93(1):8-13
Agents: Morphine Sulfate **Vehicle:** Not stated; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 7 days;
ALZET Comments: Dose (50 mg/kg/day); animal info (Male, Sprague Dawley, 4-7 weeks old); dependence;

Q7171: S. Arttamangkul*, et al.* Cellular tolerance at the micro-opioid receptor is phosphorylation dependent. eLife Journal 2018;7(**Agents:** Morphine sulfate **Vehicle:** Water; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 7 days;
ALZET Comments: Dose (80mg/kg/day); animal info (5-6 Weeks); tolerance;

Q5922: J. Y. Xie*, et al.* Kappa opioid receptor antagonists: A possible new class of therapeutics for migraine prevention. Cephalalgia 2017;37(8):780-794
Agents: Sumatriptan **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received mp w/ vehicle;animal info (male, Sprague Dawley, 175-200g); post op. care (gentamicin 8 mg/kg SC); behavioral testing (von Frey filaments; tail flick test); Dose (0.6 mg/kg/day);

Q5469: E. Tuduri*, et al.* Acute stimulation of brain mu opioid receptors inhibits glucose-stimulated insulin secretion via sympathetic innervation. Neuropharmacology 2016;110(Pt A):322-32
Agents: DAMGO **Vehicle:** Water, distilled; DMSO; saline; **Route:** CSF/CNS; **Species:** Mice; **Pump:** Not Stated; **Duration:** 5 Days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, C57BL6J or alpha2A-KO, 8-10 weeks old); ALZET brain infusion kit 3 used; Dose (DAMGO 4.7 nmol/day); used 7 day pump;

Q4840: Z. Jiang*, et al.* Blocking mammalian target of rapamycin alleviates bone cancer pain and morphine tolerance via u-opioid receptor. International Journal of Cancer 2016;138(2013-2020
Agents: Rapamycin; CTOP; LY297002 **Vehicle:** DMSO; saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;
ALZET Comments: Controls received mp w/ saline; animal info (Wistar, 200-250g); 50% DMSO used; cancer (breast; bone); dose-response (pg 2015); behavioral testing (hindpaw withdrawal latency); Rapamycin is an mTOR antagonist; CTOP is an MOR antagonist; LY297002 an a PI3K inhibitor;

Q4836: L. S. Hwa*, et al.* Dissociation of u-opioid receptor and CRF-R1 antagonist effects on escalated ethanol consumption and mPFC serotonin in C57BL/6J mice. Addiction Biology 2016;21(111-124
Agents: CP154526; naltrexone **Vehicle:** DMSO; CSF, artificial; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 1002; **Duration:** 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, C58BL/6J, 8 weeks old); functionality of mp verified by IAA drinking test or morphine-sensitive tail withdrawal; ALZET brain infusion kit 3 used; 4% DMSO used; Cannula placement verified via Nissl staining;

Q5226: S. H. Lockie*, et al.* Combination cannabinoid and opioid receptor antagonists improves metabolic outcomes in obese mice. Mol Cell Endocrinol 2015;417(10-19
Agents: Naloxone **Vehicle:** Saline, normal; **Route:** SC; **Species:** mice; **Pump:** 1007D; **Duration:** 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info: obesity induced, C57black/6J male mice, 6 wks old; functionality of mp verified by behavioral test; dose-response (pg 13, 14); dose-response (pg 13, 14); behavioral testing (Porsolt forced swim, Elevated Plus Maze, Dowel Gnawing); delayed delivery (24 hours via a 1.5 cm vinyl catheter); Isoflurane anesthesia used; minipump combined with a dose of 1 mg/kg/day of rimonabant (rim nal) injected IP; Dose: 0.5 mg/mouse/day

Q5018: K. J. Jackson*, et al.* Effects of orally-bioavailable short-acting kappa opioid receptor-selective antagonist LY2456302 on nicotine withdrawal in mice. Neuropharmacology 2015;97(270-4
Agents: Nicotine hydrogen tartrate salt **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2002; **Duration:** 14 days; 28 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, ICR, 8-10 weeks old); behavioral testing (elevated plus maze; hyperalgesia); dependence; Dose (24 mg/kg/day);

Q4319: Y. J. Bao*, et al.* Engagement of signaling pathways of protease-activated receptor 2 and -opioid receptor in bone cancer pain and morphine tolerance. INTERNATIONAL JOURNAL OF CANCER 2015;137(1475-1483
Agents: FSLLRY-NH2 **Vehicle:** Saline; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 20 hours;
ALZET Comments: Controls received mp w/ vehicle; animal info (Wistar 200-250g); cancer (bone); no stress (see pg. 1476); behavioral testing (mechanical paw withdrawal, thermal hyperalgesia); peptides;

Q5432: D. Suarez-Boomgaard*, et al.* Dopamine D(4) receptor counteracts morphine-induced changes in micro opioid receptor signaling in the striosomes of the rat caudate putamen. Int J Mol Sci 2014;15(1):1481-98

Agents: Morphine; PD168,077; L745,870 **Vehicle:** DMSO; saline; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 6 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (adult male Sprague-dawley rats, 250-300g); 2% DMSO used; Combinational treatments; anesthesized with ketamine and medetomidine; PD168,077 is a dopamine D4 receptor agonist; L745,870 is a dopamine D4 receptor antagonist; Dose (morphine 20 mg/kg/day; PD168,077 1 mg/kg/day; L745,870 1 mg/kg/day);

Q3543: A. Lantero*, et al.* TGF-beta and Opioid Receptor Signaling Crosstalk Results in Improvement of Endogenous and Exogenous Opioid Analgesia under Pathological Pain Conditions. Journal of Neuroscience 2014;34(5385-5395
Agents: Transforming growth factor-B1 **Vehicle:** HCl; albumin; **Route:** SC; **Species:** Mice (transgenic); **Pump:** 1002; **Duration:** 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, BAMBI-KO or WT, 14-18 weeks old); behavioral testing (von Frey monofiliments; formalin test); Transforming growth factor-B1 aka TGF-B1; sciatic nerve crush injury;

Q3152: M. Shaqura*, et al.* Reduced Number, G Protein Coupling, and Antinociceptive Efficacy of Spinal Mu-Opioid Receptors in Diabetic Rats Are Reversed by Nerve Growth Factor. JOURNAL OF PAIN 2013;14(7):720-730
Agents: Nerve growth factor **Vehicle:** CSF, artificial; rat serum albumin; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (male, Wistar, 225g); behavioral testing (paw pressure test); peptides; used PE-10 attached to PE-60 catheter

Q2587: K. L. Sato*, et al.* Spinal cord stimulation reduces hypersensitivity through activation of opioid receptors in a frequency-dependent manner. European Journal of Pain 2013;17(4):551-561
Agents: Naloxone; naltrindole **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** 1007D; **Duration:** Not Stated;
ALZET Comments: Control animals received mp w/ vehicle; animal info (Sprague Dawley, 250-350 g)

Q3252: T. Nakahara*, et al.* Chronic Peripheral Administration of Kappa-Opioid Receptor Antagonist Advances Puberty Onset Associated with Acceleration of Pulsatile Luteinizing Hormone Secretion in Female Rats. JOURNAL OF REPRODUCTION AND DEVELOPMENT 2013;59(5):479-484
Agents: Nor-binaltorphimine; senktide **Vehicle:** Sodium bicarbonate; **Route:** IP; **Species:** Rat; **Pump:** 2002; **Duration:** 14 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (female, Wistar-Imamichi, 20 days old); Nor-binaltorphimine aka nor-BNI; Nor-binaltorphimine is a KOR agonist; senktide NK3R agonist;

Q2571: S. A. Mousa*, et al.* Rab7 Silencing Prevents mu-Opioid Receptor Lysosomal Targeting and Rescues Opioid Responsiveness to Strengthen Diabetic Neuropathic Pain Therapy. Diabetes 2013;62(4):1308-1319
Agents: Nerve growth factor, beta **Vehicle:** CSF, artificial; albumin, rat serum; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Control animals received mp w/ vehicle; animal info (Wistar, male, STZ induced diabetes)

Q3077: C. R. Gibbons*, et al.* Involvement of brain opioid receptors in the anti-allodynic effect of hyperbaric oxygen in rats with sciatic nerve crush-induced neuropathic pain. Brain Research 2013;1537(;):111-116
Agents: Naltrexone HCl **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 1007D; **Duration:** 7 days;
ALZET Comments: Animal info (male, Sprague Dawley, albino, 160-180g); ALZET brain infusion kit used; post op. care (ampicillin 100 mg/kg IM; meloxicam 2.0 mg/kg IM); behavioral testing (flexion reflex, flinch response, mechanical threshold pressure); Incision closed with wound clip

Q3048: S. R. Armstrong*, et al.* The in vivo pharmacodynamics of the novel opioid receptor antagonist, TD-1211, in models of opioid-induced gastrointestinal and CNS activity. NAUNYN-SCHMIEDEBERGS ARCHIVES OF PHARMACOLOGY 2013;386(6):471-478
Agents: Morphine **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 5 days;
ALZET Comments: Controls received mp w/ saline; animal info (male, Swiss Webster, 20-35g); Pump not mentioned much only pg.473

Q1813: E. M. Vadizan*, et al.* Chronic treatment with the opioid antagonist naltrexone favours the coupling of spinal cord mu-opioid receptors to G-alpha$_z$ protein subunits. Neuropharmacology 2012;62(2):757-764
Agents: Naltrexone **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received mp w/ saline; animal info (Sprague Dawley, male, 250-300 g)

Q2456: H. A. Tejeda*, et al.* Dysregulation of kappa-opioid receptor systems by chronic nicotine modulate the nicotine withdrawal syndrome in an age-dependent manner. Psychopharmacology 2012;224(2):289-301
Agents: Nicotine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2ML2; **Duration:** 14 days;
ALZET Comments: Animal info (adolescent, adult, Wistar, male)

Q1879: K. Lamb*, et al.* Antinociceptive effects of herkinorin, a MOP receptor agonist derived from salvinorin A in the formalin test in rats: New concepts in mu opioid receptor pharmacology: From a symposium on new concepts in mu-opioid pharmacology. Drug and Alcohol Dependence 2012;121(3):181-188
Agents: Morphine hydrochloride **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 5 days;
ALZET Comments: Animal info (Sprague Dawley, male, 250-275 g)

Q2420: F. Berrendero*, et al.* Influence of delta-Opioid Receptors in the Behavioral Effects of Nicotine. Neuropsychopharmacology 2012;37(10):2332-2344
Agents: Nicotine **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 6 days;
ALZET Comments: Animal info (C57BL/6, male, DOR KO, 8-12 wks old)

Q0846: R. S. Yamdeu*, et al.* p38 Mitogen-activated Protein Kinase Activation by Nerve Growth Factor in Primary Sensory Neurons Upregulates μ-Opioid Receptors to Enhance Opioid Responsiveness Toward Better Pain Control. Anesthesiology 2011;114(1):150-161
Agents: Fentanyl propionanilide; buprenorphine hydrochloride **Vehicle:** Saline, isotonic; **Route:** CSF/CNS (intrathecal); **Species:** Rat; **Pump:** Not Stated; **Duration:** 96 hours;
ALZET Comments: Controls received mp w/ vehicle; animal info (male Wistar, 200-250 g); pain

Q1406: Y. Wu*, et al.* JWA regulates chronic morphine dependence via the delta opioid receptor. Biochemical and Biophysical Research Communications 2011;409(3):520-525
Agents: Oligonucleotide, sense, JWA; oligonucleotide, antisense JWA **Vehicle:** CSF, artificial; **Route:** CSF/CNS; **Species:** Rat; **Pump:** Not Stated; **Duration:** Not Stated;
ALZET Comments: Animal info (adult, male, Wistar, 190 g); antisense (JWA)

Q0694: N. Quillinan*, et al.* Recovery from mu-Opioid Receptor Desensitization after Chronic Treatment with Morphine and Methadone. Journal of Neuroscience 2011;31(12):4434-4443
Agents: Morphine; methadone **Vehicle:** Water; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; 2001; **Duration:** 6 days;
ALZET Comments: Controls received mp w/ vehicle; tolerance; animal info (adult (150-250 g, male, Sprague Dawley)

Q1441: J. N. Peart*, et al.* Sustained Ligand-Activated Preconditioning via delta-Opioid Receptors. Journal of Pharmacology and Experimental Therapeutics 2011;336(1):274-281
Agents: Naloxone; BW373U86; U50,488H; morphine-6-glucuronide; morphine-3-glucuronide; wortmannin; PKI-(14-22)-amide **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1007D; **Duration:** 5 days;
ALZET Comments: Animal info (7-12 wks old, C57/BL6, male);BW373U86 also known as ()-4-[(*R*)--[(2*S*,5*R*)-4-allyl-2,5-dimethyl-1-piperazinyl]-3-hydroxy-hydroxybenzyl]-*N,N*-diethylbenzamide is a delta opioid receptor selective agonist; U50,488H also known as *trans*-()-3,4-dichloro-*N*-methyl-*N*-(2-(1-pyrrolidin)cyclohexyl)-benzeneacetamide methane sulfonate hydrate is a kappa opioid selective receptor agonist

Q0697: B. Mathew*, et al.* The Novel Role of the Mu Opioid Receptor in Lung Cancer Progression: A Laboratory Investigation. Anesthesia & Analgesia 2011;112(3):558-567

Agents: Naltrexone, methyl **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1002; **Duration:** 12 days;
ALZET Comments: Controls received mp w/ PBS; animal info (MOR KO, C57BL/6 wt); cancer (lung); Methylnaltrexone (also known as MNTX) is a mu opioid receptor inhibitor

Q0820: H. Zheng*, et al.* μ-Opioid Receptor Agonists Differentially Regulate the Expression of miR-190 and NeuroD. MOLECULAR PHARMACOLOGY 2010;77(1):102-109
Agents: Morphine; fentanyl **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** 1003D; **Duration:** 3 days;
ALZET Comments: Controls received mp w/ saline; animal info (CD1 (ICR), 6-8 wks old)

P9960: K. J. Jackson*, et al.* Effect of the selective kappa-opioid receptor antagonist JDTic on nicotine antinociception, reward, and withdrawal in the mouse. Psychopharmacology 2010;210(2):285-294
Agents: Nicotine **Vehicle:** Not Stated; **Route:** Not Stated; **Species:** Mice; **Pump:** 1007D; **Duration:** 7, 14 days;
ALZET Comments: Animal info (8-10 wks old, 20-25 g); 28-day pumps used; withdrawal

Q0746: R. J. Horvath*, et al.* Inhibition of microglial P2X(4) receptors attenuates morphine tolerance, Iba1, GFAP and μ opioid receptor protein expression while enhancing perivascular microglial ED2. Pain 2010;150(3):401-413
Agents: Morphine sulfate; naloxone **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2ML1; **Duration:** 1, 4, 7 days;
ALZET Comments: Controls received mp w/ saline; animal info (male, Sprague-Dawley, 175-200 g); one pump contained morphine plus naloxone; "All morphine pumps were filled with 0.833 mg/kg/hr morphine to deliver the equivalent of twice daily 10 mg/kg injections over the course of 24 h" pg 402; tolerance

Q0727: A. R. Waxman*, et al.* Acute and chronic fentanyl administration causes hyperalgesia independently of opioid receptor activity in mice. Neuroscience Letters 2009;462(1):68-72
Agents: Fentanyl **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 6 days;
ALZET Comments: Controls received mp w/ vehicle; animal info (adult, male, CD-1); comparison of SC injections vs. mp; "Although acute fentanyl injection (0.25 mg/kg) caused hyperalgesia within 15 min, hyperalgesia was not similarly evident on infusion Day 1 even though pumps were filled with a fentanyl dose (10mg/kg/24 h) that dispenses ~0.42 mg/kg/h, almost double the dose given by bolus injection." pg 71

P9868: M. S. Virk*, et al.* Buprenorphine Is a Weak Partial Agonist That Inhibits Opioid Receptor Desensitization. Journal of Neuroscience 2009;29(22):7341-7348
Agents: Buprenorphine **Vehicle:** DMSO; water; **Route:** Not Stated; **Species:** Rat; **Pump:** 2ML1; **Duration:** Not Stated;
ALZET Comments: Controls received mp w/ vehicle; functionality of mp verified by plasma drug levels; animal info (male, Sprague Dawley, 150-200 g.); 40% DMSO used; "the osmotic minipump delivered buprenorphine efficiently and predictably" pg. 7342

Q0272: E. L. A. van Dorp*, et al.* Morphine-6 beta-glucuronide Rapidly increases Pain Sensitivity Independently of Opioid Receptor Activity in Mice and Humans. Anesthesiology 2009;110(6):1356-1363
Agents: Morphine-6 beta-glucuronide; MK-801 **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** Not Stated;
ALZET Comments: Animal info (adult, male, CD-1, TrKO, B6129F1); "Osmotic pumps afford continuous opioid infusions and control for hyperalgesia associated with withdrawal in opioid-dependent subjects that potentially confounds experiments in which chronic opioid treatment is accomplished via repeated acute injections." pg 1357

P9445: S. Sirohi*, et al.* The analgesic efficacy of fentanyl: Relationship to tolerance and mu-opioid receptor regulation. Pharmacology Biochemistry and Behavior 2008;91(1):115-120
Agents: Fentanyl hydrochloride **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 7 days;
ALZET Comments: Controls received placebo pellets; dose-response (fig. 3); comparison of SC injections vs. mp; tolerance; animal info (male, Swiss Webster, 23-35 g.)

P9162: P. Kumar*, et al.* Hydromorphone efficacy and treatment protocol impact on tolerance and mu-opioid receptor regulation. European Journal of Pharmacology 2008;597(1-3):39-45

Agents: Hydromorphone **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received inert placebo pellet; tolerance; animal info (male, Swiss Webster, 22-30 g.); "There was substantially more tolerance with infusion treatment compared to injection treatment." pg. 43

P8864: S. A. Hesketh*, et al.* Effects of chronic treatment with citalopram on cannabinoid and opioid receptor-mediated G-protein coupling in discrete rat brain regions. Psychopharmacology 2008;198(1):29-36
Agents: Citalopram **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat; **Pump:** 2ML2; **Duration:** 14 days;
ALZET Comments: Comparison of IP injections vs. mp; animal info (adult, male, Sprague Dawley, 200g.); paper incorrectly states 2ML2 pump model as 2002

P8494: D. C. Stoller*, et al.* Role of kappa and delta opioid receptors in mediating morphine-induced antinociception in morphine-tolerant infant rats. Brain Research 2007;1142(28-36
Agents: Morphine **Vehicle:** Not Stated; **Route:** SC; **Species:** Rat (neonate); **Pump:** 1003D; **Duration:** 72 hours;
ALZET Comments: Controls received mp w/ vehicle; tolerance; post op. care (10% povidone iodine swab); animal info (P14, 30 g); Vetbond tissue adhesive used to close incision

P8708: S. Sirohi*, et al.* mu-opioid receptor up-regulation and functional supersensitivity are independent of antagonist efficacy. Journal of Pharmacology and Experimental Therapeutics 2007;323(2):701-707
Agents: Naltrexol HCl, 6B-; naloxone HCl **Vehicle:** Saline, physiological; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received placebo pellets; dose-response (fig 3, 5); comparison of pellets, SC injections vs. mp; animal info (male, Swiss-Webster, 22-30g)

P7344: Q. Y. Zhang*, et al.* Continuous opioid agonist treatment dose-dependently regulates mu-opioid receptors and dynamin-2 in mouse spinal cord. Synapse 2005;56(3):123-128
Agents: Etorphine **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2001; **Duration:** 7 days;
ALZET Comments: Controls received placebo pellet; dose-response (p. 125, 126)

P7624: S. Tanaka*, et al.* Butorphanol dependence increases hippocampal kappa-opioid receptor gene expression. Journal of Neuroscience Research 2005;82(2):255-263
Agents: Butorphanol tartrate **Vehicle:** Saline, physiological; **Route:** CSF/CNS; **Species:** Rat; **Pump:** 2001; **Duration:** 3 days;
ALZET Comments: Controls received mp w/ vehicle; dependence; post op. care (procaine penicillin G; animal info (male, Sprague-Dawley, 250-275 g)

P6906: S. Roy*, et al.* In vivo activation of a mutant mu-opioid receptor by naltrexone produces a potent analgesic effect but no tolerance: role of mu-receptor activation and omega-receptor blockade in morphine tolerance. Journal of Neuroscience 2005;25(12):3229-3233
Agents: Naltrindole; SNC-80 **Vehicle:** Not Stated; **Route:** SC; **Species:** Mice; **Pump:** 1003D; **Duration:** 3 days;
ALZET Comments: Controls received mp w/ vehicle