Recent References (2018-2020) on the Administration of Nicotine Using ALZET® Osmotic Pumps

Q8581: B. Kim, et al. Chronic nicotine impairs sparse motor learning via striatal fast-spiking parvalbumin interneurons. Addict Biol 2020;e12956
Agents: Nicotine ditartrate Vehicle: Saline; Route: SC; Species: Mice; Pump: 1004; Duration: 2 weeks;
ALZET Comments: Dose (24 mg/kg/day); Controls received mp w/ vehicle; animal info (2- to 3-month-old C57BL/6J male mice); behavioral testing (Open field test; light-dark transition; rotarod test); dependence;

Agents: Nicotine Vehicle: Not stated; Route: SC; Species: Rat; Pump: Not stated; Duration: 6 weeks;
ALZET Comments: Dose (3 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague-Dawly rats, 2-4 months old); toxicology;

Agents: Zonisamide; Nicotine Vehicle: Not stated; Route: SC; Species: Rat; Pump: 2ML1; Duration: 7 days;
ALZET Comments: Dose (40 mg/kg/day Zonisamide, 10, 25 and 50 mg/kg/day Nicotine); animal info (Male S286L-TG and wild-type littermates); Zonisamide aka ZNS; neurodegenerative (Epilepsy);

Agents: Nicotine Hydrogen Tartrate Vehicle: Saline; Route: CNS/CSF; Species: Rat; Pump: 2ML2; Duration: 21 days;
ALZET Comments: Dose (4.5 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague Dawley, 6 or 14 weeks old); ischemia (Stroke);

Agents: Nicotine Vehicle: Alcohol, Saline; Route: SC; Species: Rat; Pump: Not stated; Duration: Not stated;
ALZET Comments: Dose (6 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague Dawley (Time pregnant) rats); behavioral testing (Y maze); toxicology;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Dose (6 mg/kg/ day); 0.9% NaCl used; Controls received mp w/ vehicle; animal info (pregnant lactating Wistar rat); toxicology;

Agents: Nicotine Bitartrate Vehicle: Saline; Route: SC; Species: Mice; Pump: 1002; Duration: 2 weeks;
ALZET Comments: Dose (6 mg/kg/day or 60 mg/kg/day); 0.9% NaCl used; Controls received mp w/ vehicle; animal info (pregnant ePET-EYFP mice); dependence;

Agents: Nicotine hydrogen tartrate, (-)- Vehicle: Saline; Route: SC; Species: Mice; Pump: 1004; Duration: 28 days;
ALZET Comments: Dose (18 mg/kg/day); Controls received mp w/ vehicle; animal info (6-8 weeks, male and female, C57BL/6NTac, 20-30g); behavioral testing (stress exposure); dependence; “While the minipump does not recapitulate the pulsatile mode of NIC delivery experienced by human smokers, it does provide several experimental advantages. For
example, minipumps allow for consistent administration of NIC doses across subjects, precise temporal control over the initiation and termination of NIC treatment, and their ease of use facilitated replication across cohorts.” pg.143 ; pumps implanted for PND 28–56 before being removed. Stress exposure tests described in supplementary data although access to pages is limited.;

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<td><strong>Agents:</strong> Nicotine hydrogen tartate salt <strong>Vehicle:</strong> Saline; <strong>Route:</strong> SC; <strong>Species:</strong> Mice; <strong>Pump:</strong> 2002; <strong>Duration:</strong> 14 days;</td>
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<td><strong>ALZET Comments:</strong> Dose (25 mg/kg/day); animal info (8-weeks old male C57BL/6J mice (Charles River)); dependence;</td>
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<td><strong>Agents:</strong> Nicotine Ditartrate <strong>Vehicle:</strong> Saline; <strong>Route:</strong> SC, IV (jugular); <strong>Species:</strong> Rat; <strong>Pump:</strong> 2ML4; <strong>Duration:</strong> 4 weeks;</td>
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<td><strong>ALZET Comments:</strong> Dose (2.5 mg/kg/day); animal info (Young adult female Sprague-Dawley rats); post op. care (ketoprofen, bupivacaine); behavioral testing (dual-lever experiment);</td>
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<td><strong>Agents:</strong> Nicotine Hydrogen Bitartrate salt <strong>Vehicle:</strong> Saline; <strong>Route:</strong> SC; <strong>Species:</strong> Rat (pregnant); <strong>Pump:</strong> Not Stated; <strong>Duration:</strong> 28 days;</td>
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<td><strong>ALZET Comments:</strong> Dose (6 mg/kg/d); Controls received mp w/ vehicle; animal info (Pregnant female Sprague–Dawley (SD) rats); dependence;</td>
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<td><strong>ALZET Comments:</strong> Dose (1.2 mg/kg/d or 4.8 mg/kg/d); Controls received mp w/ vehicle; animal info (Male Sprague-Dawley rats, p25-p28 or p59-p62); post op. care (buprenorphine); behavioral testing (Precipitated withdrawal test); dependence;</td>
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<td><strong>Agents:</strong> Nicotine hydrogen tartrate salt <strong>Vehicle:</strong> Saline; <strong>Route:</strong> IP; <strong>Species:</strong> Rat; <strong>Pump:</strong> 2ML4; <strong>Duration:</strong> 14 days;</td>
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<td><strong>ALZET Comments:</strong> Dose (1.2, 4.8 mg/kg/day); saline pH adjusted to 7.2+/-.0.5 used; Controls received mp w/ vehicle; animal info (male, Sprague-Dawley, 275-300g); behavioral testing (Precipitated withdrawal); pulsed delivery (Lynch coil 1hr-ON-1hr-OFF); dependence;</td>
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<td><strong>Agents:</strong> Nicotine <strong>Vehicle:</strong> Saline; <strong>Route:</strong> SC; <strong>Species:</strong> Mice; <strong>Pump:</strong> 1002; <strong>Duration:</strong> 12 days;</td>
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<td><strong>ALZET Comments:</strong> Dose (12.6 mg/kg/d); Controls received mp w/ vehicle; animal info (preadolescent (P23), adolescent (P38), or adult (P54), male, C57BL/6J); behavioral testing (fear conditioning); dependence; “While noncontingent nicotine administration does not recapitulate all aspects of human smoking, this dose and method of nicotine administration was used because it maintains blood plasma levels of nicotine similar to levels reported in smokers and it ensures that all mice receive identical doses of nicotine.” pg.3; pumps were removed on day 12 of infusion;</td>
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<td><strong>Agents:</strong> Nicotine <strong>Vehicle:</strong> Saline; <strong>Route:</strong> SC; <strong>Species:</strong> Rat; <strong>Pump:</strong> 2ML4; <strong>Duration:</strong> 56 days;</td>
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<td><strong>ALZET Comments:</strong> Dose (2 mg/kg/day); Controls received mp w/ vehicle; animal info (Male, Sprague Dawley, 200-250 g); behavioral testing (Housing and behavioral test, Elevated plus maze test, Figure 8 apparatus test); pumps replaced every 4 weeks; dependence;</td>
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Agents: Nicotine or benzo[a]pyrene, or Nicotine +BaP Vehicle: DMSO; Route: SC; Species: Rat; Pump: 2ML4; Duration: 4 weeks;
ALZET Comments: Dose (Nicotine-2 mg/kg/day or BaP- 0.03 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague Dawley, Female); behavioral testing (Elevated Plus Maze Test, Radial Maze Test); benzo[a]pyrene aka BaP; neurodegenerative (Neurobehavioral Impairment);

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML4; Duration: 12 weeks;
ALZET Comments: Dose (36 mg/ml); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Sprague Dawley, 10-13 weeks old, 367-425 g); long-term study; dependence;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Pump: 1002; Duration: 12 days;
ALZET Comments: Dose (0.7 mg/kg/h); Controls received mp w/ vehicle; animal info (2-5 months old, Male); dependence;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2002; Duration: 21 days;
ALZET Comments: Dose (6 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague Dawley); post op. care (buprenorphine); dependence;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Pump: 2002; Duration: 14 days;
ALZET Comments: Dose (24 mg/kg/day); Controls received mp w/ vehicle; animal info (6-8 weeks old, Male, 27-32 g); dependence;

Q6079: D. DiPalma, et al. Persistent attenuation of nicotine self-administration in rats by co-administration of chronic nicotine infusion with the dopamine D1 receptor antagonist SCH-23390 or the serotonin 5-HT2C agonist lorcaserin. Pharmacol Biochem Behav 2019;176(16-22
Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML4; Duration: 4 weeks;
ALZET Comments: Dose (2.5 mg/kg/day); Controls received mp w/ vehicle; animal info (young adult female Sprague-Dawley rats, aged 66–72 days with an average weight of 210 g); post op. care (ketoprofen (5 mg/kg, s.c.); topical bupivacaine); behavioral testing (lever press);

Q7279: Y. Ding, et al. Peroxynitrite-Mediated SIRT (Sirtuin)-1 Inactivation Contributes to Nicotine-Induced Arterial Stiffness in Mice. Arteriosclerosis, Thrombosis, and Vascular Biology 2019;ATVBAHA118312346
Agents: Nicotine Vehicle: Saline; Route: Not Stated; Species: Mice; Pump: 2006; Duration: 4 weeks;
ALZET Comments: Dose (5 mg/kg/day); Controls received mp w/ vehicle; animal info (8 weeks of age, WT and Sirt1Super mice); cardiovascular;

**Agents:** nicotine hydrogen tartrate  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 1002;  
**Duration:** 2 weeks;

**ALZET Comments:** Dose (3.0 mg/kg/d - adolescent, 6.3 mg/kg/d-adult); Controls received mp w/ vehicle; animal info (adolescent, adult); stability verified by (measuring the residual volume following surgical removal at the end of the exposure period for each time point); half-life 10 min (p.841); dependence;


**Agents:** Nicotine, (+) hydrogen tartrate salt  
**Vehicle:** saline, heparin buffered;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2ML2;  
**Duration:** 14 days;

**ALZET Comments:** Dose (2.1 mg/kg/day); saline (pH 7.4 with sodium hydroxide) with 25IU helparin used; Controls received sham surgery; animal info (male, Sprague-Dawley and Long Evans, 175–200g and 200–250g); post op. care (betadine ointment and recovery on a heating pad); behavioral testing (cue-reinstatement test); functionality of mp verified by weight after mp removal; dependence; pumps removed and reinstated on days 7 and 13. procedure listed on p.366;


**Agents:** Nicotine Tartrate, Bic-  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2004;  
**Duration:** 28 days;

**ALZET Comments:** Dose (12 mg/kg/d); animal info (6-24 weeks old); dependence;


**Agents:** Nicotine hydrogen tartrate  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat (pregnant);  
**Pump:** 1004D;  
**Duration:** 16-21 days;

**ALZET Comments:** Dose (6 mg/kg/day); 0.9% saline used; Controls received no mp or mp w/ vehicle; animal info (pregnant, female, Sprague-Dawley); pumps were implanted on gestational day 5 to expose pups through remaining gestation (16 days) and postnatal (0-5 days);
Agents: Nicotine bitartrate Vehicle: Saline; Route: SC; Species: Rat (pregnant); Pump: 1007D; Duration: Not Stated;
ALZET Comments: (6 mg/kg/day); Controls received mp w/ vehicle; animal info (pregnant dams on gestational day 5); post op. care (buprenorphine sc 0.5 mg/kg); dependence;

Agents: Nicotine Vehicle: PBS; Route: SC; Species: Mice; Pump: Not Stated; Duration: 10, 40 days;
ALZET Comments: Dose (20, 25 mg/kg/day); Controls received mp w/ vehicle; animal info (10 weeks, male, C57BL/6, 24-26g); functionality of mp verified by cotinine level measurement; cardiovascular; pump model not stated. Abstract lists 20 mg/kg/day while methods states 25 mg/kg/day used.;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Pump: 2004; Duration: 1 or 6 months;
ALZET Comments: Dose (0.4 mg/kg/h and 2.0 mg/kg/h); dose-response (); dose-response (); pumps replaced every 4 weeks; long-term study; stress/adverse reaction: Mice treated with the higher nicotine dose (2.0 mg/kg/h) lost weight after surgery and 50% died after one week. This was as a result of combined toxic effects of isoflurane and a higher dose of nicotine. Therefore, pentobarbital was used instead of isoflurane for induction of anesthesia, which reduced the mortality rate and improved weight gain in the higher dose group. (see pg. 172);

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML4; Duration: 20 days;
ALZET Comments: Dose (1.2, 3.16, or 6.32 mg/kg/dau); animal info (male Wistar rats weighing 320-360g); dependence;

Agents: Nicotine Vehicle: Not stated; Route: SC; Species: Mice; Pump: 1002; Duration: 14 days;
ALZET Comments: Dose (12.6, 18, or 24 mg/kg/day); Controls received mp w/ vehicle; animal info (C57BL/6J, 8-12 weeks old); neurodegenerative (Post Traumatic Stress Disorder);

Agents: Morphine sulfate, Nicotine bitartrate Vehicle: Saline, isotonic; Route: SC; Species: Rat; Pump: 2ML1; Duration: 7 days;
ALZET Comments: Dose (morphine at 0.3 and 0.6 mg/kg/hr, nicotine at 9 mg/kg/day); Controls received mp w/ vehicle; animal info (male Sprague-Dawley rats averaging 234 g); dependence;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: Not Stated; Duration: 7 days;
ALZET Comments: Dose (2 mg/kg/day); Controls received mp w/ vehicle; animal info (Male Sprague-Dawley rats);
Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat (pregnant); Pump: 2ML4; Duration: Not Stated;
ALZET Comments: Dose (6 mg/kg/day); Controls received mp w/ vehicle; animal info (female Sprague-Dawley dams);

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Pump: 1004; Duration: 14 days;
ALZET Comments: Dose (1 mg/kg/hr); 9% NaCl used; animal info (male C57BL/6 mice, 6–8 weeks of age); dependence;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Pump: 1007D; Duration: 7 days;
ALZET Comments: Dose (6, 12, or 24 mg/kg/day); 0.9% Saline used; animal info (Male, C57BL/6J, 8 weeks old, 20-30 g); cancer (Chemotherapy-induced peripheral neuropathy);

Agents: Nicotine Hydrogen Tartrate Salt Vehicle: Saline; Route: SC; Species: Mice; Pump: 1002; Duration: 14 days;
ALZET Comments: Dose (24 mg/kg/day); 0.9% Saline used; animal info (Male, 8-10 weeks old, C57BL/6J); dependence;

Agents: Nicotine hydrogin tartrate Vehicle: Saline; Route: SC; Species: Mice; Pump: 2002; Duration: 14 days;
ALZET Comments: Dose (24 mg/kg/day); Controls received mp w/ vehicle; animal info (Male, C57BL/6J); dependence;

Agents: Nicotine Hydrogen tartrate Vehicle: Saline; Route: SC; Species: Rat (pregnant); Pump: Not Stated; Duration: 4 weeks;
ALZET Comments: Dose (6 mg/kg/day); Controls received mp w/ vehicle; animal info (pregnant female Sprague–Dawley rats); minipumps released nicotine for 4 weeks from gestational day 6 to postnatal day 14;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Pump: 2004; Duration: 4 weeks;
ALZET Comments: Dose (5 mg/kg/day); Controls received mp w/ vehicle; animal info (9 week old, Male, C57BL/6J); cardiovascular;

Agents: Nicotine hydrogin tartrate Vehicle: Saline; Route: SC; Species: Mice; Pump: 2002; Duration: 14 days;
ALZET Comments: Dose (24 mg/kg/day); Controls receiveJacksod mp w/ vehicle; animal info (8 week old ICR male mice;

Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2006; Duration: Not Stated;
ALZET Comments: Controls received mp w/ vehicle; animal info (3-month old Wistar rats);

Agents: Nicotine  
Vehicle: Saline;  
Route: SC;  
Species: Rat;  
Pump: 2ML4;  
Duration: 28 days;

ALZET Comments: Dose (3 mg/kg/day); 0.9% sterile saline solution used; Controls received mp w/ vehicle; animal info (male Long Evans rats); post op. care (NSAID analgesic, an antibiotic);


Agents: Nicotine hydrogen tartrate  
Vehicle: Saline;  
Route: SC;  
Species: Rat;  
Pump: 2ML2;  
Duration: 16-21 days;

ALZET Comments: Dose (4.5 mg/kg/day); Controls received mp w/ vehicle; animal info (adult female Sprague–Dawley rats); ischemia (brain);


Agents: Nicotine  
Vehicle: Saline;  
Route: SC;  
Species: Rats;  
Pump: 2ML1;  
Duration: 1 week;

ALZET Comments: Dose (9 mg/kg/day); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Male, Sprague-Dawley, 6 weeks old, 200-250 g); behavioral testing (Open Field Test); Brain coordinates (3.8 mm posterior to bregma, 2.5 mm lateral to midline); neurodegenerative (Concussion);


Agents: Nicotine hydrogen tartrate salt  
Vehicle: Saline;  
Route: SC;  
Species: Rat;  
Pump: 2ML2;  
Duration: 14 days;

ALZET Comments: 0.9% saline used; animal info (Adult male and female Wistar rats); post op. care (analgesic flunixin - 2.5 mg/kg); dependence;


Agents: Nicotine, Metformin  
Vehicle: Saline;  
Route: CSF/CNS (lateral ventricle);  
Species: Mice;  
Pump: 1002;  
Duration: 2 weeks;

ALZET Comments: Dose (18 mg/kg/day-nicotine, 50 ug/day-metformin); 0.85% saline used; Controls received mp w/ vehicle; behavioral testing (Marble Burying Test, Novelty-Induced Hypophagia Test); Brain coordinates (anteroposterior, -0.8 mm; mediolateral, +1.5 mm); dependence;