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


**Agents:** Nicotine  **Vehicle:** Saline, sterile  **Route:** SC  **Species:** Mice  **Pump:** 2001; 2004  **Duration:** 7 days; 28 days

**ALZET Comments:** Dose (6 mg/kg/day); Controls received mp w/ vehicle; animal info (pregnant C57BL/6N mice); dependence;


**Agents:** Nicotine  **Vehicle:** Saline  **Route:** SC  **Species:** Rat  **Pump:** 2ML2  **Duration:** 14 days

**ALZET Comments:** Dose (6 mg/kg/d); 0.9% NaCl used; Controls received mp w/ vehicle; animal info (virgin female Wistar rats, 3 months old); Nicotine aka NIC; dependence;

Q9410: T. C. Peixoto, et al. Nicotine exposure during lactation causes disruption of hedonic eating behavior and alters dopaminergic system in adult female rats. Appetite 2021;160(105115

**Agents:** Nicotine  **Vehicle:** Saline  **Route:** SC  **Species:** Rat  **Pump:** 2ML2  **Duration:** 14 days

**ALZET Comments:** Dose (6 mg/kg body mass); Controls received mp w/ vehicle; animal info (Wistar rats, male and female); Nicotine aka Nic; dependence;


**Agents:** Nicotine  **Vehicle:** Saline  **Route:** SC  **Species:** Rat  **Pump:** 2004  **Duration:** 28 days

**ALZET Comments:** Dose: (3 mg nicotine/kg bodyweight/day); Controls received mp w/ vehicle; animal info: Wistar female rats (9 weeks old)teratology; dependence;


**Agents:** Nicotine; Mecamylamine  **Vehicle:** Saline  **Route:** SC  **Species:** Rat  **Pump:** 2ML2  **Duration:** 14 days

**ALZET Comments:** Dose (3.2 mg/kg/day Nicotine; 3.0 mg/kg Mecamylamine); Controls received mp w/ vehicle; animal info (Fully outbred adult Wistar rats, 260 g females, 400 g males); dependence;


**Agents:** Nicotine; Mecamylamine  **Vehicle:** Saline  **Route:** SC  **Species:** Rat  **Pump:** 2ML2  **Duration:** 14 days

**ALZET Comments:** Dose (3.2 mg/kg/day Nicotine; 3.0 mg/kg Mecamylamine); Controls received mp w/ vehicle; animal info: Male C57/Bl6 mice 2.5–3.5 months of age and with weights of 20–32g; dependence;

Q10004: M. A. Kwiatkowski, et al. Chronic nicotine, but not suramin or resveratrol, partially remediates the mania-like profile of dopamine transporter knockdown mice. European Neuropsychopharmacology 2021;42(75-86

**Agents:** Nicotine Hydrogen Tartrate  **Vehicle:** Saline, Sterile  **Route:** SC  **Species:** Mice  **Pump:** 2004  **Duration:** 26 days

**ALZET Comments:** Dose (40 mg/kg/day); 0.9% Sterile Saline used; Controls received mp w/ vehicle; animal info (male wildtype C57BL6/J mice, 50 to 60 weeks old); behavioral testing (Behavioral Pattern Monitor); dependence;


**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 Hydrogen Tartrate Salt  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 1004;  
**Duration:** 28 days;  
**ALZET Comments:** Dose (12.6 mg/kg/day); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Male, 8 weeks old); dependence;

**Agents:** Nicotine  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2ML4;  
**Duration:** 30 days;  
**ALZET Comments:** Dose (4 μg/kg/min); Controls received mp w/ vehicle; animal info (Sprague-Dawley male rats (8-months-old)); ischemia (cardiac injury);

**Agents:** Nicotine  
**Vehicle:** Saline;  
**Route:** IP;  
**Species:** Rat;  
**Pump:** 1007D;  
**Duration:** 7 days;  
**ALZET Comments:** Dose (1 mg/kg/day); Controls received mp w/ vehicle; animal info (male and virgin female adult Sprague-Dawley rats, 12-14 weeks old); Blood pressure measured via tail-cuff method;105 mmHg - 130 mmHg; cardiovascular;

**Agents:** Nicotine  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Mice;  
**Pump:** 1007D;  
**Duration:** 7 days;  
**ALZET Comments:** Dose (1.67 ng/0.5 uL/hr/20 g); Controls received mp w/ vehicle; animal info (Male C57BL/6J Jcl mice) 19-21g; Resultant plasma level (23 fmol/mL Ghrelin); dependence;

**Agents:** Nicotine  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** SMP-200;  
**Duration:** 21 days;  
**ALZET Comments:** Dose (1.0 mg/d or 0.3 mg/d); Controls received mp w/ vehicle; animal info (Male Long-Evans rats , 300–350 g); dependence;

Q8847: T. C. Peixoto, et al. Nicotine exposure during breastfeeding reduces sympathetic activity in brown adipose tissue and increases in white adipose tissue in adult rats: Sex-related differences. Food and Chemical Toxicology 2020;140(111328
**Agents:** Nicotine  
**Vehicle:** Saline;  
**Route:** SC;  
**Species:** Rat;  
**Pump:** 2ML2;  
**Duration:** 14 days;  
**ALZET Comments:** Dose (6 mg/kg of nicotine per day); Controls received mp w/ vehicle; animal info (Lactating Wistar rats); teratology;

Q8667: R. A. Miranda, et al. Thyroid redox imbalance in adult Wistar rats that were exposed to nicotine during breastfeeding. Scientific Reports 2020;10(1):15646
**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 female Wistar rats); Nicotine aka NIC; dependence;

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: Saline; Route: SC; Species: Rat; Pump: 2ML4; Duration: 14 days;
ALZET Comments: Dose (1.2 or 4.8 mg/kg/day); 0.9% Saline used; Controls received mp w/ vehicle; animal info (Sprague Dawley, 275-300 g); dependence;

Agents: Nicotine hydrogen tartrate Vehicle: Saline; Route: SC; Species: Rat; Pump: Not Stated; Duration: 14 days;
ALZET Comments: Dose (6 mg/kg/day); Controls received mp w/ vehicle; animal info (Pregnant female Sprague Dawley rats); dependence;

Q8553: G. Jia, et al. Nicotine induces cardiac toxicity through blocking mitophagic clearance in young adult rat. Life Sciences 2020;257(118084
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: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Rat; Pump: Not Stated; Duration: 28 days;
ALZET Comments: Dose (0.8 mg/kg/d; 4 mg/kg/d); Controls received mp w/ vehicle; animal info (Male C57BL/6J mice, 8 weeks old; Female and Male Sprague Dawley OFA rats); dependence;

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 Vehicle: Not Stated; Route: Not Stated; Species: Rat; Pump: 2ML2; Duration: 14 days;
ALZET Comments: Dose (3.2 mg/kg/d); animal info (Male and female Wistar rats); behavioral testing (physical signs test, Anxiety-like behavior assessments); replacement therapy (Estradiol, progesterone);

Agents: Nicotine Hydrogen Tartrate Vehicle: Salline; 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 Hydrogen Tartrate Vehicle: Saline; Route: SC; Species: Rat; Pump: ML2; Duration: 16, 21 days;
ALZET Comments: Dose (4.5 mg/kg/day); Controls received mp w/ vehicle; animal info (Female, Sprague Dawley, 6 or 14 weeks old); ischemia (Hypoperfusion);
**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 salt **Vehicle:** Saline, Physiological; **Route:** SC; **Species:** Mice; **Pump:** Not Stated; **Duration:** 14 days;
**ALZET Comments:** Dose (24 mg/kg/day); Controls received mp w/ vehicle; animal info (10-12 weeks, female, CD-1 and G72 transgenic, 31-35g); dependence; pump model not stated;

**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;,

**Agents:** Nicotine Hydrogen Tartrate **Vehicle:** Saline; **Route:** CSF/CNS; **Species:** Mice; **Pump:** 2002; **Duration:** 14 days;
**ALZET Comments:** Dose (48 mg/kg/hour); Controls received mp w/ vehicle; animal info (Male, 4-6 months old); neurodegenerative (Alzheimer’s Disease);

**Agents:** Nicotine; Mecamylamine **Vehicle:** Saline; **Route:** SC; **Species:** Rat; **Pump:** Not Stated; **Duration:** 14 days;
**ALZET Comments:** Dose (3.16 mg/kg/day nicotine; 1 mg/kg mecamylamine); 0.9% NaCl used; Controls received mp w/ vehicle; animal info (Wistar rats, males 200-225 g, females 175-200 g); behavioral testing (Large Open Field Test; Elevated Plus Maze Test); dependence;

**Agents:** Nicotine bitartarate; Benzo[a]pyrene; Both **Vehicle:** H2O; DMSO; **Route:** SC; **Species:** Rat; **Pump:** 2ML4; **Duration:** 4 weeks;
**ALZET Comments:** Nicotine bitartrate or Benzo[a]pyrene or both
Agents: Nicotine hydrogen tartrate salt Vehicle: Saline; Route: SC; Species: Mice; Pump: 2002; Duration: 14 days;
ALZET Comments: Dose (25 mg/kg/day); animal info (8-weeks old male C57BL/6J mice (Charles River)); dependence;

Agents: Nicotine Bitartrate Salt Vehicle: Saline; Route: SC; Species: Rat; Pump: 2002; Duration: 2 weeks;
ALZET Comments: Dose (15 mg/kg/day); Controls received mp w/ vehicle; animal info (3-4 week old, Male); post op. care (Buprenorphine); Blood pressure measured via Tail-cuff Plethysmography;cardiovascular;

Agents: Nicotine Vehicle: Not Stated; Route: SC; Species: Mice; Pump: 2004; Duration: 14 days;
ALZET Comments: Dose (24 mg/kg/day); animal info (8-16 weeks old, 20-30 g, C57BL/6J); dependence;

Agents: Nicotine bitartrate Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML1; Duration: 7 days;
ALZET Comments: Dose (9 mg/kg/day); Controls received mp w/ vehicle; animal info: Thirty-seven male Sprague-Dawley rats, weighing from 284 to 323 g; behavioral testing: (Fisher’s LSD and Dunnett’s tests); dependence;

Agents: Nicotine bitartrate Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML1; Duration: 7 days;
ALZET Comments: Dose (9 mg/kg/day); Controls received mp w/ vehicle; animal info (male Sprague-Dawley rats, 284 to 323 g); behavioral testing (dual-lever experiment);

Agents: Nicotine Ditartrate Vehicle: Saline; Route: SC, IV (jugular); Species: Rat; Pump: 2ML4; Duration: 4 weeks;
ALZET Comments: Dose (2.5 mg/kg/day); animal info (Young adult female Sprague-Dawley rats); post op. care (ketoprofen, bupivacaine); behavioral testing (dual-lever experiment);

Agents: Nicotine hydrogen tartrate salt Vehicle: Saline; Route: SC; Species: Rat (pregnant); Pump: Not Stated; Duration: 28 days;
ALZET Comments: Dose (6 mg/kg/d); Controls received mp w/ vehicle; animal info (Pregnant female Sprague–Dawley (SD) rats); dependence;

Agents: Nicotine Hydrogen Bitartrate salt Vehicle: Saline; Route: SC; Species: Rat; Pump: 2002; Duration: 14 days;
ALZET Comments: 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;

Agents: Nicotine hydrogen tartrate salt Vehicle: Saline; Route: IP; Species: Rat; Pump: 2ML4; Duration: 14 days;
ALZET Comments: 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;


Agents: Nicotine Vehicle: Saline; Route: SC; Species: Mice; Pump: 1002; Duration: 12 days;
ALZET Comments: Dose (12.6 mg/kg/day); 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;


Agents: Nicotine Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML4; Duration: 56 days;
ALZET Comments: 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;


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: Rat; Pump: 2002; Duration: 2 weeks;
ALZET Comments: Dose (3 mg/kg/day); Controls received mp w/ vehicle; animal info (Sprague Dawley); 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 Vehicle: Saline; Route: SC; Species: Rat; Pump: 2ML4; Duration: 3 months;
ALZET Comments: Dose (61 mg/mL); Controls received mp w/ vehicle; animal info (adult male Sprague-Dawley rats 400-450g); pumps replaced every 4 weeks;

Agents: Nicotine Tartrate, Bi- Vehicle: Saline; Route: SC; Species: Rat; Pump: 1007D; Duration: 16 days;
ALZET Comments: Dose (6 mg/kg/d); Controls received mp w/ vehicle; animal info (Sprague Dawley rat pups of either sex, ranging in age from P1 through P7); dependence;
Q7398: M. Biet, et al. In utero exposure to nicotine abolishes the postnatal response of the cardiac sodium current to isoproterenol in newborn rabbit atrium. Heart Rhythm 2019;16(4):494-501

**Agents:** Nicotine **Vehicle:** Saline; **Route:** SC; **Species:** Rabbit; **Pump:** 2ML2; **Duration:** 14 days;

**ALZET Comments:** Controls received mp w/ vehicle; animal info (New Zealand, female); Multiple pumps per animal (2); Resultant plasma level ((100 and 150 ng/mL)); cardiovascular;


**Agents:** Nicotine hydrogen tartrate **Vehicle:** Saline; **Route:** SC; **Species:** Rat (pregnant); **Pump:** 2004; **Duration:** 14 days;

**ALZET Comments:** Dose (4 mg/kg/day); 0.9% saline used; Controls received mp w/ vehicle; animal info (Timed-pregnant Sprague-Dawley rats 250 g- 300 g); pumps implanted during gestation); behavioral testing (open field test, forced swim test); dependence;


**Agents:** Nicotine hydrogen-tartrate **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 tartrate **Vehicle:** Saline; **Route:** SC; **Species:** Mice; **Pump:** 2002; **Duration:** 14 days;

**ALZET Comments:** Dose (18 mg/kg/day); Controls received mp w/ vehicle; animal info (Male B6/129; 8–10 weeks of age; 20–31 g); B6/129 F1 mouse strain is a hybrid of C57BL/6 and 129SvEv strains that are commonly used for the development of knockout mouse models); behavioral testing (OF test; MB test); dependence;