

Marking and Identifying Free-Roaming Dogs and Cats

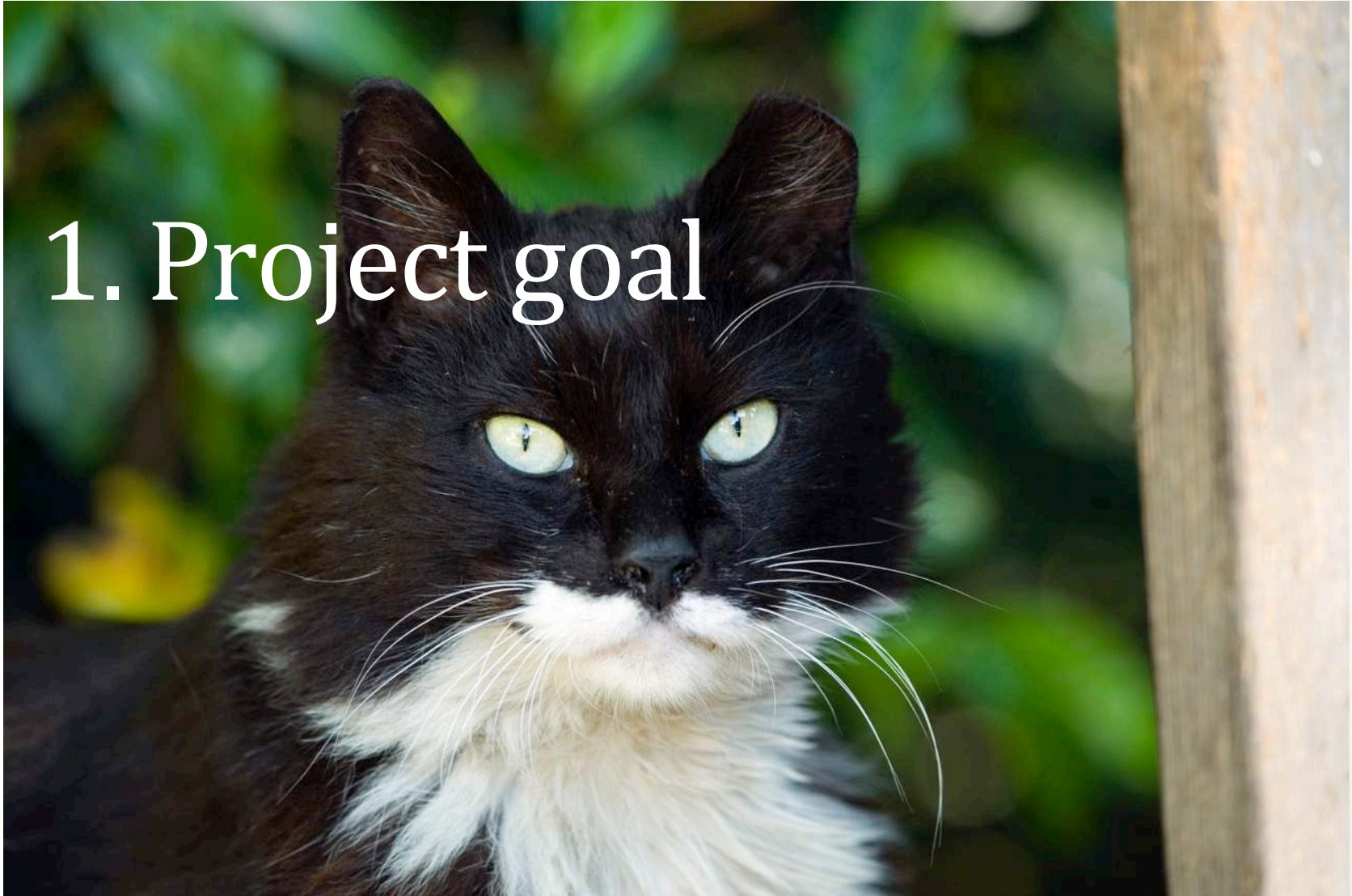
Valerie Benka & Susan Getty



Presentation Outline

1. Project goal
 1. Think Tank
 2. Marking criteria
2. Cornell partnership to develop ear tags
3. Pilot/field studies
 1. Sheltered dogs in Romania (Summer 2015)
 2. Study in pet cats in Illinois (March 2016)
 3. Study in free-roaming owned dogs in Kenya (September 2016)
 4. Next steps; 2nd study in cats in Illinois
4. Microneedle patch

1. Project goal





Project Goal: To identify a new method, or improve upon an existing method, to mark animals as non-surgically sterilized or contracepted.

Think tank

- Broad expertise
- Review current marking across species and contexts
- Establish criteria for non-surgical marking of dogs and cats

ACC & D
Alliance for Contraception
in CATS & DOGS

**Identifying & Prioritizing Marking Methods
for Non-Surgically Sterilized Cats & Dogs
Scientific Think Tank**

May 16-18, 2013
Phoenix, AZ

Overview

On May 16-18, 2013, the Alliance for Contraception in Cats & Dogs (ACC&D) convened a Think Tank on surgically sterilized cats and dogs. The meeting was held in Phoenix, Arizona, with financial support from PetSmart Charities. ACC&D undertook this initiative in response to the growing need for a means to identify animals who have been treated with a non-surgical sterilant or long-term contraceptive. The Think Tank focused on cats and dogs, particularly free-roaming populations, who have undergone non-surgical interventions. However, the value is not limited to these animals—improved marking methods could have benefits for surgically sterilized animals as well.

The mission of ACC&D is to expedite the successful introduction and to support the distribution and promotion of non-surgical methods to sterilize cats and dogs. ACC&D's vision is to reduce animal death and suffering worldwide by enhancing the tools available to humanely control their populations. Non-surgical approaches can be less expensive, less labor-intensive, and require shorter recovery times than surgery, allowing more animals to be treated quickly and safely.

This was ACC&D's fifth scientific Think Tank. Prior Think Tanks have addressed:

- Population modeling as a tool to guide the design and implementation of contraceptive approaches to best achieve stabilization or reduction of population size
- Delivery technologies that could be used to precisely control administration of slow-release, timed-release, or multi-dose treatments
- Methods to improve immunocontraceptive vaccines for sterilization of dogs and cats
- Gene silencing and immunocontraception as research areas with promise for achieving the goal of a non-surgical sterilant

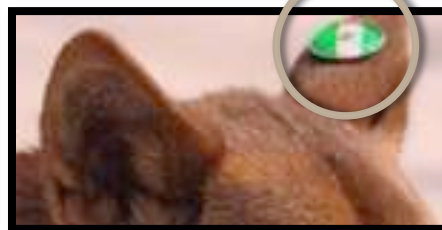
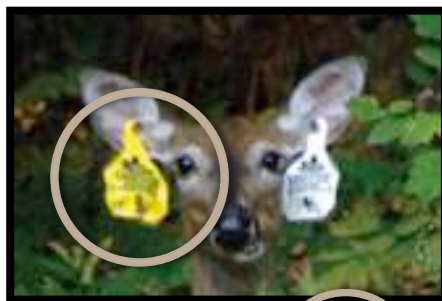
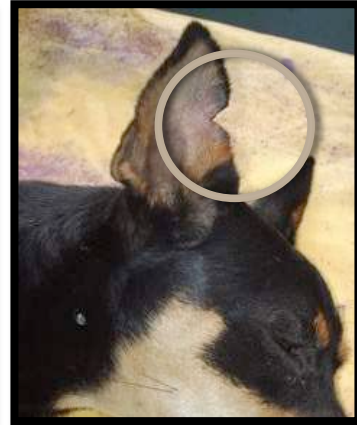
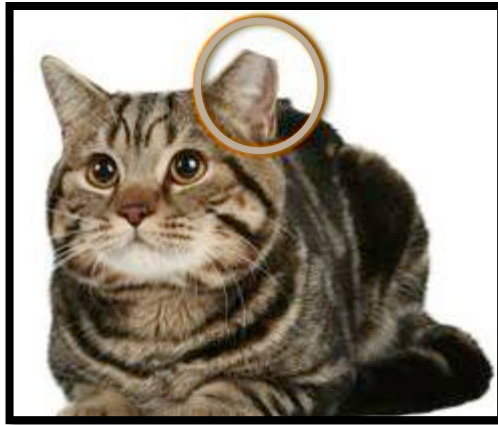
The marking methods Think Tank sought to identify the most promising near-term and long-term methods to mark animals treated with a non-surgical sterilant. Towards this end, ACC&D convened experts from diverse fields, each invited for his or her capacity to contribute varied and valuable insights on the challenge. Experts in population and wildlife biology, dog and cat reproductive biology, software and database design, and animal identification technologies such as radio frequency identification (RFID) joined individuals experienced in vaccination and sterilization initiatives of free-roaming cats and dogs for this Think Tank. Experts in invention and innovation were also involved as participants and facilitators.

We gratefully acknowledge PetSmart Charities for sponsoring this Think Tank.

**PETSMART
Charities**

www.acc-d.org

Current Animal Marking Methods



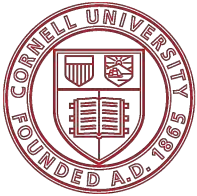
Marking Criteria: Minimum and Ideal

Criteria		Minimum	Ideal
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Behavioral Impact (i.e., interference with normal behavior, other animals, or humans)		None	None
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	Cost per application	<\$10	<\$1
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	Quantity of information	Treated (yes/no)	Type/date(s) of treatment, other info
	Info retrieval device cost	<\$50	\$0

2. Ear tags



R&D partners and funders



Cornell University
David R. Atkinson Center
for a Sustainable Future



Cornell University
College of Veterinary Medicine

ACC & D
Alliance for Contraception
in CATS & DOGS



Cornell University
College of Engineering



Cornell University
College of Human Ecology
Fiber Science & Apparel Design

Key Cornell players:

- PI: Margaret Frey, PhD (Fiber Science)
- Co-Inv: Elizabeth Berliner, DVM (CVM)
- Co-Inv: Edwin Kan, PhD (Engineering)
- DVM student: Eloïse Cucui

Partners and volunteers:

- Kaos Softwear, Portland, OR
- Dr. Karl Citek, Pacific University College of Optometry
- Asociația de Protecție a Animalelor “Milioane de Prieteni”, Romania
- Dr. Kevin McGowan, Cornell Ornithology Lab
- David Buffington, Glen Raven Custom Fabrics
- Gene Pancheri, Proctor & Gamble (ret).

Development – multiple expertise

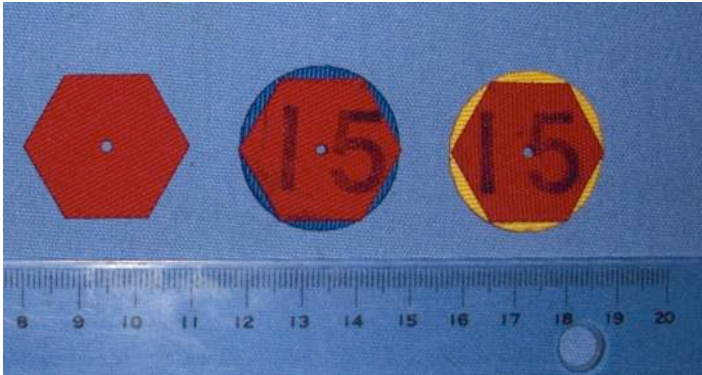
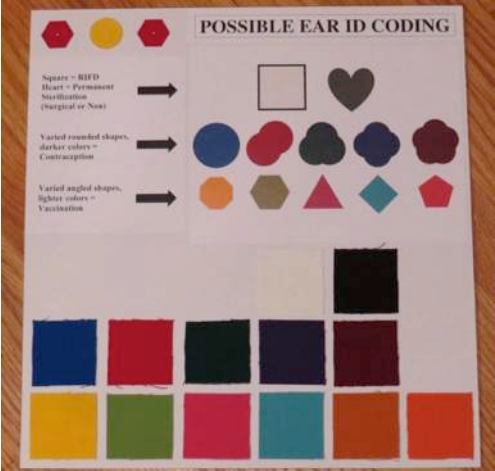
Tag Material



Application



Coding/ Visibility



3. Pilot/field studies



Sheltered dog study: Braşov, Romania





Animals & Methods

- 54 dogs of both sexes and varied ages and types
- Tag applied under anesthesia for s/n surgery
- Observations on days 0-8, 10, 12, 14, 21, 28, etc.





Results

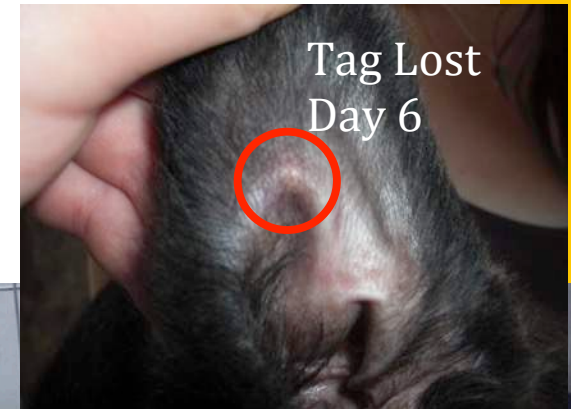
- Applicator works well in anesthetized animals
- Tags do not cause infection or pain in animals treated with antibiotics and analgesics
- Tag visibility is not always ideal; RFID beneficial





Results

- Tag loss was low but significant; 5 of 54 tags (9.25%) failed over 643 dog days = 0.008 tags/dog day
- Tags might not work for closely confined and/or teething puppies
- Multiple outstanding questions for future field studies – not least tolerance of application and durability





Indoor/outdoor pet cat study:
St. Joseph, Illinois

Generously funded by:

ASPCA[®]

Animals & Methods

- 9 indoor/outdoor pet cats belonging to Amy Fischer
- Tag applied under anesthesia for routine or Grade 1 periodontal treatments
- Same monitoring protocol as in Romania

Results: Ears

- Cats developed slight scabbing at point of application—not serious or bothersome
- Skin underneath tag was healthy



Results: Behavior

- All but one cat exhibited normal behavior throughout.
- One female initially exhibited ear flicking and head shaking, which stopped within a few days.
- No change in non-tagged cats' behavior toward tagged cats.



Results: Tag Loss

- 3/9 cats lost tags (D19, 30, 119)
 - All tags failed at the fastener
 - No damage to ear
- 2/9 cats have tags after 28 months
- 4/9 removed for reasons unrelated to tag failure



Photo credit: Amy Fischer

A group of people, including several men in bright green t-shirts, are gathered in a dusty, open area with sparse trees. Many of the people are holding leashes for various breeds of dogs. A young child in the foreground is looking towards the camera. The scene is set in a rural, arid environment under a clear blue sky.

Free-roaming owned dog field study Laikipia, Kenya

Animals & Methods

- *Objectives*: evaluate 1) practicality and humaneness of application in conscious dogs, 2) tag performance
- *Study population*: >100 free-roaming owned dogs with owner permission to tag.
- Selected calm, stable dogs who did not respond to handling or other medical treatments.
- Used ethyl chloride topical anesthetic spray



Results

- Dogs struggled and vocalized during ethyl chloride and tag application
 - Indicators of pain
 - Ethyl chloride did not have adequate anesthetic effect
- Attempted tagging in 6 dogs
 - Four successful, two aborted
- Study halted on animal welfare grounds
- Pain/distress was very transient; dogs behaved normally within minutes post-procedure
- Tag loss: 3 dogs followed, all had lost tags by day 16

Marking Conclusions

- Suspend further lab or controlled field studies of prototype ear tag in dogs due to combined:
 - Indications of pain
 - Limited anesthetic options for field use
 - Tag loss
- Still a possibility for cats?

4. Partnership with Dr. Mark Prausnitz of Georgia Tech

Laboratory for Drug Delivery

Prof. Mark R. Prausnitz
Georgia Institute of Technology

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Welcome to the Laboratory for Drug Delivery!



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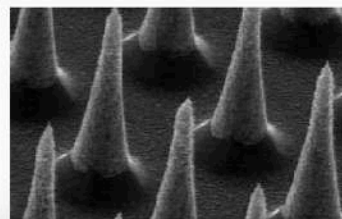
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What is a microneedle patch and how does it work?

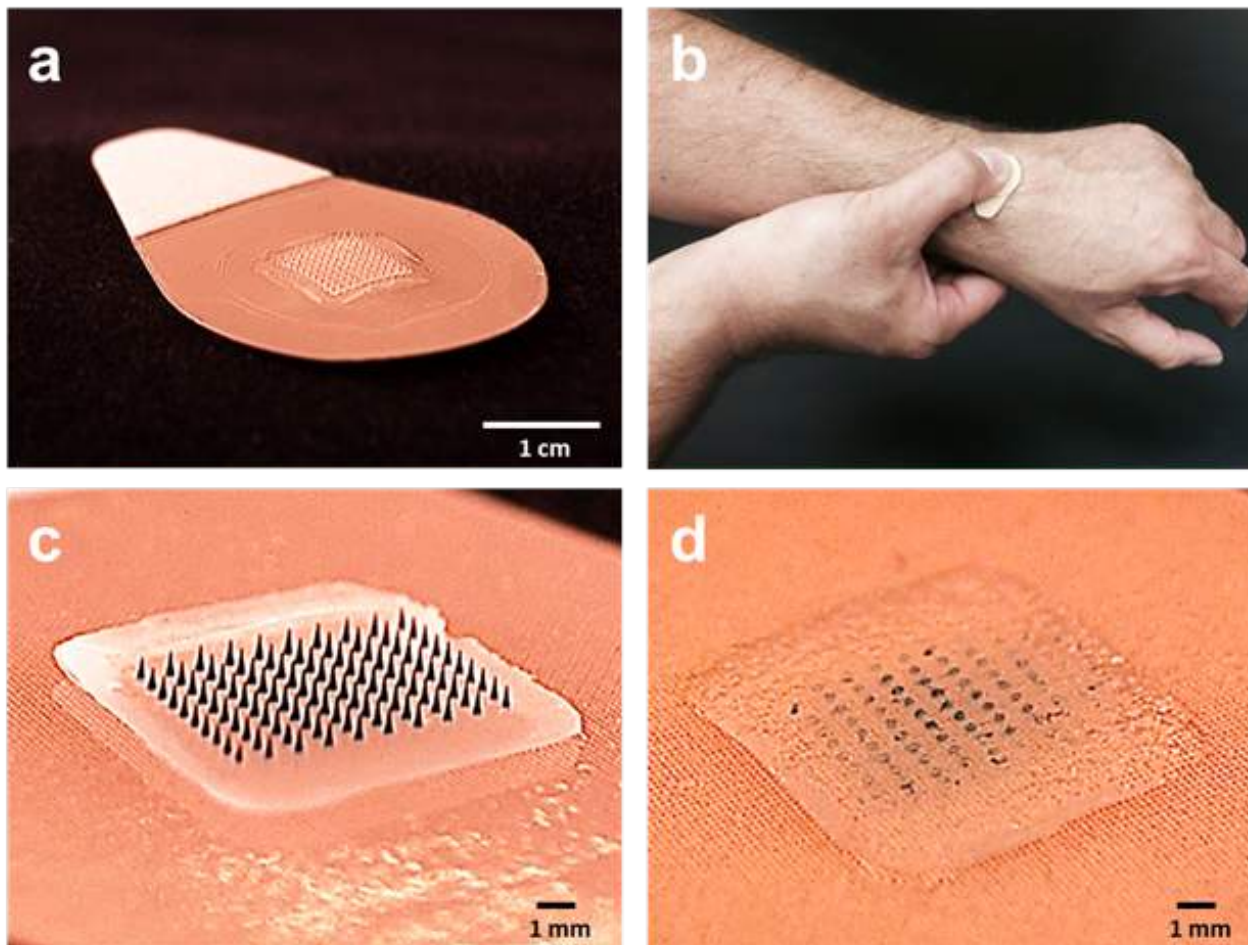
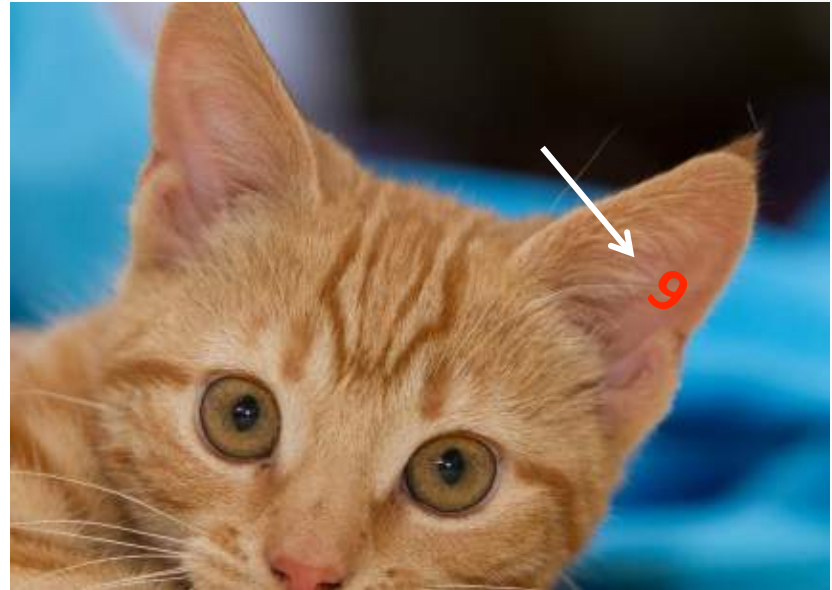
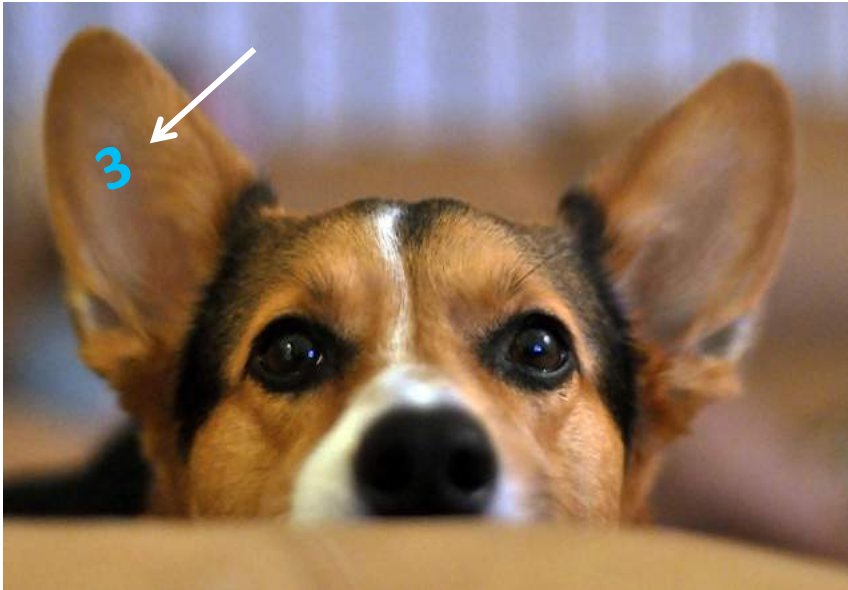


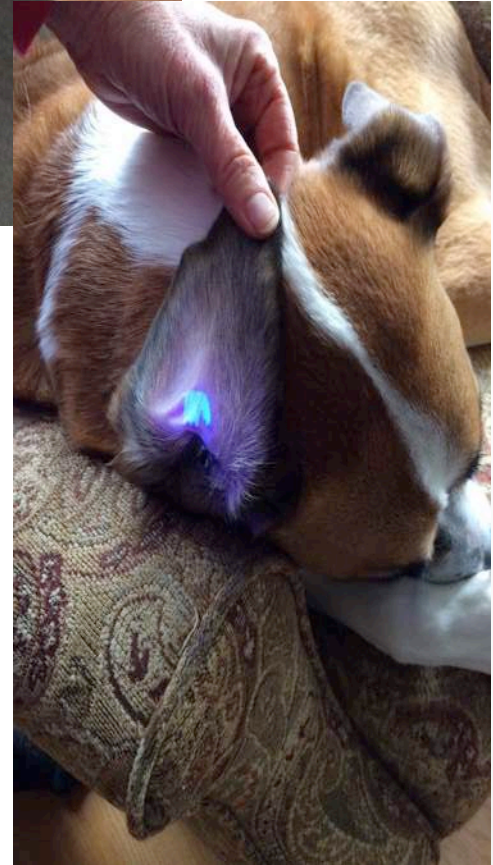
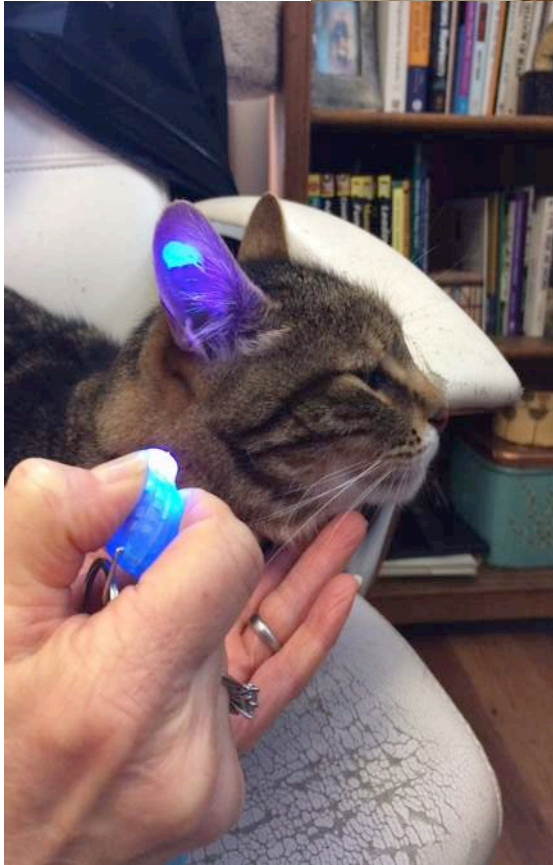
Photo courtesy of Mark Prausnitz

How would this work on dogs and cats?



- **Color indicates gender**
- **Number indicates year**

UV ink



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Rabies vaccination in dogs using a dissolving microneedle patch



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ABSTRACT

Because humans get rabies primarily through dog bites, stray dog population control and mass or mandatory vaccination of domestic dogs and other animals has virtually eliminated human rabies in industrialized countries. However, thousands of people in developing countries die of rabies each year due to the inability to control dog populations and implement mass vaccination because of financial, logistical and other challenges. The availability of an easier-to-administer and more cost-effective vaccine may help to address some of these issues. Here, we propose the use of dissolving microneedle patches for simple and potentially cost-effective rabies vaccination, and assess the safety and immunogenicity of microneedle patch vaccination using a rabies DNA vaccine in dogs. The vaccine was stable upon formulation and storage for at least 3 weeks at 4 °C in a microneedle patch. For vaccination, the patches were applied to the inner ear by hand without an applicator. Microneedle patches were well tolerated in the skin, with mild erythema, minimal wheal formation and complete resolution of skin reactions within 7 days, and generated no systemic adverse events. Microneedle patches were at least as immunogenic as intramuscular injection at the same dose, as demonstrated by similar serum neutralizing antibody titers. A ten-fold lower vaccine dose administered by microneedle patch generated a weaker immune response compared to full-dose intramuscular vaccination. We conclude that dissolving microneedle patches may provide an innovative approach to mass vaccination of dogs.

Table 1Tolerance of dogs to vaccination by IM injection and microneedle patch¹.

	Prime (day 0)	Boost (day 28)
Intramuscular injection 50 µg	 60%	 0%
Microneedle patch 50 µg	 0%	 0%
Microneedle patch 5 µg	 0%	 20%
Placebo microneedle patch	 0%	 0%

 Dogs were tolerant
 Dogs were intolerant

¹ Dogs were considered intolerant of injection if they vocalized, withdrew or tried to bite upon injection.

Table 2Number and type of local injection site reactions¹.

	Erythema	Wheal formation	Swelling	Pain upon palpation	Ulceration
IM 50 µg	○ 0%	○ 0%	○ 0%	○ 0%	○ 0%
MN 50 µg	● 100%	◐ 20%	○ 0%	○ 0%	○ 0%
MN 5 µg	● 100%	◐ 40%	○ 0%	○ 0%	○ 0%
MN Placebo	◐ 50%	◐ 50%	○ 0%	○ 0%	○ 0%

□ Skin reactions absent
■ Skin reactions present (Percentages provided)

¹ The dogs were observed for local injection site reactions on the day of the vaccination, daily for the first three days following each vaccination and intermittently for any dogs with reactions persisting for more than three days. This table reports the cumulative percentage of dogs with injection site reactions after both vaccinations.

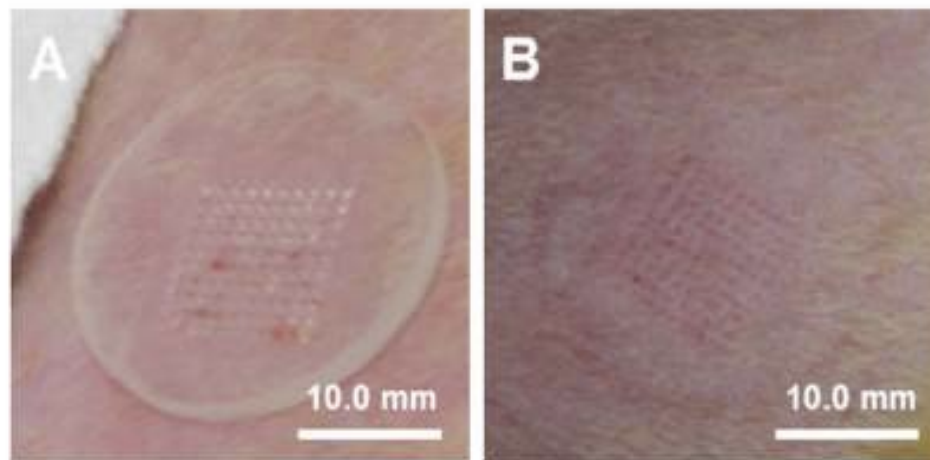
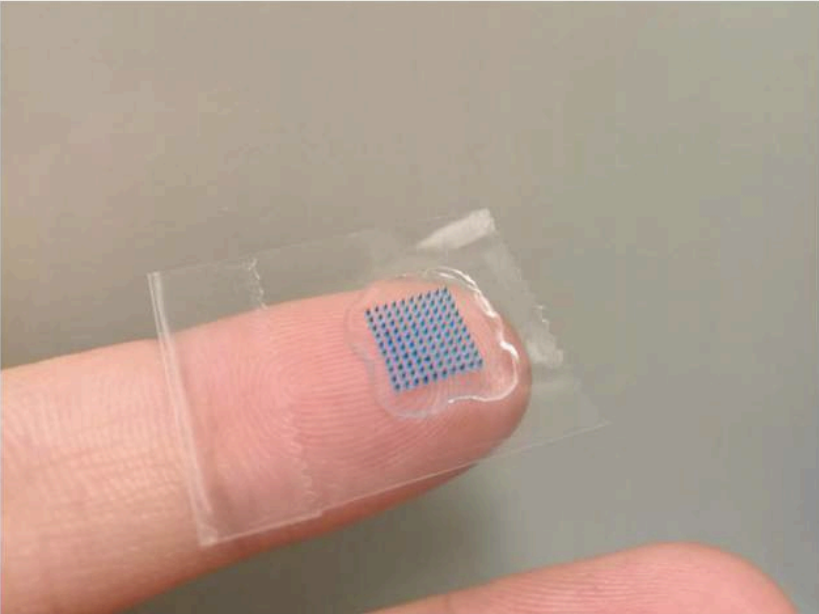
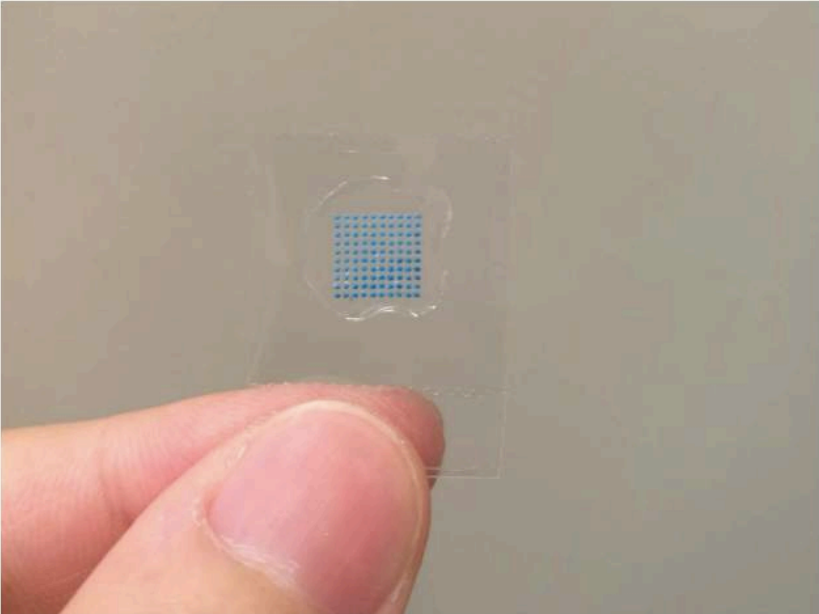


Fig. 5. Dog ear during and after microneedle patch vaccination in vivo. Microneedle patches were applied onto dog ears with hair removed, left on the skin for 15 min and then removed. (A) Microneedle patch applied to skin. (B) Same section of skin immediately imaged after microneedle patch application and removal showing a faint grid where microneedles inserted and slight skin erythema.

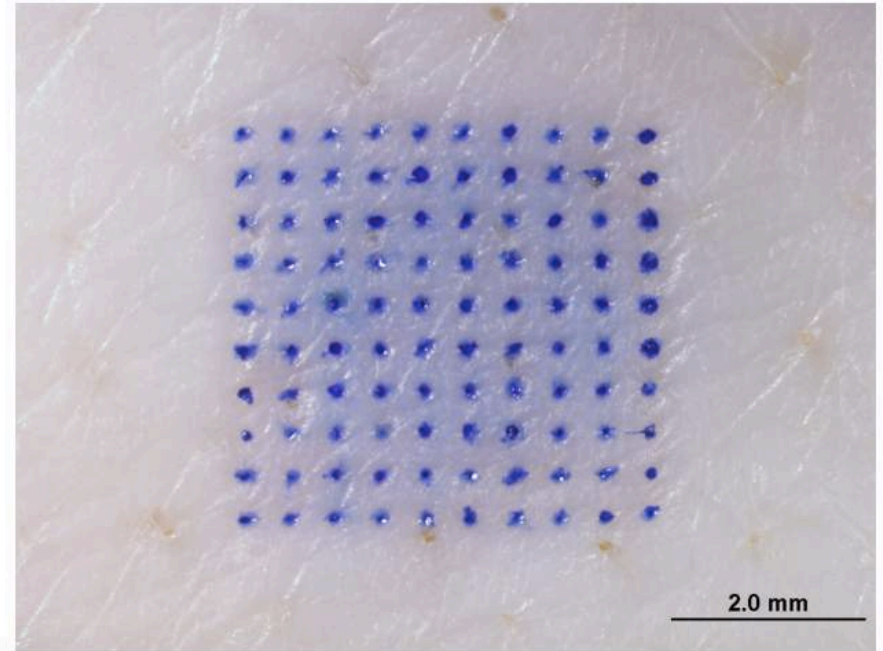
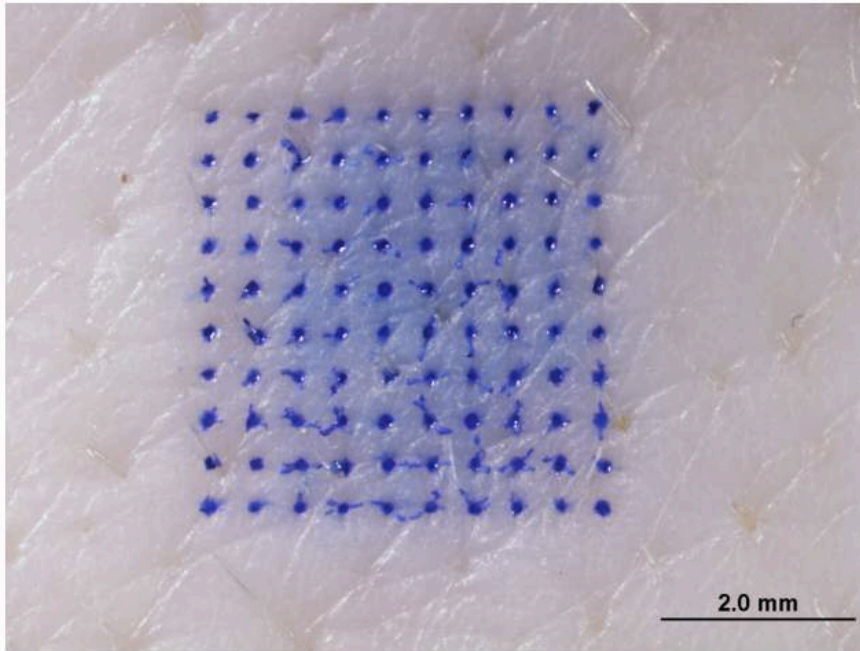
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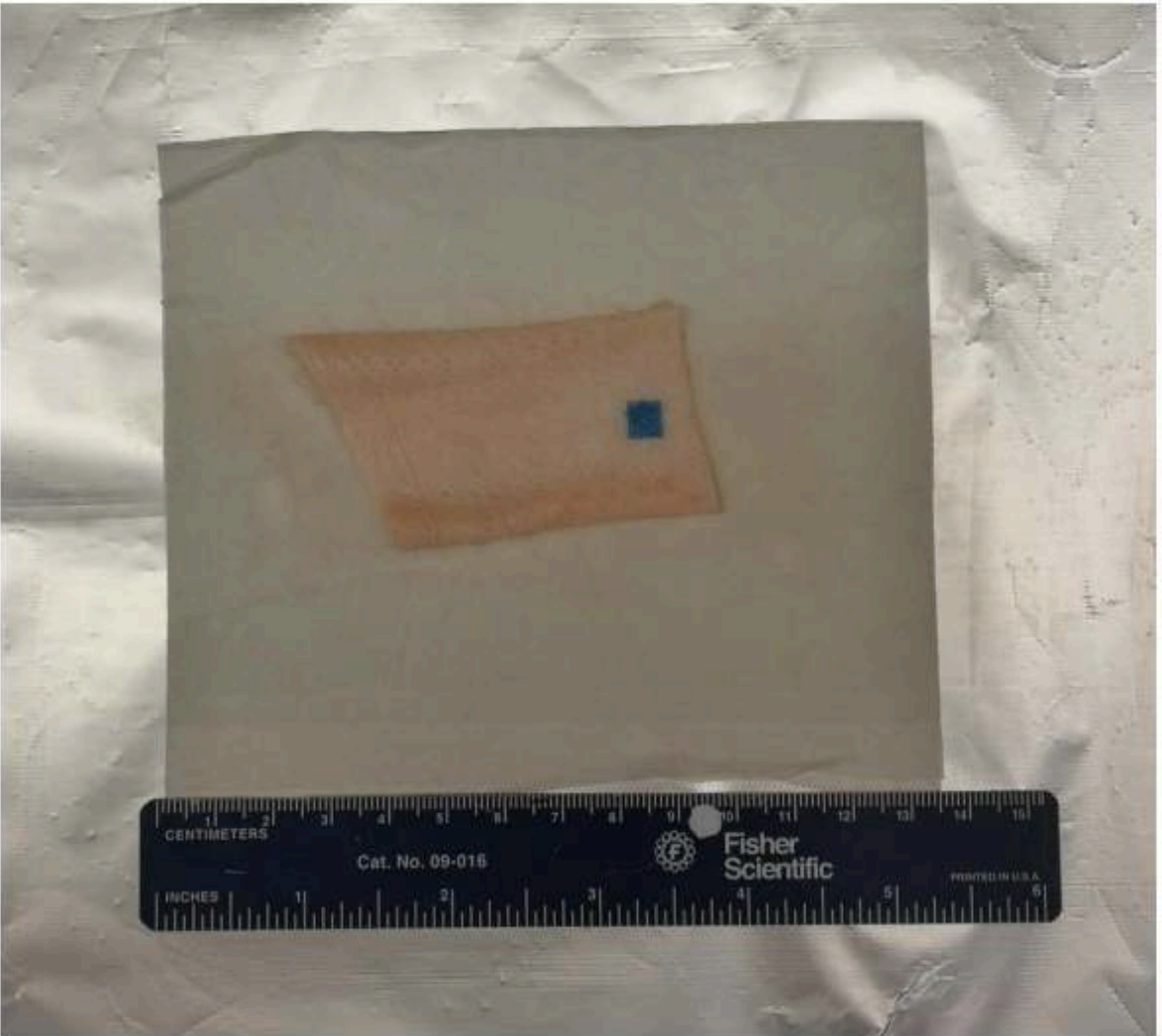
Microneedle patch loaded with blue tattoo ink:
before use



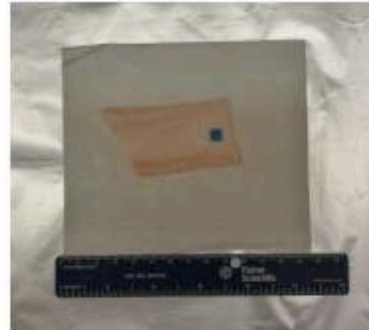
Pig ear skin tattooed with blue ink: microscopic view



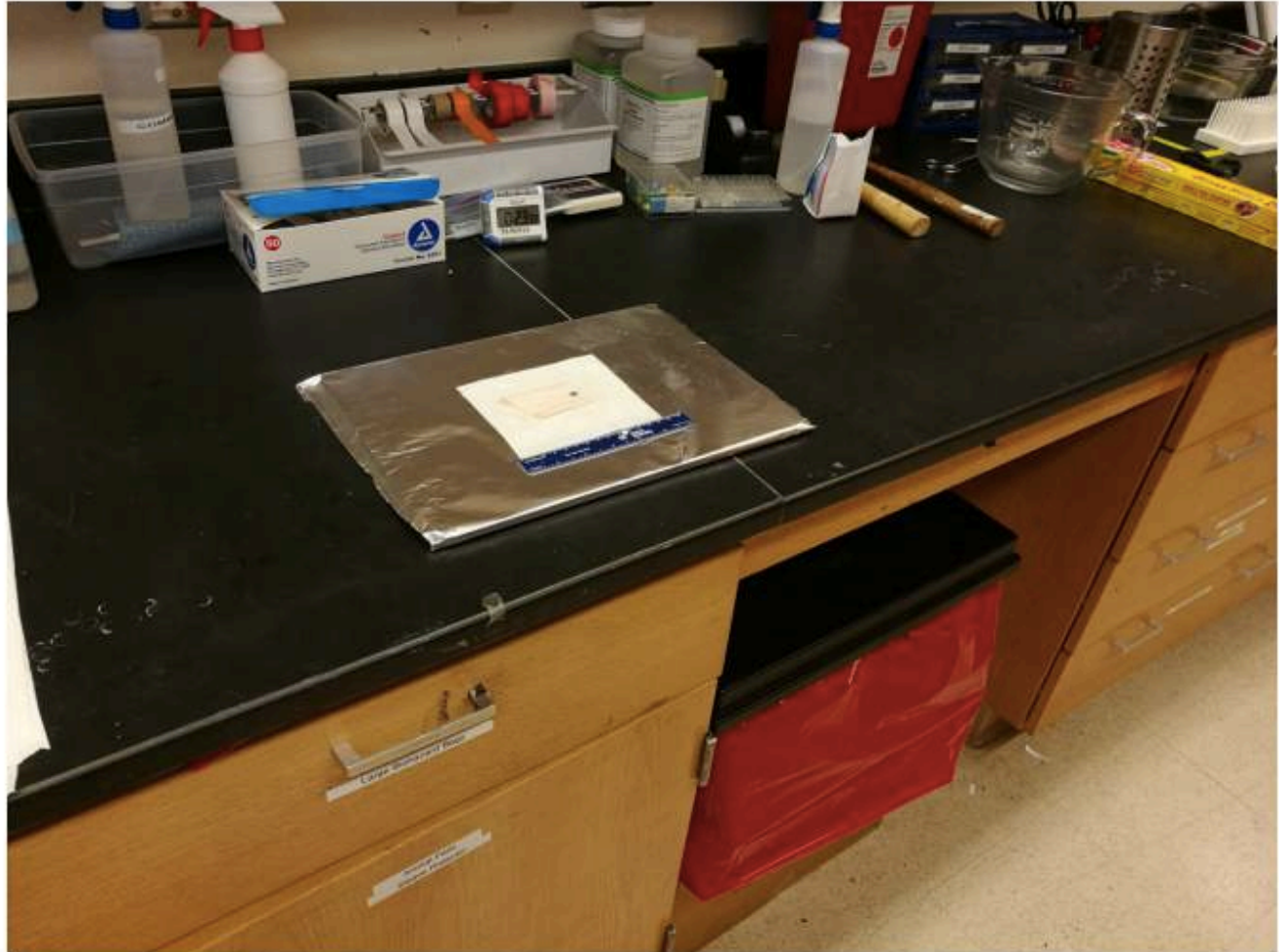
Pig ear skin tattooed with blue ink: macroscopic view



Pig ear skin tattooed with blue ink:
viewed at a distance

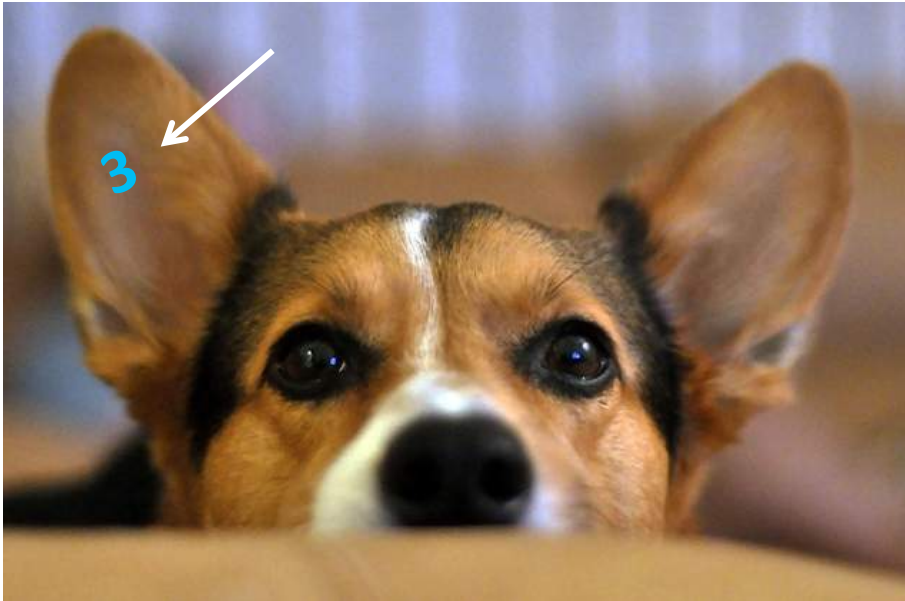
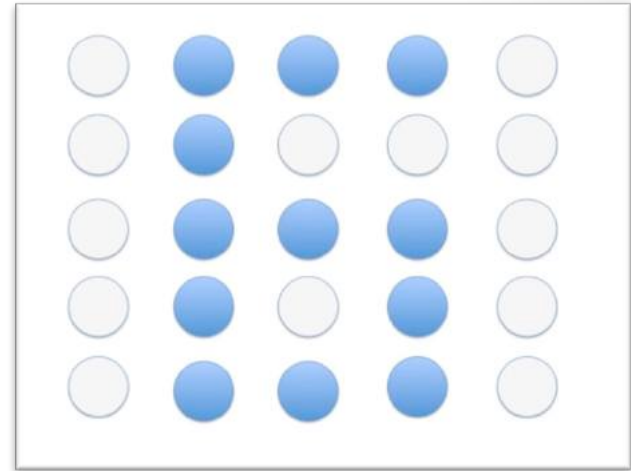


Pig ear skin tattooed with blue ink:
viewed at a distance




Next Steps:

- ink patterned in numbers
- UV ink
- Patch with shorter application time
- Patch with biodegradable adhesive



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Potential problems

We welcome your feedback!

- **For those of you working in the field, what are your thoughts?**
 - **When would this work, and when wouldn't it work?**
 - **If we couldn't get application to a matter of seconds, would it work to press the patch on, have it be held on with a sticky, biodegradable material that falls off eventually?**

