

NTCA Health Committee
Annual Report, 2020-2021
Jane R. Schubart, Chair
September 13, 2021

Norwich Terrier Breed Health Survey

The breed health survey questionnaire was made available to the Norwich Terrier community June to August 2021. The results are being analyzed at this time. After removing incomplete and duplicate responses, there are 588 completed surveys for alive dogs, age 1 and older. 72% of these questionnaires were completed by owners who did not breed the dogs, representing dogs ages 1-17 years with median of 11 years. In addition, 180 surveys were completed for deceased dogs. The results will be presented at the NTCA Health Seminar by Jane, October 7, with time allotted for discussion and questions. The results will also be available on the NTCA website.

Norwich Terrier Upper Airway Syndrome (NTUAS Study)

Project Lead: Bryden J. Stanley

Dr. Stanley presented the results of the NTUAS Study in November 2020, in a live VetVine webinar titled "Upper Airway Syndrome: Results of a Cross-Sectional Study in Norwich Terriers". In case you missed the live webinar, it was recorded and you can view it "on demand" via VetVine.

<https://www.vetvine.com/article/673/akcchf-upper-airway-syndrome-results-of-a-cross-sectional-study-in-norwich-terriers>

Resources for veterinarians, including the NTUAS scoring form, visual guide, and history questionnaire are available here: <https://norwichterrierclub.org/NTUAS/> Additional information and resources will be added to our website when available.

Dr. Lynelle Johnson published a study that included a subset of the dogs that were part of the main NTUAS study. The article is open access and available here (and on the NTCA website):

[Johnson LR, Mayhew PD, Culp WTN, Stanley BJ. Results of owner questionnaires describing long-term outcome in Norwich terriers with upper airway syndrome: 2011-2018. J Vet Intern Med. 2021;1-7. https://doi.org/10.1111/jvim.16180](#)

NTUAS Genetic Study (MSU): Preliminary Work

In June, Jane met with the MSU genetics team and discussed a proposed study with the goal of identifying the underlying genetic cause of NTUAS. In preliminary work, 22 dogs have been genotyped and GWAS conducted. Some interesting regions emerged but not significant. Subsequently, the Marchant et al. paper was published, and the MSU team genotyped DNA samples collected in Dr. Stanley's study for the mutation in *ADAMTS3* and found the same pattern. Next, they identified 8 dogs from the study and did whole genome sequencing (data currently being analyzed).

The direction of a future study involves sequencing additional dogs, combining the current and future genetic data (WGS+GWAS), and assessing any promising variants for association with the clinical status in 180+ DNA samples that have been collected. Importantly, the analytic plan would remove the confusion of *ADAMTS3* as this is most likely a separate modifier. There are challenges and no guarantee that this work would be successful.

Characterizing Developmental Lung Disease as a Cause of Sudden Death in the Norwich Terrier

Canine Health Foundation Grant# 02507, March 2018 – February 2022

Project Lead: Kurt Williams, DVM, PhD; Michigan State University

Dr. Williams has documented microscopic evidence of abnormal lung development in puppies who died suddenly in various breeds and a high incidence in Norwich Terrier puppies. This breed association provides an opportunity to correlate the pathology and genetics to sudden death in Norwich Terrier puppies. The initial attempts to identify a gene the "easy" way, through GWAS, failed to identify a genetic basis. The next stage, currently underway, is to compile an expansive list of candidate genes known to be important in lung development and then wade through the entire genome of the Norwich Terrier looking at these genes in the affected and normal dogs.

Norwich Terrier Coat Color Genetics

This project was part of a larger project that identifies new allele types that better define many dogs including Norwich Terriers. The results were recently published by Bannasch et al. (2021). This manuscript is difficult reading for non-geneticists, however, the pertinent findings for our breed are best shown in Figure 2.

Bannasch, D.L., Kaelin, C.B., Letko, A. *et al.* Dog colour patterns explained by modular promoters of ancient canid origin. *Nat Ecol Evol* (2021). <https://www.nature.com/articles/s41559-021-01524-x>

There were 20 Norwich included in this published study. In addition, Jane collected approximately 30 cheek swab samples, chosen to represent the variety of color variations seen in our breed. Whereas old A-locus testing identified nearly every dog as AY/AY, AY/at, or at/at, it could not distinguish between the varying amounts of black seen in primarily red dogs. A previous result of AY would now be either A^ΔDY (dominant yellow) or A^ΔSY (shaded yellow). Shaded yellow is far less common than dominant yellow by about ten-fold. One additional locus was examined, and the MFSD12 red dilution mutation was found in the breed. Dogs with two copies of this mutation will have their red pigment reduced to the point where the dog is buff colored (wheaten). Also, the study verified that two color variations are caused by previously reported mutations that were expected. True pinkies are ee at MC1R (E locus). Blues are d1/d1 at the D locus.

Jane will summarize the results for our NTCA membership with photos and will include information about black and tan, grizzle and wheaten. Additional samples are welcomed if you have a Norwich terrier with an unusual color or color pattern. While this color study is not specifically a health project, another benefit is that there are now 20 more full genome sequences of Norwich Terriers available in the public domain which might provide aid to future studies of all sorts in the breed.

New projects underway or planned, 2021:

1. Exercise Tolerance Test (ETT) pilot to be conducted by the new regional North Texas Norwich Terrier Club.
2. Developing easy-to-understand materials to describe NTUAS and interventions (useful to puppy buyers).
3. Breed Survey 2022: Reproduction Health