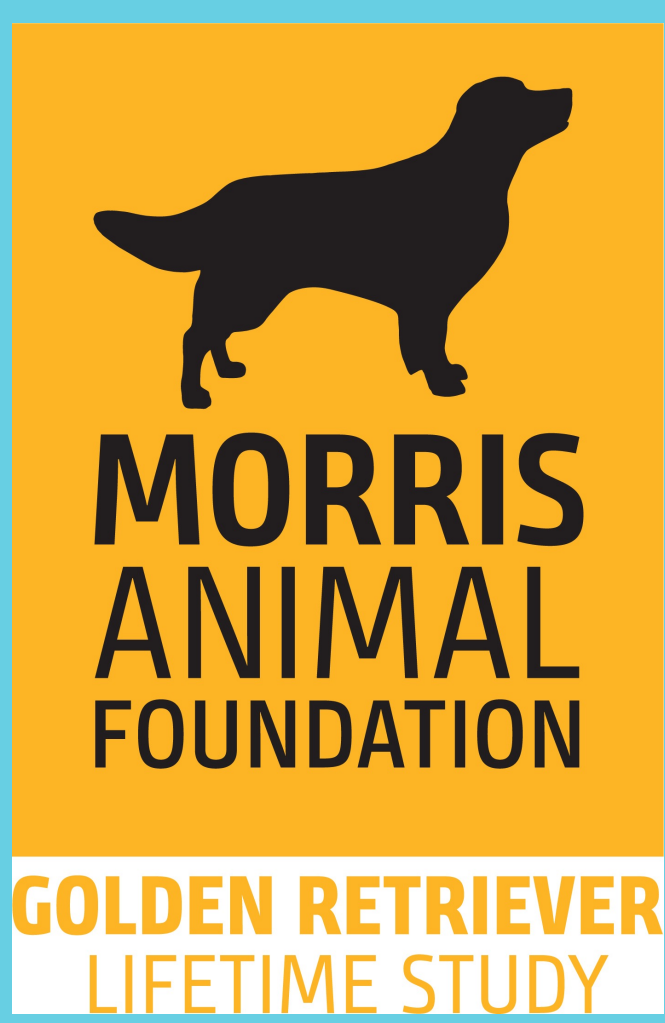


# The Golden Retriever Lifetime Study: progress and prospects

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## Background

- Approximately 1 in 4 dogs die of cancer. This estimate is higher in Golden Retrievers at 60-65%.
- Many canine cancers share morphological and clinical similarities to their human counterparts. Benefits of canine models for human diseases include 1) inbreeding to create dog breeds enhances ability to detect genetic risk factors for disease, 2) shared environmental exposures, 3) shorter lifespan conducive to cohort studies.

## Study Objectives

The Golden Retriever Lifetime Study (GRLS) is a longitudinal cohort study developed to:

- Identify genetic, environmental, lifestyle, nutritional, and reproductive risk factors that contribute to cancer and other significant diseases
- Establish extensive data and biological sample repositories for future analyses

The primary outcomes of interest are hemangiosarcoma, lymphoma/leukemia, high grade mast cell tumors (MCT), and osteosarcoma (OSA), but information is collected on all conditions diagnosed in the cohort.

## Data and Sample Access

- A subset of questionnaire data is freely available on our Data Commons website:  
<https://datacommons.morrisanimalfoundation.org>
- Researchers can apply to access additional data and/or biospecimens through our request for proposal process. More information can be found at:  
<https://www.morrisanimalfoundation.org/golden-retriever-lifetime-study-rfp>

## Methods

### Study Population

3,044 dogs aged 6 months through 3 years of age residing in the continental United States were recruited for participation from 2012 – 2015.

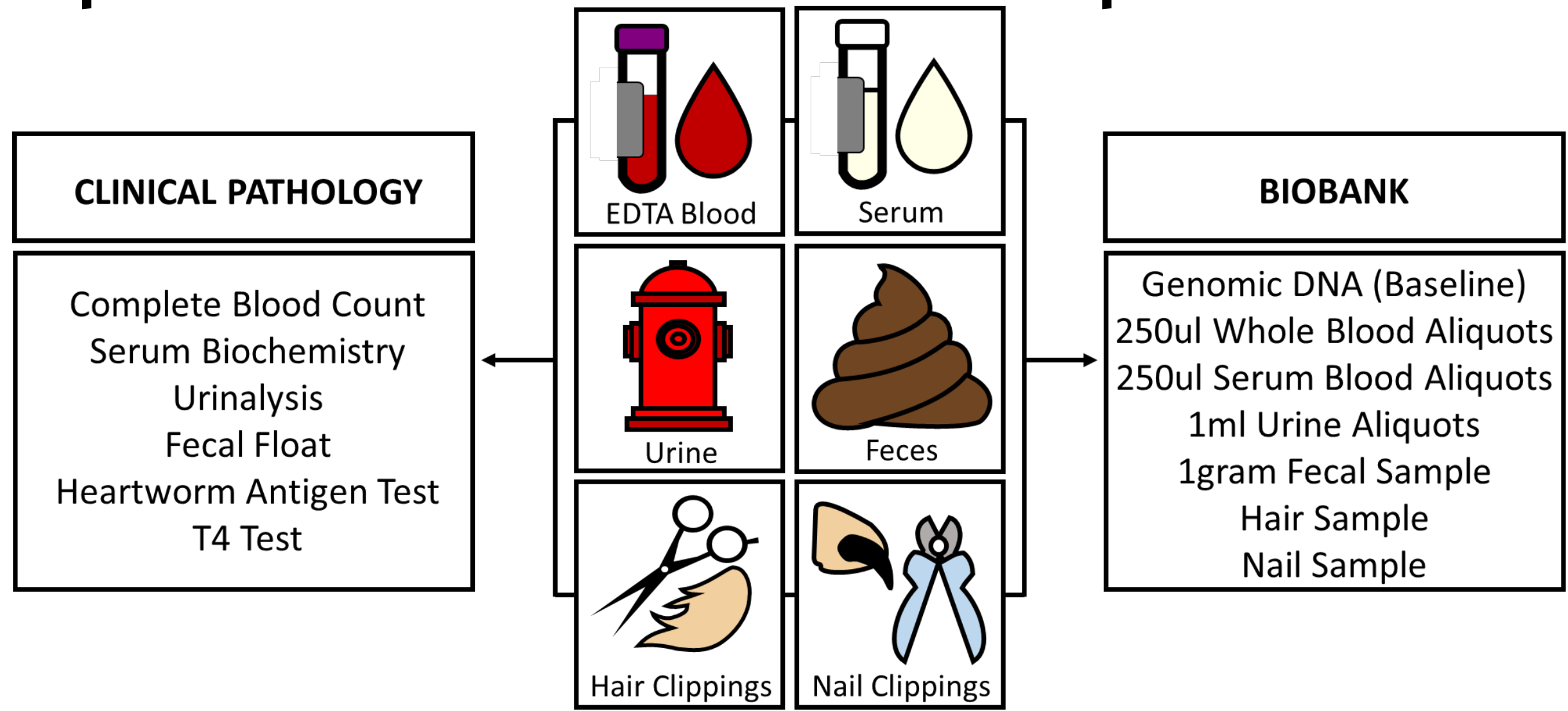
Dogs were required to have a three-generation pedigree and be free of life-limiting conditions as assessed by a veterinarian. Enrollment was stratified by five geographical regions, dog sex, and spay/neuter status.

### Annual Data Collection

Three study components are completed annually:

- Comprehensive annual owner questionnaire** – includes questions about the dog’s lifestyle, reproductive history, physical activity, over-the-counter medications, diet and feeding practices, environment and living conditions, and behavioral information

- Biospecimen collection of core samples**



- Annual veterinarian questionnaire** – comprehensive physical examination, vaccination and prescription medication history, superficial mass map, any diagnoses since the last questionnaire

### Additional Data Collection

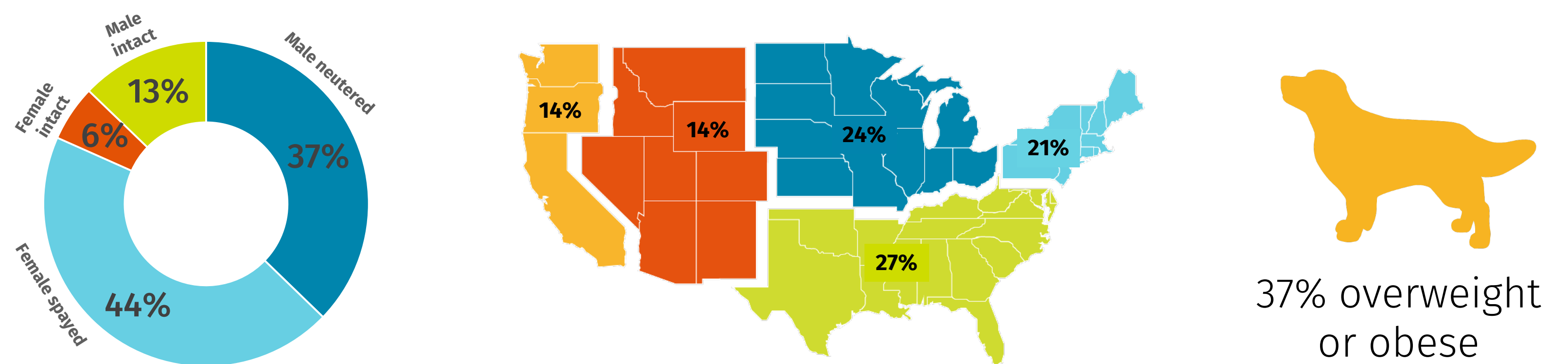
Malignancy	Death
<ul style="list-style-type: none"><li>Malignancy-related questionnaire</li><li>Histology, flow cytometry, or other diagnostic methods</li><li>Biobanking:<ul style="list-style-type: none"><li>Tumor sample in RNAlater</li><li>Core samples if obtained</li></ul></li></ul>	<ul style="list-style-type: none"><li>Death and necropsy questionnaire</li><li>Necropsy with histology encouraged</li><li>Biobanking:<ul style="list-style-type: none"><li>Diseased and normal tissues in RNAlater</li><li>Core samples if obtained</li></ul></li></ul>

## Results

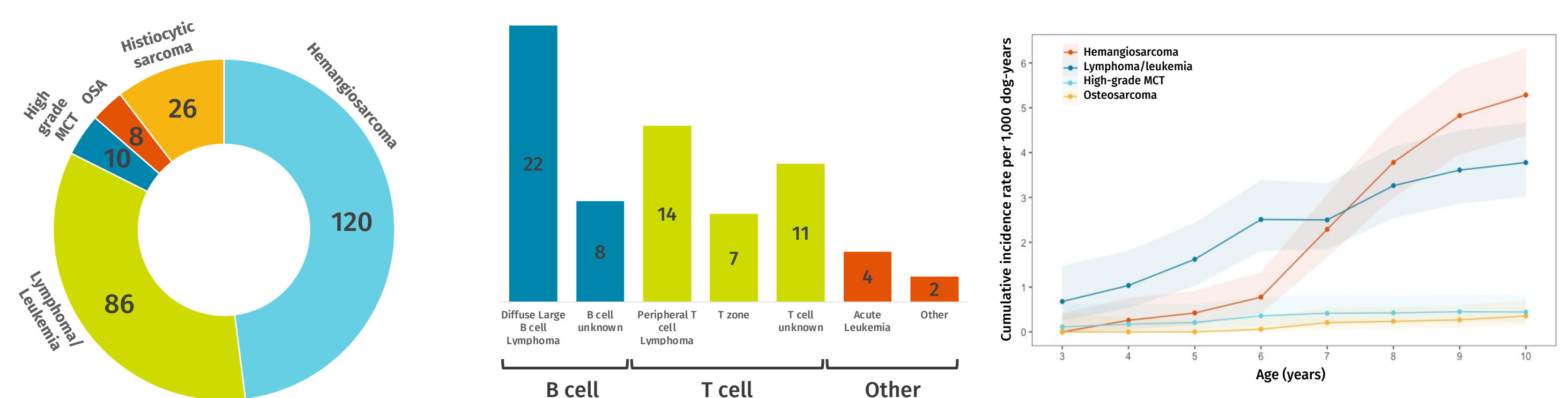
As of May 31, 2021, 352 dogs are deceased and 441 have either withdrawn or been lost to follow-up, leaving 2,251 dogs alive and active in the study. About 70% of deaths have been attributed to cancer and 62% have had a necropsy performed. We have nearly 19,000 of each core sample type stored in our biorepository.

### Demographics of 2,251 alive enrolled dogs

The median age is 8.5 years (range 6.9 – 11.6). Other demographics are shown below



### Primary cancer diagnoses



223 dogs have been diagnosed with our primary cancers of interest. As expected, hemangiosarcoma and lymphoma are the most common. While not a primary outcome, we have observed more histiocytic sarcoma than expected.

68 lymphoma cases have been subtyped by flow cytometry, PCR for antigen receptor rearrangement, or immunohistochemistry. Future analyses will focus on subtype-specific risk factors.

Cumulative incidence of the four primary cancers of interest by dog age. Shaded areas represent 95% confidence intervals. Lymphoma had a higher incidence among younger dogs, but hemangiosarcoma has been more common in older dogs.

### What’s next?

Genotyping of the entire cohort is expected to be complete by the end of the year. Studies on a variety of topics from fecal microbiome to early cancer detection are currently underway.

### Acknowledgements

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