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OPINION ARTICLE

Finding Yourself in the Arena of Scientific Writing: The Journey From Idea to Publication in Shelter and Community Medicine

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Abstract

Irrespective of discipline, scientific study relies upon systematic reasoning from observations to formulate and refine hypotheses and develop theories that can explain documented phenomena. Our understanding of science and its influence on the world around us is ever evolving, yet science cannot advance without clear communication to disseminate findings that result from reproducible research. Veterinary and animal care team members can contribute significantly to the advancement of science by sharing ideas, experiences, perspectives, case management decisions, and patient outcomes. The uniqueness of shelter medicine, with recent emphasis on how to maintain animals within their homes, offers a wealth of observations and discoveries that are worthy of publication. For those in clinical practice in shelter and community medicine, the primary obstacles to publishing are time, confidence, and lack of familiarity or experience with the structure and style of scientific writing. Such barriers can be overcome through a combination of graduated exposure, mentoring, patience, and practice. This article explores the journey from idea to publication to encourage those in shelter and community medicine who generate and have access to vital data to come forward. Writing to publish is a teachable skill, one that the veterinary profession relies upon to translate scientific inquiry into print capable of broadening global perspectives and influencing the clinical practice of tomorrow.

Keywords: *Research documentation*; *science communication*; *writing manuscripts*; *scientific publishing*; *framework for scientific writing*; *barriers to scientific publishing*; *translating research into publications*

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As a profession, veterinary and animal care team members rely upon each other to expand the evidence base to support or refute interventional strategies. Clinicians desire to lean on and learn from the best available evidence to guide decision-making surrounding patient care.[1] Anecdotal therapeutics only help patients in isolation, locally, whereas publishing disseminates information to a broader audience, globally, particularly through the advent of open educational resources. Shelter and community medicine teams are in a unique position to contribute significant data to the growing evidence base, thereby advancing the current state of veterinary practice.

The American Board of Veterinary Practitioners formally recognized shelter medicine as a specialty in 2014.[2] At a time when the costs of veterinary care are steadily increasing, the discipline of shelter medicine counter-balances trends toward advanced and more expensive practices that threaten to turn veterinary care into a luxury.[3–5] As a discipline, shelter and community medicine most recently modeled adaptation to uncertain times during the height of the COVID-19 pandemic.[6] At a time when many businesses and organizations were forced to close their doors, many shelters continued to function while simultaneously being at the forefront of guidelines to protect animal, staff, and public safety.[6] The ability to pivot and move One-Health initiatives forward demonstrates that those in shelter and community medicine have much to contribute to scientific inquiry. The diversity of sheltering systems and personnel's passionate investment in advancing medicine, surgery, emergency care, and behavioral health offers a wealth of opportunities for engagement.

Scientific inquiry leads to the development and refinement of consensus statements as well as clinical practice guidelines, such as Guidelines for Standards of Care in Animal Shelters.[7] Documentation of clinical observations, diagnostic and therapeutic plans, and associated patient outcomes also paves the way for evidence-based contextualized care and progressive medicine. For instance, high-quality, high-volume, spay/

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neuter (HQHVSN) surgical techniques were pioneered by shelter and community medicine advocates who demonstrated that they could improve patient outcomes and reduce surgical complications.[8,9] A 2017 study by Levy et al. documented that mortality rates at a HQHVSN clinic that performed elective sterilization on 71,557 cats and 42,349 dogs over a 7-year period were approximately 1/10th of those reported at low-volume private veterinary practices.[8] HQHVSN clinics have documented 98% survival rates for bright, alert, and responsive dogs and cats that present for surgical management of pyometra.[10] HQHVSN clinics have also demonstrated that sutureless scrotal castration improves morbidity and mortality rates as compared to traditional prescrotal castration in canine patients.[11–13]

These examples demonstrate that those engaged in shelter and community medicine are at the forefront of advances in healthcare. As leaders in this arena, it is essential that shelter and community medicine veterinary teams document observations and clinical findings and disseminate these to the rest of the veterinary medical community. Scientific writing may take the form of a full-length original study, designed around well-formulated research questions.[14] Retrospective studies, case reports, conference abstracts, editorials, and review articles, which track pre-existing knowledge about a given subject, are also appropriate and necessary avenues for scientific writing.[14]

Content that describes or advances spectrum of care is particularly in demand. Spectrum of care is a non-binary approach to healthcare delivery in which case management decisions are not framed as all-or-none, either/or, or best versus lesser.[15] Instead, the provider and client tailor the practice of veterinary medicine to the patient, allowing the veterinary team to focus on a wide array of diagnostic and/or treatment options.[16,17] This approach to contextualized case management focuses on the 'more flexible and inclusive acknowledgement that different treatment modalities may be equally valid in different contexts',[18] and that 'we cannot separate clinical decisions from their social contexts'.[18] Spectrum of care also reminds us to critically question the status quo when it comes to diagnostic and therapeutic 'best practices'. Are 'best practices' truly supported by evidence?[19] Are they truly necessary?[19]

Although veterinary teams are exposed to spectrum of care based decision-making on a routine, if not daily, basis, few publications establish and promote those diagnostic and/or therapeutic interventions that fall outside of the so-called standard of care. A good example in the veterinary medical literature with respect to spectrum of care in canine patients is parvoviral enteritis.[20,21] Feline practice has concentrated on pharmacotherapy[22] and decompressive cystocentesis,[22] which, when paired with a low-stress environment, may alleviate urinary tract obstruction in male cats without urethral catheterization.[22]

Not every investigator has the capacity, funding, or non-fiscal resources to launch an original study. In this case, consider a case report instead. These have been in circulation since at least 1600 B.C., when the management of a dislocated jaw was described on preserved Egyptian papyrus.[23] The goal of case reports is to relay firsthand experiences about the identification or progression of clinical disease. They may describe novel clinical presentations, unexpected responses to treatment, adverse events, or unusual side effects.[24] In so doing, they may prompt additional investigations, such as cohort studies or clinical trials.[24] They may even lead to the discovery of new diseases.[24,25]

Admittedly, there are remarkably few shelter and community medicine case reports or case series in the veterinary literature. Shelter and community medicine team members also bear witness to outbreaks and other 'herd' type 'cases' that are much less commonly reported in other areas of companion animal medicine. For example, Rodriguez and Berliner reported on the management of multidrug-resistant *Bordetella bronchiseptica* in shelter-housed cats[26], and Rozental et al described multiple cases of infection with *Rickettsia rickettsii* in Brazil among employees of an animal shelter in an urban area.[27] These reports are valuable because they describe clinical conditions that are not isolated to one patient and, as is true of the latter example, may have correlates to One Health.

Begin with the seed of an idea

All research begins with a seed of an idea[28] from which intellectual curiosity germinates. Ideas bloom when they are borne out of passion for the subject matter. Investigations require steep inputs of time, dedication, determination to see the project through, and perseverance to translate ideas into scientific writing. Passion for the project helps to sustain and endure the process that leads from idea to publication. Passion alone is not sufficient to make a research project worth doing or a manuscript worth writing, but it is the fuel that feeds the process and keeps one moving toward the finish line. So, dip your toes into something that intrigues you. Find something that makes you want to dive deep enough to ask 'why?'[28] You can only convince others that your study is both viable and valuable if you have convinced yourself first.

Beyond that initial criterion, your chosen subject of study should be 'timely, relevant, and new; it corroborates what was known or contributes a new concept or understanding or both'.[29] For example, determinants of length of stay (LOS) of sheltered animals are key to understanding adoptability. Recent studies have explored

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how phenotypic characteristics influence adoption rates of sheltered dogs[30] and cats,[31] and how cat name and narrative voices in online adoption profiles influence LOS.[32] Rix et al reviewed 4,460 records from three UK shelters from 2011 to 2015 and reported that LOS was significantly shorter for younger cats, male cats, and cats with adoption profiles written in the third person.[32] This information is relevant to shelters, which may now consider amending feline adoption profiles to the third person voice to enhance adoptability.

In addition to adoptability, shelter and community medicine offers a vast array of topics that are well suited for scientific investigations or case reports, including but not limited to:

- Animal welfare, well-being, and overall wellness, including quality of life and criteria for decision-making surrounding humane euthanasia.
- Behavior and behavioral assessment upon intake and serially throughout LOS.
- Weight and body condition score (BCS) assessment upon intake and serially throughout LOS.
- Disaster and emergency response planning services; assistance for domestic violence programs by the inclusion of animals in safety planning.
- Education, public health, and community outreach, through clinics that provide care to both free-roaming and owned, at-risk animals.
- Facility design, heating, ventilation, air quality, and environmental enrichment.
- Herd health, preventative medicine, incidence of disease, diagnosis, and treatment of individual animals.
- Infectious disease and quarantine protocols, outbreak investigation, and response.
- Legal and policy issues, including, but not limited to animal neglect, animal cruelty, and mandatory reporting.
- Patient outcomes associated with a particular therapeutic or surgical intervention.
- Reproductive control and surgical expertise.
- Standard operating protocols (SOPs) for sanitation, primarily cleaning and disinfection.

Germinate the seed: root it in the context of what has been done before

Once you have identified a subject for study, perform a literature search to contextualize your scientific investigation.[29,33] Canvas the literature to identify what is known about your research query.[29,33] If you are unsure where to begin, consider reaching out to librarians, particularly those affiliated with veterinary medical colleges. They may be able to partner with you to provide tips on where to begin to dive deep into your topic of choice. Electronic databases can also help you to identify gaps in knowledge. Subject databases, for instance, those that concentrate on biological sciences, can be especially valuable, including, but not limited to PubMed, Cochrane Library, and Web of Science. Find where your research fits into one or more gaps. The goal of research is not to replicate what has been done before, but rather to chip away at the unknown or unresolved, thereby contributing to a topic's growing knowledge base. Evaluate past studies with a fine-tooth comb. What limitations in past study design have been identified in the literature and how might you overcome these? Limitations do not negate the value of scientific inquiry; they open the door to next steps and new chapters of research that can be learned from past errors or oversights.

The quest to elevate scrotal castration as an acceptable method of canine castration is a prime example of revisiting the evidence base, and finding that gaps could not be explained by the then current literature. For decades, prescrotal canine orchiectomy was taught as the only acceptable surgical approach.[34,35] The prevailing perception of the time was that dogs would self-mutilate if scrotal skin was prepped, clipped, sutured, or otherwise disturbed.[34,36] This dogma persisted despite a paucity of reported scientific evidence that supported it[34,37] until those in shelter and community medicine asked critical questions that prompted research to compare and contrast prescrotal and scrotal castration techniques.[13]

Water the seed and nurture the seedling: from conception to design

Once you have explored your topic in greater depth, you are ready to translate what was once an abstract idea into a concrete action plan.[29] What is your aim? Which specific question are you seeking answers to?

Original studies benefit from a so-called FINER research question: is the topic of study *feasible, interesting, novel, ethical*, and *relevant*?[38] Is the study necessary? Do you have the resources that are needed to initiate and complete the study? Consider all resources that may be required. Resources include direct costs, meaning those associated with materials, supplies, and equipment, as well as time and labor. Learn from those aspects of study type that you may not have even considered and apply lessons learned to your own proposed methodology to refine and strengthen your conceptual approach. Also consider broadening your scope in terms of whom you might enlist to support your cause. Do not be afraid to reach out to universities or to contact faculty members who are experienced with research who may be willing to help. Some colleges may also support graduate students who elect to pursue independent studies. Perhaps one or

more graduate students might find your topic of interest compelling and commit to the project.

Document your hypothesis and outline the methodology by which you will test it. In some instances, research papers are not hypothesis-driven but are instead an attempt to answer one or more research questions or meet specific objectives. These investigations also require forethought and strategic planning. Consider your sample population as well as sample size. Is your sample population accessible? Are you ethically allowed to sample from your population of choice? What, if any, guidelines, or restrictions may narrow the scope of your study?

Retrospective studies and those that do not depart from routine case management might not need formal ethical review board approval, whereas studies that involve humans and/or non-human animals as subjects do. Formal review boards are typically associated with academic institutions. This means that non-academic organizations that carry out and publish research must develop their own internal processes or collaborate with academic partners, both of which take time and planning. What steps are necessary to obtain and maintain approval? Who will you exclude from the study and why? Factoring in those who are excluded, will you have an adequate sample? If not, how will you obtain one? Consult with others who have experience designing studies to glean insight into best practices.[28] These consultants bring significant experience to the table in terms of strategic planning and can help to troubleshoot potential obstacles before they arise.[28] Be flexible and make adjustments to study design.[28] Also do not hesitate to reach out to journal editors for their advice in advance in terms of what the journal will require of you.

Another important consideration is the location of your study. Will the study be run in-house? Does it require external sites? If so, will you be traveling between sites or will you select point people to navigate questions and concerns as they arise off-site? Who are these point people and what are their qualifications? What training, if any, do they require to be sure that research protocol is implemented in a uniform manner across the board?

Beyond the question of who, how will data be gathered and analyzed? Statistics are critical to any study because they help us to describe and summarize the data.[39] Before research commences, you need to have a clear plan for data analysis.[39] Which variables are being measured and what type of statistics is best suited to organize and interpret that specific data set?[39] Descriptive statistics help investigators learn more about the study sample, for instance, in terms of averages and ranges. Comparisons and conclusions stem from inferential statistics and allow investigators to generalize beyond their study sample.[39] Consult colleagues, including biostatisticians, whenever possible to glean advice on best practices for selecting statistical methodology.[39]

A final question of significance to ask yourself is, do you have the capacity to invest in this project? If not today, then when? What is your timeframe? Can you perform the study now? Or should the study be put on hold in a queue until resources free up?

For those whose time constraints preclude launching a prospective study, it may be worthwhile to consider a retrospective study. Such an approach offers flexibility because the data have already been gathered, and focus can shift onto data mining for patterns and themes. Data analysis may more easily be built into the schedule as time allows, whereas timestamps in a prospective study are often rigid and immovable.

Establish your approach as a tripartite decision: which approach will best suit you, your research subjects, and your anticipated audience? Your study design should be clear and concise. Share it with colleagues who you trust. Ask them what clarification is needed to strengthen your design. Identify flaws that need correction and take appropriate measures to amend them. Once you are certain that an appropriately trained person could replicate your approach, it is time to begin your research. As your research progresses, methodically document all observations. These are critical pieces of data to sift through during the writing process.

Propagate the plant through cuttings: writing the manuscript

Scientific writing cannot be completely separated from the study design and conduct. We often think of these two processes as being disparate, but in many ways, you begin your manuscript long before it takes the shape of its preprint form. You begin your manuscript the moment you conceive of an idea to research and put pen on the paper to carve out the study design.

Historically, manuscripts were developed by junior researchers who learned to write through trial and error.[40] The process begins with outlining your aims and goals for publication. Consider your audience: for whom are you writing?[28,38] How will your readers benefit from the knowledge that you have to share?[38,41]

Consider all available journals that are accessible to you, as a submitting author.[14] Review the scope of the journal(s) in which you aspire to publish.[28,38,42] Which journals cover topics that are in alignment with yours? Is your article a good 'fit'?[42] Explore all avenues, including those that you may never have before considered. Your article may find its 'fit' in an education- or research-based journal.

Once you have narrowed your selection to your journal of choice, review the journal's submission guidelines.[42–46] Keep these handy and refer to them as needed during

the manuscript writing process. Guidelines include journal-specific structural details, such as what each section of the manuscript should be labeled and what each section should contain.[38] Find a similar article in the journal of choice that may mirror your approach and use this as a template with respect to article structure and design, and how tables and figures should be incorporated into the text. Because publications are rarely read from start to finish in one sitting, authors must utilize structure to highlight key concepts and takeaways. Brevity and clarity are valued.[41,47] Enhance readability through sentence structure.[41]

Manuscript writing is a learned process that is mastered through repetition, mentorship, and experience.[40,47,48] Alexander Pope, one of the most prominent English poets of the 18th century, expressed it best when he wrote that 'true ease in writing comes from art, not chance / As those who move easiest have learnt to dance'.[49] Pope's depiction of prose as an art form can be applied to manuscript writing. It is not a one-step task, but rather a journey along which the author(s) continually evaluate(s) and refine(s) workable prose into a final submission-worthy draft. That draft in turn inspires feedback in the form of peer-review to improve efficiency, accuracy, and clarity of messaging.[47,50] Each step of the process is essential because it cements for the author(s) and readers alike the purpose of the study, the uniqueness of the work, the methodology employed, the outcomes of the study, and the significance of those results.[51]

Both skill and commitment to the process are key.[52] Manuscript writing requires patience and investment in the form of time, effort, foresight, and critical reflection. At times, the process may feel insurmountable. Yet, in those moments, it is essential to engage in perspective taking. Manuscript writing should not feel like trying to climb Mount Everest overnight, particularly if the climber has never climbed. Rather, it is about dividing up the distance of a marathon relay into legs or sprints that are reasonably sized and setting the writing team up for success. Teams can be significantly strengthened by the addition of members with prior publication experience who can serve as well-intentioned guides through the process.[42] These guides can remind novices that the view from the mountaintop is doable, even during times when ascent seems impossible.

Break the process into bite-sized chunks. Set reachable deadlines and hold the team accountable. Identify team members' individual and collective strengths. Distribute the workload and make distributions transparent. Focus on those sections for which you have been assigned the primary workload. Set aside 10–15 min every day and write. Do your best to turn off the inner critic. Initially, write to write, rather than critique. The first draft is never the last draft. There are often dozens of iterations in between. It matters less that what you first produce is 'good' and more that you are practicing how to share your process with others. When time is 'up', review what you have written. Pay attention to what you did not write about as much as if not more so than what you did write about. Ask clarifying questions of yourself:

- Did you leave out key concepts or themes that you need to infuse throughout the manuscript? If so, why? Jot down notes in the margins to prompt consideration of what additional elements belong that have not yet materialized.
- Did you identify study limitations and consider how these will inform the next scientist? Studies are inherently imperfect. Highlight limitations so that you can report objectively about what you might have done differently, were you to repeat the study. Science is about the process rather than perfection, and if subsequent research is to build upon yours, then you need to be very clear about your own journey, including those areas that may have consciously or unconsciously influenced study outcomes.
- Are there areas that are unclear? If so, how might you infuse clarity into your writing so that someone who may be unfamiliar with your research can understand the study and its design, results, and implications?
    - Start by asking a fellow team member to review your work. Even better yet, swap your work with one another. Often what we want to share the first time around does not necessarily mesh with what is on paper. Use this as a learning opportunity to strengthen the final paper.
    - Once all team members are in alignment concerning your section and the way that it is worded, consider asking a colleague who is not within your same field of study to review your drafts. Do they understand the information that you are reporting? Could they replicate your study if left to their own devices? If not, what additional support might they require? Use their feedback to fine-tune those areas that are clear to you, but not to others. Consider that each pass through the manuscript makes it much stronger.

Refer to Supplemental Material for additional insight. Once you and the team have completed your own internal review of the manuscript and have refined all aspects to the best of your ability, submit the paper to the journal of choice.

Manuscript review

After a manuscript has been submitted, the editor of the associated journal assigns it to two or more experts for

independent review.[47,53] These reviewers are tasked with evaluating the manuscript based upon a rubric, providing feedback, and making recommendations to the editor as to whether the manuscript should be accepted for publication. Manuscripts may be accepted or rejected outright.[47] Reviewers may also request minor changes prior to publication. More frequently, they require extensive revisions and resubmission.[47]

Any response that is not an outright rejection is still a win. Inexperienced authors can be prematurely discouraged by recommendations for extensive rewrites. However, reworking the manuscript and embedding substantial changes is an opportunity to revisit the content with fresh eyes and to enhance clarity for readers.[47] A good review is a lot like having a skilled colleagues provide feedback on the manuscript. Think of the reviewers as your colleagues. They function to highlight your work and strengthen its delivery so that it will have maximal impact. Consider also that journal editors are on your team. When questions arise during the review process, do not hesitate to reach out to them. Journal editors are a bridge between writers and reviewers. As such, editors are available and eager to offer support and clarity to help you navigate the review process.

Barriers to writing and overcoming them

Scientists are passionate about the topics that they choose to investigate, and healthcare professionals are passionate about the practice of medicine, which drives patient outcomes. Authors of scientific manuscripts are often both. Because they are accomplished in their professional aspirations, many are time-constrained when it comes to improving their writing.[54] Clinicians also see it as their duty to provide services to the community at large. Classically, they interpret this as tending to patients,[55] rather than reporting clinical findings.

Writing up projects is an enormous barrier to completion. Most studies can be executed from beginning to completion, but putting study design and results into a publishable form is its own feat. If you find the actual writing component to be a tremendous obstacle, you are not alone. You are in fact in good company. A 2009 study by Jatin interviewed novice researchers to explore writing-specific challenges. Interviewees identified several constraints to manuscript development: cognitive burden, mentorship, structuring content, and backward design.[54] Interviewees perceived the task of writing to be mentally arduous, complex, and at times, overwhelming.[54] Excitement about writing quickly faded, dampened by apprehension about the process.[54] Lack of time and/or procrastination compounded anxiety, particularly as deadlines loomed.[54] Researchers recalled their own internal struggles to focus and self-motivate.[54] Many sought mentorship and encouragement from others within their discipline; however, self-judgment about lack of productivity made it difficult for them to initiate reaching out.[54]

Unfamiliarity with the process of scientific writing is its own challenge.[50,56] Research may have been performed well; however, if writers do not know how to communicate their findings coherently, in a manner that is suitable for publication, then results go unreported.[57] Many manuscripts are submitted only to be rejected because they are unfocused. The topic is too broad, and the writing sets out to achieve too many purposes.[44] Fact may become blurred with opinion.[44] Writers may not know how to address scientific discoveries that challenge prevailing theories about how the world around them works.[58]

Proficiency in scientific writing takes time. Be open to writing as a process and accept that proficiency in it requires a learning curve.[47] Attentiveness to the manuscript, willingness to seek feedback, and commitment to frequent and necessary revisions are critical components that inspire growth.[47,59,60] The manuscript becomes a living, breathing document of the journey that you embark upon as a writer. Feedback strengthens the journey by tasking you to improve accuracy of claims, clarity of messaging, and concision.[47] This requires outreach to mentors, who can provide experience, support, and encouragement.[42,48]

The cognitive burden of writing can also be eased by setting reachable goals and deadlines.[54,61] This is made easier by virtue of the fact that writing a manuscript based on original research lends itself to dividing the work into discrete tasks. This sectioning of the load is forced upon the writer by the chronology of the investigation itself: the methodology comes before the results, the discussion section is contingent upon the results, and the abstract is often written last, after the remainder of the manuscript has been solidified. This division of labor yields intermediate steps that are more easily managed and can bring the ultimate goal of publication nearer to reach. Sometimes visualizing the end result and working backward from that can help to clarify the process itself.[54] Manuscripts in essence evolve, and our understanding of their contents morphs as we clarify the messaging for ourselves and subsequent readers. Clarity strengthens purpose, which solidifies the framework upon which our efforts are built. Writing with purpose communicates passion for scientific discovery and advancement. Passion is a manuscript's raison d'etre.

Concluding thoughts

Passion is no stranger to shelter and community medicine leaders, and veterinary and animal care team members who bear witness to and participate in the advancement of

science. The uniqueness of this ever-expanding field offers an abundant landscape in which to make publication-worthy observations and discoveries. These milestones need to be voiced. All efforts to bring forward new, relevant, and innovative advancements are vital starting points in the attempt to be seen and heard. In the process of working toward publication, we develop into more experienced, polished scientists. The process, irrespective of outcome, shapes the way in which we engage in, reflect upon, and interpret science. Scientific writing is in essence a 'window into thinking'[58] that is both instructive and transformative. It challenges us to embrace the fact that how we think about the surrounding world is not always on point.

Every time we commit to the writing process, we improve our approach to science by learning how to better formulate, refine, and revise the questions that we ask. We also set into motion a process by which our readers can gain insight into our thoughts, perspectives, observations, and experiences. In that way, we continually contribute to the growth and evolution of science as we set out to establish, validate, define, and refine spectrum of care practices that advance contextualized care.

Shelter and community medicine plays a pivotal role in human and animal well-being. Your one publication may seem insignificant, but every step forward advances the field and the practice of veterinary medicine as a whole. Consider, for instance, the Association of Shelter Veterinarians' 2016 publication on veterinary medical care guidelines for spay-neuter programs,[62] or the ways in which Hurley[63] and Boone[64] et al re-imagined the ways in which we approach free-roaming cat management strategies. These highly influential and impactful articles were built upon a body of literature that shelter and community medicine leaders invested time and effort into cultivating. A harvest begins with a single seed. What will your contribution be?

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