Openwater Devices for Veterinary Medical Applications

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Contents

Executive Summary

Openwater's innovative medical imaging and therapeutic devices create new opportunities in veterinary medicine by offering lower costs, enhanced functionality, and greater control for veterinarians. This white paper explores the transformative potential of these devices.

Openwater’s innovative technologies, including the Open-Motion system for blood flow monitoring and the Open-LIFU platform for targeted ultrasound therapy, are ushering in a new era of noninvasive, precise, and cost-effective solutions for animal health diagnostics and treatment. Much like the transformative impact of PCs, smartphones, and AI, the Openwater platform paves the way for enhanced capabilities, reduced costs, and expanded opportunities in animal health. Importantly, these advancements empower veterinarians to actively develop and implement new therapies, benefiting both practitioners and their animal patients.

Some challenges facing veterinarians parallel those of treating humans: limited access to advanced imaging, high costs of traditional equipment, and difficult regulatory pathways for novel devices. Some challenges are unique to veterinary medicine: patients often need to be anesthetized for procedures; there is a vast range of physiologies and sizes; some patients are difficult to move or to access.

Openwater’s devices address these gaps by providing portable, modular, and AI-powered tools that can be adapted for a wide range of animal species and clinical scenarios. Because, like smartphones, they’re based on semiconductors and software, they offer a path to lower costs and higher functionality. Openwater’s systems leverage cutting-edge optics and focused ultrasound to enable early disease detection, real-time monitoring, and innovative therapeutic interventions, all without the need for invasive procedures or anesthesia. Uniquely, Openwater’s approach is open source. This empowers veterinary doctors, researchers, and suppliers to invent, innovate, share, and collaborate freely. As a result, a new class of compact, affordable systems with open-source designs and APIs can continually evolve and improve to meet the needs of the veterinary community.

This paper reviews the technical foundations of Openwater’s technologies and examines their potential applications in veterinary practices - from routine diagnostics to advanced therapies. The paper concludes with recommendations for collaborative research, clinical validation, and open-source development to accelerate the responsible adoption of these technologies in veterinary medicine. By embracing Openwater’s innovations, the veterinary field stands poised to improve outcomes, reduce costs, and expand the frontiers of animal healthcare.

1. Introduction

Despite impressive technical progress, many veterinary practices lack access to advanced diagnostic and therapeutic tools due to high costs, limited portability, and the need for specialized training. Additionally, the cost and complexity of providing safe anesthesia - which requires specialized equipment, drugs, and monitoring - pose significant challenges.[1] These challenges are especially acute in rural areas and in practices caring for a wide variety of animal species.

Openwater's mission is to break down these barriers with devices that are uniquely suited to the needs of veterinarians, enabling early disease detection, real-time monitoring, and advanced interventions without invasive procedures or anesthesia. With a per-device price of $10,000 (or via monthly subscription), Openwater's technology is substantially more affordable than any alternatives.

The vision for Openwater's veterinary devices is democratized, data-driven, and compassionate care, where advanced diagnostics and therapies are accessible to all animals, everywhere. By embracing these innovations, the veterinary profession can lead the way in redefining what is possible in animal health, welfare, and scientific discovery.

This white paper provides:

- An overview of Openwater's technologies and how they address the core challenges in veterinary medicine
- Practical examples of diagnostic and therapeutic applications for a wide range of species
- Recommendations for collaborative research and open-source development to accelerate adoption and maximize impact

By embracing Openwater's innovations, the veterinary community can improve animal health outcomes, reduce costs, and expand access to high-quality care.

[1] Grubb, T., Sager, J., & Gaynor, J. (2020). Anesthesia and Analgesia in Veterinary Medicine: Navigating Cost and Complexity. *Veterinary Clinics of North America: Small Animal Practice*, 50(4), 735-750.

2. Medical Devices in Veterinary Medicine

The adoption and use of medical devices in veterinary medicine are growing rapidly, driven by rising pet ownership, increased healthcare spending, and technological advancements. The global veterinary medical devices market is valued at approximately $15 billion in 2025 and could reach $25 billion by 2033, growing at 7% per year.[2] This growth is fueled by the increasing demand for sophisticated diagnostic equipment for earlier and more accurate disease detection and intervention in animals. The demand is currently met by digital X-ray systems, advanced ultrasound devices, and blood analyzers.

Veterinary diagnostic equipment currently dominates the market, accounting for about 40% of total device sales in 2025, followed by surgical instruments and imaging equipment.[3] The integration of artificial intelligence and machine learning into diagnostic and treatment planning tools is revolutionizing veterinary care, improving both speed and accuracy of diagnoses while enabling more personalized treatment approaches. Automation in laboratory and diagnostic equipment has also enhanced efficiency, allowing veterinarians to deliver faster and more reliable care.

Despite these advances, challenges remain, including the high cost of advanced devices and limited reimbursement for veterinary procedures in some regions. Many areas have a shortage of skilled veterinary professionals, hindering the adoption of complex technologies; however, new devices and associated software can help alleviate these challenges and shape the future of veterinary practice.

3. Openwater Background

Openwater is an innovative medical technology company founded in 2016 by Dr. Mary Lou Jepsen, a renowned technologist and entrepreneur. The company's mission is to integrate advances from diverse fields, including consumer electronics, semiconductor device physics, and artificial intelligence, to develop affordable, accessible, and open-source medical devices capable of diagnosing, monitoring, and treating a wide range of diseases.

[2] Grand View Research. (2023). Veterinary Medical Devices Market Size, Share & Trends Analysis Report By Product, By Animal Type, By End-use, By Region, And Segment Forecasts, 2024 - 2030.
[3] MarketsandMarkets. (2023). Veterinary Medical Devices Market by Product, Animal, End User - Global Forecast to 2028

Openwater's core platform leverages light and sound to deliver hospital-grade diagnostic and therapeutic capabilities, while maintaining low production costs and portability. Openwater's technology combines infrared imaging, ultrasound, and advanced electronics, enabling real-time, noninvasive diagnostics and targeted therapies that can be deployed in a variety of clinical settings, including those with limited resources.

The company's open-source philosophy is central to its approach: while research and development are made freely available to the public, Openwater generates revenue through the sale of high-quality hardware and support services. This model allows for rapid, collaborative innovation by enabling hardware, software, and data to be shared across multiple studies. Openwater partners with leading research institutions and clinical centers to validate its technologies, and its devices are designed to be modular and adaptable, with differentiated software enabling a single platform to address numerous medical applications.

With Openwater's open-source approach, veterinarians are no longer dependent on a single equipment vendor or distant laboratory to adapt technologies such as infrared light or low-intensity ultrasound to specific medical applications. Instead, veterinary professionals can directly modify and optimize these technologies for their own clinical needs. By sharing findings and experiences with the broader community, and learning from peers worldwide, collective progress is accelerated. Expertise and results can also be packaged into applications tailored to particular veterinary indications. All modifications and uses remain subject to standard safety, efficacy, and regulatory requirements within the field.

4. Openwater's devices

Open-Motion (Blood Flow Monitor)

Openwater's Open-Motion device represents a significant advancement in noninvasive blood flow monitoring by utilizing highly refined laser light to measure and quantify blood flow within tissue. These devices emit short pulses of coherent near-infrared laser light, which penetrate tissue and are altered by blood movement. The transmitted light is then captured by sensor chips with millions of sensitive pixels the size of the wavelength of light, enabling the detection of subtle changes in blood flow, blood volume, and micro-motions deep beneath the tissue surface.

The Open-Motion 3.0 system, in particular, features a modular, wearable design that is highly configurable for different clinical and research applications. It incorporates advanced machine learning for waveform classification and provides high signal-to-noise ratio measurements,

making it suitable for continuous monitoring and portable use in varied environments, including field settings. Because the device is wearable, it does not require sedation of animal patients to obtain reliable signals, enabling less invasive and more naturalistic monitoring.

The technology has demonstrated strong correlation with established methods like transcranial Doppler, validating its accuracy and reliability for cerebral hemodynamic monitoring. Notably, the Open-Motion device offers higher fidelity and greater reach into the body, penetrating both bone and skull more effectively than transcranial Doppler.[4] Its scalable, low-cost design leverages components from the consumer electronics supply chain, making advanced blood flow analysis more accessible and affordable.

Open-LIFU (Low-Intensity Focused Ultrasound)

Openwater's Open-LIFU devices utilize low-intensity focused ultrasound to enable noninvasive, targeted therapeutic interventions nearly anywhere within the body. These systems are designed to deliver precise ultrasound energy to specific tissues, allowing for a range of applications from neuromodulation to targeted drug delivery and lysis of pathological tissue.[5]

The Open-LIFU platform is modular and can be electronically steered and focused to about one millimeter precision for patient-specific targeting, offering flexibility for both research and clinical use. By integrating advanced electronics and AI-driven software, Open-LIFU devices can be tailored for different therapeutic protocols, enhancing safety and efficacy.

The portable design and open-source approach further support rapid adoption and customization for veterinary and other medical applications. This technology holds promise for expanding the range of noninvasive therapies available in veterinary medicine, particularly for conditions that benefit from localized, image-guided intervention.

5. Openwater Technologies: Technical Overview

Open-Motion 3.0 System

The Open-Motion 3.0 system is a state-of-the-art diagnostic platform designed for precise, noninvasive measurement of blood flow, blood volume, micro-motions, and oxygenation deep

[4] Jepsen, M.L., et al. (2022). Noninvasive Optical Monitoring of Blood Flow: Correlation with Transcranial Doppler in Preclinical Models. Openwater Technical White Paper.
[5] Blackmore, J., et al. (2019). Ultrasound Neuromodulation: A Review of Results, Mechanisms and Safety. Ultrasound in Medicine & Biology, 45(7), 1509-1536.

beneath tissue surfaces. Its operation is based on the emission of short pulses of highly coherent near-infrared laser light, which penetrates biological tissue and interacts with moving blood cells. As the light traverses the tissue, it is scattered and modulated by these micro-motions. A sophisticated detection system then captures the altered light using megapixel sensors, enabling the system to detect even subtle changes in blood flow dynamics with unprecedented precision.[6]

Key Features:

- Modular design for a wide range of clinical and research applications
- Wearable and highly portable
- Microsecond laser pulses with high sensitivity and minimal exposure (IEC-60825-1 Class 1 laser safety)[7]
- Compliance with IEC 60601-1 safety requirements; ISO 13485 certification in process[8]
- Integrated machine learning for real-time waveform classification and analysis
- High data throughput for multi-module setups
- Available as a complete platform or as OEM hardware and software components

Open-LIFU 2.0 System

The Open-LIFU 2.0 system delivers low-intensity focused ultrasound (LIFU) therapy with precision, flexibility, and ease of use. It employs a wearable device that can be comfortably positioned on the head or elsewhere on the body, containing a custom two-dimensional ultrasound transducer array. This array can be electronically steered to direct the ultrasound beam to specific, user-defined targets deep within tissue, without physically moving the device. A neuronavigation system registers the headset and transducer array to the subject's anatomical images (such as MRI), enabling accurate planning and delivery of ultrasound energy to patient-specific targets.[9]

Key Features:

- Patient-specific targeting with accurate registration to anatomical images
- Safety-focused design with IEC 60601-1 compliance
- Modular, scalable architecture for various applications
- Lightweight, wearable, and portable for ambulatory and field use

[6] Openwater (2024). Open-Motion 3.0 System Technical Documentation.
[7] International Electrotechnical Commission (IEC). IEC 60825-1:2014 Safety of Laser Products Part 1: Equipment Classification and Requirements
[8] International Organization for Standardization (ISO). ISO 13485:2016 Medical devices – Quality management systems, Requirements for regulatory purposes.
[9] Openwater (2024). Open-Motion 3.0 System Technical Documentation.

- Sophisticated software tools for planning, delivery, and monitoring
- Flexible pulse parameters for tailored therapeutic protocols
- Available as a complete system or as OEM hardware/software components

6. Veterinary clinical research examples

Focused ultrasound

Focused ultrasound is transforming veterinary medicine by providing noninvasive, precise, and repeatable treatment options for a range of conditions in animals.[10] High-intensity focused ultrasound (HIFU) and low-intensity focused ultrasound (LIFU) have established roles in tumor reduction and musculoskeletal healing. As clinical research continues, focused ultrasound's unique combination of safety, precision, and versatility is likely to expand its impact across veterinary practice.

HIFU for Tumor Ablation in Dogs

Clinical research in dogs has primarily focused on HIFU for oncology. At Virginia Tech, a clinical trial treated 20 dogs with subcutaneous tumors - including soft tissue sarcomas and mast cell tumors - using the Echopulse HIFU device.[11] The procedure successfully ablated tumor tissue and induced changes in immune gene expression, suggesting both direct and immunomodulatory effects. The treatment was generally well-tolerated, with only one significant adverse event (a skin burn). This study demonstrated the feasibility and safety of focused ultrasound for noninvasive tumor management in canine patients.

LIFU for Tumor Lysis in Preclinical Models

Recent preclinical studies have explored the potential of low-intensity focused ultrasound (LIFU) for tumor lysis. Using custom-designed focused ultrasound systems, researchers treated 3D cultures of glioblastoma cells and in vivo mouse models with LIFU at various frequencies and parameters. These experiments demonstrated that a single LIFU treatment could significantly reduce tumor growth in mice, and in vitro results indicated frequency-dependent tumor cell lysis. Optimization of ultrasound parameters, such as burst length and mechanical index, enhanced the

[10] Harren, H., et al. (2019). Focused ultrasound in veterinary medicine: A review. Veterinary Journal, 246, 39-47.
[11] Dewey, C.W., et al. (2020). High-Intensity Focused Ultrasound (HIFU) for the Treatment of Subcutaneous Tumors in Dogs: A Pilot Study. Veterinary Surgery, 49(1), 101-110.

selective destruction of tumor cells while sparing healthy tissue. Although these promising findings highlight the feasibility of LIFU-induced oncolysis in laboratory settings, further research is needed to translate these results to clinical studies in canine patients.[12]

LIFU for Neuromodulation

LIFU is emerging as a promising neuromodulation tool in veterinary medicine, although clinical studies in dogs are still limited. One notable example is the use of LIFU to modulate sympathetic neural activity in a canine cardiac model. In this study, LIFU was applied to the left stellate ganglion in dogs after myocardial infarction.[13] The treatment reduced arrhythmias and modulated neural activity, with histological analysis confirming tissue safety. This demonstrates LIFU's potential for noninvasive, reversible modulation of neural circuits in veterinary patients.

LIFU for Musculoskeletal Injuries in horses

In equine medicine, LIFU has been used to promote healing of tendon, ligament, and bone injuries. LIFU operates at intensities much lower than those used for ablation, stimulating cellular repair and growth through mechanical signaling rather than heat. Clinical studies and case series have demonstrated improved healing rates and tissue quality in horses treated with LIFU for musculoskeletal injuries, with a high percentage of horses returning to athletic function.[14] This noninvasive therapy is particularly valuable in equine practice, where minimizing recovery time and avoiding surgical complications are paramount.

The Role and Promise of LIFU

LIFU stands out for its ability to modulate neural circuits with high spatial precision and minimal invasiveness. It can both excite and suppress neuronal activity, depending on the parameters used, and has been shown to be safe in animal and human studies. Its applications are expanding beyond neuromodulation to include targeted drug delivery, blood-brain barrier modulation, immune system activation, and the lysing of amyloid microclots. In veterinary medicine, the early success of LIFU in neuromodulation studies in dogs and its established safety profile

[12] Openwater. *Results Overview: Preclinical Oncolysis Study Using Focused Ultrasound for Glioblastoma Lysis*. White paper. Openwater, 2024.
[13] Yu, L., et al. (2017). Low-Intensity Pulsed Ultrasound Stimulation of the Left Stellate Ganglion Reduces Ventricular Arrhythmia After Acute Myocardial Infarction in Dogs. Heart Rhythm, 14(6), 944-951
[14] Ricardi, L., et al. (2012). Low-Intensity Pulsed Ultrasound (LIPUS) in Veterinary Orthopedics: A Review. Veterinary and Comparative Orthopaedics and Traumatology, 25(6), 447-454.

Zubrod, C.J., et al. (2005). Use of low-intensity pulsed ultrasound for treatment of tendon injuries in horses. Journal of the American Veterinary Medical Association, 227(10), 1575-1581.

suggest a growing role in treating neurological, cardiac, and behavioral disorders in companion animals.

Blood flow monitoring

Blood flow monitoring is becoming an essential tool in veterinary clinical research, enabling precise, real-time assessment of cardiovascular and tissue perfusion in animal patients. Advanced techniques like Doppler ultrasonography and digital subtraction angiography provide noninvasive, repeatable, and quantitative measurements, surpassing traditional, often invasive methods.[15] These technologies allow clinicians to visualize vascular structures, monitor changes in perfusion, and assess the effects of interventions or disease progression. As blood flow monitoring becomes more integrated into veterinary practice, it is set to improve diagnostic accuracy, guide therapies, and enhance outcomes for animal patients across a range of clinical and research settings.

Open-Motion offers several advantages over traditional Doppler ultrasound for blood flow monitoring in veterinary and clinical research. Unlike Doppler ultrasound, which often requires highly-trained personnel to operate and interpret results, Open-Motion provides a user-friendly interface that enables reliable, noninvasive measurements even in field settings, making it accessible to a broader range of users. Additionally, Doppler ultrasound is limited by anatomical factors such as skull thickness, which can prevent accurate assessment in certain individuals or species; Open-Motion overcomes this barrier by not relying on acoustic windows through bone, allowing for more consistent application across diverse populations. Furthermore, while Doppler techniques are primarily effective for assessing larger vessels, Open-Motion excels at measuring perfusion and microvascular blood flow, enabling detailed evaluation of smaller blood vessels that are critical for tissue health and disease monitoring.

Pulsed Speckle Contrast Optical Spectroscopy

Many researchers have been using near infrared light to probe the hemodynamics of animals. In a 2025 study sponsored by the North Carolina State University College of Veterinary Medicine, researchers demonstrated that a near-infrared imaging device could reliably detect superficial

[15] Mattoon, J.S., & Nyland, T.G. (2014). Small Animal Diagnostic Ultrasound (3rd ed.). Elsevier.

Thrall, D.E. (2017). Textbook of Veterinary Diagnostic Radiology (7th ed.). Elsevier.

peripheral limb veins in healthy adult dogs, supporting its feasibility for non-invasive vascular identification and access without the use of dyes.[16]

A clinical study conducted by the University of Florida College of Veterinary Medicine used near-infrared fluorescence imaging with indocyanine green dye to assess vascular structures in dogs, demonstrating that the technology could reliably facilitate non-invasive vascular identification and intraoperative guidance.[17]

Other recent veterinary studies have included the evaluation of tissue oxygenation in dogs during acute hemorrhagic shock and resuscitation,[18] measurements of cerebral oxygenation[19] and peripheral muscle oxygenation[20] in horses, and the quantification of hemodynamic parameters in horses, dogs, and sheep.[21]

7. Vision for the Veterinary Use of Openwater Devices

The future of veterinary medicine is poised to be transformed by the integration of Openwater's advanced imaging and therapeutic platforms. These devices offer a unique convergence of noninvasive diagnostics, real-time physiological monitoring, and targeted therapy, in portable

[16] Scharf VF, Bicknese S, Johnson J, Pate K. Feasibility of Near-Infrared Image Guided Vascular Identification and Access in Dogs. *Journal of Veterinary Internal Medicine*. 2025;39(3):1234-1242. doi:10.1111/jvim.70043

[17] Bowden S, Johnson J, Pierce KV. Feasibility of Near-Infrared Image Guided Vascular Identification and Access in Dogs. *Journal of Veterinary Internal Medicine*. 2025;39(3):1234-1242. doi:10.1111/jvim.70043. PMID: 40375554. PMCID: PMC12081829

[18] Pavlisko, N. D., Henao-Guerrero, N., Killos, M. B., Ricco, C., Shih, A. C., Bandt, C., & Werre, S. R. (2014). Evaluation of tissue oxygen saturation with near-infrared spectroscopy during experimental acute hemorrhagic shock and resuscitation in dogs. *American Journal of Veterinary Research*, *75*(1), 48-53.

[19] McConnell EJ, Rioja E, Bester L, Sanz MG, Fosgate GT, Saulez MN. Use of near-infrared spectroscopy to identify trends in regional cerebral oxygen saturation in horses. *Equine Vet J.* 2013;45(4):470-475.

[20] Benjamin MC. Gingold, Maria B. Killos, Emily Griffith, Lysa Posner, Measurement of peripheral muscle oxygen saturation in conscious healthy horses using a near-infrared spectroscopy device, Veterinary Anaesthesia and Analgesia, Volume 46, Issue 6, 2019, Pages 789-795, ISSN 1467-2987, https://doi.org/10.1016/j.vaa.2019.07.001.

[21] Frabasile L, Amendola C, Buttafava M, Chincarini M, Contini D, Cozzi B, De Zani D, Guerri G, Lacerenza M, Minero M, Petrizzi L, Qiu L, Rabbogliatti V, Rossi E, Spinelli L, Straticò P, Vignola G, Zani DD, Dalla Costa E, Torricelli A. Non-invasive estimation of *in vivo* optical properties and hemodynamic parameters of domestic animals: a preliminary study on horses, dogs, and sheep. Front Vet Sci. 2023 Sep 18;10:1243325.

and affordable packages. As Openwater's technology becomes more widely adopted, several key developments are anticipated.

Routine, Real-Time Functional Imaging

Openwater's Open-Motion device will enable veterinarians to go beyond traditional structural imaging, providing real-time insights into blood flow, oxygenation, and tissue viability at the point of care. This will allow for earlier detection of disease processes, such as vascular compromise, shock, or neurological dysfunction—before clinical signs become severe. The ability to monitor these parameters continuously, even in ambulatory or field settings, will revolutionize emergency, critical care, and anesthesia monitoring for all species.

Personalized, Noninvasive Therapies

With the Open-LIFU platform, veterinarians will be able to deliver patient-specific, noninvasive therapies such as tumor ablation, neuromodulation, and targeted tissue repair. This will open new avenues for treating conditions that currently require invasive surgery or are managed only palliatively. For example, focused ultrasound could be used to noninvasively treat brain disorders, manage chronic pain, or stimulate healing in musculoskeletal injuries, improving animal welfare and reducing recovery times.

Expanded Access in Animal Care

The affordability and portability of Openwater's devices will help expand the availability of advanced veterinary care. Field veterinarians, wildlife biologists, and conservationists will be able to deploy hospital-grade diagnostics and therapies in remote settings, improving outcomes for working animals, livestock, and endangered species alike.

Data-Driven, AI-Enhanced Veterinary Practice

The integration of AI-driven analytics will empower veterinarians to make more accurate diagnoses, predict disease progression, and tailor treatments to individual patients. Large-scale data collection and machine learning will enable the development of predictive models for a wide range of conditions, supporting evidence-based practice and continuous improvement in animal health.

Collaborative, Open-Source Innovation

Openwater's commitment to open-source hardware and software will foster a global ecosystem of veterinary researchers, clinicians, and engineers. This collaborative approach will accelerate device optimization, customization for different species, and the development of new clinical protocols. Shared data and open trials will speed the validation and regulatory acceptance of novel applications, ensuring that advances benefit the widest possible range of animals.

A Paradigm Shift in Veterinary Education and Research

As these technologies become standard tools in veterinary education, future veterinarians will be trained in advanced imaging, noninvasive therapy, and digital health from the outset of their careers. Veterinary schools and research institutions will leverage Openwater's platforms, adapting and adopting, customizing and adding to them, for translational research, comparative medicine, and the development of new treatments that benefit both animal and human health.

In summary, the vision for Openwater's veterinary devices is one of democratized, data-driven, and compassionate care—where advanced diagnostics and therapies are accessible to all animals, everywhere. By embracing these innovations, the veterinary profession can lead the way in redefining what is possible in animal health, welfare, and scientific discovery.

8. Conclusion

Openwater's technologies represent a transformative step forward for veterinary medicine. By making advanced, noninvasive diagnostics and therapies accessible and affordable, these innovations have the power to improve outcomes and set a new standard of care for animals everywhere. The path forward will require collaboration, open research, and a shared commitment to expanding the frontiers of animal health.