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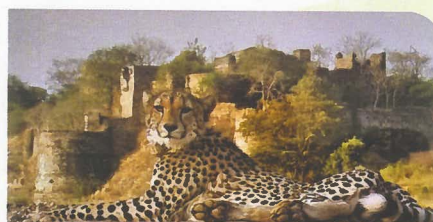
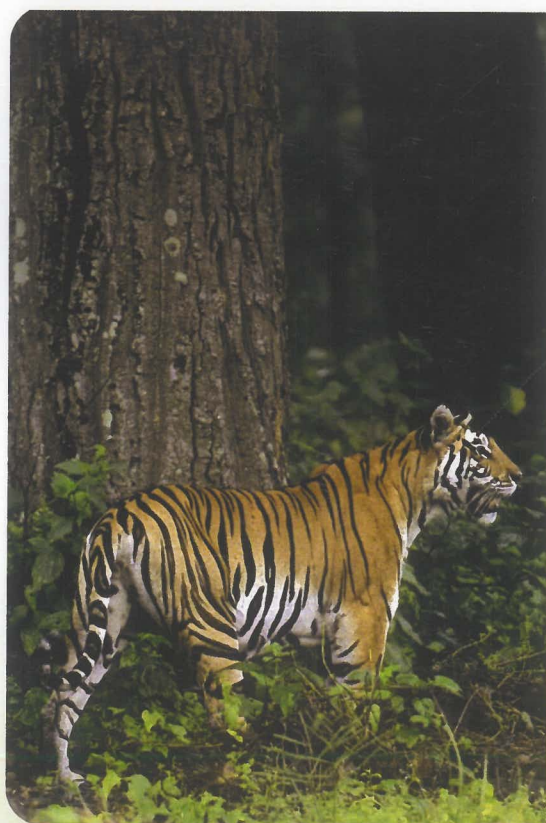
INTERNATIONAL ZOO AND WILDLIFE HEALTH CONFERENCE

on

**BALANCING HUMAN NEEDS
AND WILDLIFE CONSERVATION
THROUGH INTEGRATED HEALTH MANAGEMENT**

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*Lead Paper***ADVANCING ZOO VETERINARY CARE: INNOVATIONS,
TECHNOLOGIES AND COLLABORATIONS SHAPING THE FUTURE OF
ZOOLOGICAL MEDICINE****Dr. Brij Kishor Gupta**

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The discipline of zoological medicine is undergoing rapid transformation, driven by technological innovation, multidisciplinary research, and an increasingly sophisticated understanding of species-specific pathophysiology. As anthropogenic pressures escalate biodiversity loss, the integration of veterinary science with ecological, ethological, and epidemiological principles has become paramount in wildlife conservation.

At the forefront of this evolution is the Greens Zoological, Rescue and Rehabilitation Centre (GZRRC), serves as a critical node for the rescue and rehabilitation of fauna impacted by illegal trafficking, habitat fragmentation, and anthropogenic conflict. GZRRC operates at the intersection of *ex situ* conservation and translational medicine, employing a **One Health framework** to address the interconnected health of ecosystems, wildlife, and human populations. Multi-specialty veterinary hospital at GZRRC, designed to offer world-class healthcare for rescued species bringing together cutting-edge technology and expert veterinary professionals to deliver holistic healthcare. From general wellness and emergency care to specialized neonatal intensive care, GZRRC caters to a diverse array of species—including primates, big cats, reptiles, elephants, and marine life.

The facility with its advanced diagnostics integrates veterinary science with pathology, nutrition, behaviour, and environmental enrichment to ensure the physical and psychological well-being of its animal residents.

1. Diagnostic Imaging & Precision Medicine

GZRRC is equipped with a **state-of-the-art multi-specialty veterinary hospital** that supports its mission through cutting-edge medical infrastructure. Advanced imaging technologies form a corner-stone of its diagnostic capabilities, significantly enhancing accuracy and enabling species-specific care. High-resolution modalities like **64-slice CT** and **0.5T MRI with AI integration** allow for detailed visualization of internal structures, aiding in the diagnosis of complex fractures, tumours, and internal injuries—especially in large mammals, reptiles, and exotic birds where conventional methods may be limited. Complementing these are **digital radiography systems**, which provide rapid, high-clarity imaging with reduced radiation exposure, ideal for routine assessments of skeletal and soft tissue conditions. These integrated diagnostic tools not only facilitate timely medical interventions but also exemplify GZRRC's commitment to delivering evidence-based and advanced healthcare for wildlife.

High-Resolution Tomography: Expand utilization of 64-slice CT and and upgrade from 0.5T to 3T MRI for cross-species anatomical mapping, enabling early detection of neoplasms, fractures, and degenerative disorders in megafauna (elephants, rhinos) and exotics (reptiles, avians).

- **Digital Radiography Optimization:** Implement AI-driven image analysis algorithms to enhance detection of subclinical pathologies (e.g., metabolic bone disease in reptiles, dental attrition in primates).
- **Endoscopic Advancements:** Deploy narrow-band imaging (NBI) endoscopes for superior mucosal evaluation in gastrointestinal and respiratory tracts of sensitive species (e.g., psittacine, small primates).

2. Critical Care & Species-Specific ICUs

At Greens Zoological, Rescue and Rehabilitation Centre (GZRRC), specialized species-specific care units have been established to provide intensive support for critically ill or injured wildlife. The facility includes a well-equipped **General ICU** for a range of species and a dedicated **Neonatal ICU** tailored to the needs of young, vulnerable animals. Both units feature advanced monitoring systems that track vital signs, fluid balance, and metabolic parameters in real time, enabling prompt, data-driven medical decisions. These critical care units uphold high standards of welfare and ensure life-saving, individualized interventions aligned with each species' physiological requirements. Given the complex and delicate nature of primate health, GZRRC has designed tailored protocols for primate care, including behavioural health monitoring, social enrichment, and precise pharmacological therapies. Reptile species, on the other hand, require very specific temperature, humidity, and metabolic management, all of which are seamlessly integrated into the hospital's specialized ICU for reptiles.

- **Neonatal Intensive Care:** Refine protocols for neonates, integrating closed-loop fluid therapy systems and thermoregulatory matrices.
- **Primate Behavioural Health:** Introduce non-invasive neuro-monitoring (EEG, fNIRS) to assess stress responses and postoperative recovery in great apes.
- **Reptile Metabolic Support:** Upgraded ICUs with precision humidity/temperature gradients ($\pm 0.5^{\circ}\text{C}$) and point-of-care blood gas analysers.

3. Surgical Excellence & Anaesthetic Innovation

Greens Zoological, Rescue and Rehabilitation Centre (GZRRC) is equipped with advanced surgical infrastructure to support complex procedures across a wide range of rescued wildlife. Its specialized operating theatres are tailored for both large and small animals, featuring integrated anaesthetic delivery systems, advanced surgical tools, and dedicated post-operative care units. A separate, fully equipped elephant hospital accommodates the unique physiological needs of megafauna.

- **Megafauna Surgical OT:** The operating theatres are equipped with the latest technologies in surgical monitoring, including integrated anaesthetic delivery systems, advanced surgical instruments, and comprehensive post-

operative care units. From large animals like elephants to smaller species, GZRRC ensures that each OT is customized to meet the unique needs of the species being treated. The facility is also equipped with a specialized hospital for elephants, which includes hydraulic-assisted positioning systems for handling their size and physiology and with radiolucent operating tables for fluoroscopic-guided orthopaedics in large carnivores.

- **Inhalant Anaesthesia:** Standardize species-specific vaporizer settings (isoflurane/sevoflurane) using pharmacokinetic models for felids, ursids, and mammals. The use of circuit gas anaesthetic workstations enables precise control of inhalant anaesthetic concentrations, ensuring stable and safe anaesthesia during procedures. This is particularly crucial for exotic species where anaesthetic management can be challenging due to differences in metabolism and responses to drugs.
- **Lithotripsy Expansion:** The lithotripter machine is an advanced tool used for the non-invasive treatment of kidney stones in larger species, including elephants and rhinos. This technology allows for the fragmentation of stones without the need for invasive surgery, reducing the risks associated with traditional procedures and improving recovery times.

4. Regenerative & Rehabilitative Therapies

At Greens Zoological, Rescue and Rehabilitation Centre (GZRRC), advanced therapeutic modalities play a vital role in comprehensive wildlife recovery and rehabilitation. The facility integrates technologies like **hydrotherapy** and **hyperbaric oxygen therapy (HBOT)** to enhance functional recovery, support wound healing, and manage chronic or post-surgical conditions. These therapies are tailored to species-specific needs, ensuring safe and effective outcomes.

- **Hydrotherapy 2.0:** Integrate underwater treadmills with force-plate gait analysis for objective rehabilitation metrics in post-operative large mammals.
- **Hyperbaric Oxygen (HBOT):** Hyperbaric oxygen therapy has proven benefits in the treatment of a variety of conditions, including wound healing, infections, and ischemia. By increasing the amount of oxygen available to tissues, HBOT accelerates the healing process and reduces the risk of complications, especially in critically ill or injured animals. Establishing evidence-based HBOT protocols for gangrenous pododermatitis in avians and necrotizing fasciitis in reptiles.

5. Laboratory & Antimicrobial Stewardship

Given the growing concern around antimicrobial resistance (AMR), GZRRC places a key focus on antibiotic sensitivity testing to ensure the effective use of antibiotics. By routinely conducting antimicrobial susceptibility tests, the hospital can prescribe the most effective antibiotic therapy, minimizing the risk of resistance development while optimizing clinical outcomes for both common and rare species.

- **BSL-3/4 Facility Enhancement:** Upgrade to higher containment levels for zoonotic pathogen research, integrating **mass spectrometry-based rapid pathogen identification and molecular resistance gene detectionsystems** for outbreak investigations.
- **Collaborative AMR Surveillance:** Establish sentinel networks with **national public health agencies** and **global conservation partners** to monitor emerging antimicrobial resistance (AMR) patterns in wildlife populations, ensuring data-driven treatment protocols.

6. Telemedicine & Digital Integration

Telemedicine plays an increasingly critical role in modern veterinary care. At GZRRC, telemedicine is integrated into routine operations to provide remote consultations, second opinions, and specialized care for animals that are difficult to transport or are located in remote areas.

By utilizing secure, high-definition video systems, as well as remote monitoring devices, GZRRC's veterinary specialists can collaborate with international experts and offer on-demand consultations to zoos, wildlife reserves, and conservation programs globally. This also facilitates the rapid exchange of vital health information and veterinary knowledge, helping improve care for endangered species or those in remote or underserved areas.

- **Global Rounds:** Launch a blockchain-secured case repository for real-time multinational consultations on rare species (e.g., saiga antelope, vaquita).
- **IoT Biomonitoring:** Deploy implantable biosensors collars/tags for remote vital sign tracking in reintroduction candidates as planned.

7. One Health & Conservation Synergies

GZRRC is committed to enhancing its One Health approach, which recognizes the interconnections between human, animal, and environmental health. In the coming year, the hospital will implement the following strategies to strengthen this approach:

- **Collaborative Research and Data Sharing:** Increased collaboration with public health agencies, veterinary institutes, and environmental organizations to share research data on zoonotic diseases, environmental changes, and emerging threats.
- **Integrated Surveillance Systems:** Development of a centralized surveillance system to monitor diseases that impact both animals and humans, enabling early detection of outbreaks and more coordinated response efforts.
- **Environmental Health Programs:** Expanding efforts in environmental health monitoring, including the study of wildlife habitats and their interaction with human populations, to mitigate potential zoonotic risks.

8. Sustainability & Infrastructure

With an increasing focus on environmental sustainability, GZRRC will continue to invest in eco-friendly technologies and practices. This includes the use of renewable energy, waste reduction strategies, and the integration of sustainable materials in facility design.

- **Green OT Initiative:** Transition to hydrogen fuel cell-powered surgical OT by 2026, reducing carbon dioxide emissions by 40%.
- **Closed-Loop Waste Systems:** Install plasma gasification units for hazardous biowaste neutralization.

Conclusion

The Greens Zoological, Rescue and Rehabilitation Centre's Action Plan for 2025-2023, is towards revolutionizing wildlife healthcare globally. By blending translational medicine, advanced tech, and conservation biology, it's aiming to bridge the gap between lab research and real-world animal care—think of it like taking cutting-edge medical breakthroughs and applying them to everything from injured animals to endangered birds. The focus on sustainability and global standards suggests they're not just patching animals up but building long-term systems to protect species and their habitats.