

# ASSISTED REPRODUCTIVE TECHNOLOGIES AND BIOSECURITY

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## Abstract

Assisted Reproductive Technologies (ART) including artificial insemination, embryo transfer, in vitro fertilization, and semen/embryo cryopreservation have become central to improving genetic gain, efficiency, and resilience in livestock production. However, these technologies also create specific biosecurity risks because gametes, embryos, and associated equipment can carry pathogens between animals, farms, and even countries. This article examines the interface between ART and biosecurity from a practical, field-oriented perspective, summarizing major disease transmission risks linked to semen collection, AI, embryo production, and transport, and outlining evidence based mitigation strategies. It emphasizes standardized operating procedures, strict hygiene and disinfection, traceability, and staff training as core elements of an ART aligned biosecurity framework. The article also discusses how emerging digital tools such as RFID-based sanitation monitoring and electronic recordscan strengthen compliance and auditability. By integrating disease-risk management into ART workflows, veterinary practitioners and production units can sustain both genetic progress and herd health, supporting long-term food security and animal welfare.

**Keywords:** Assisted Reproductive Technologies (ART), biosecurity, artificial insemination, embryo transfer, disease transmission, cryopreservation

## Introduction

Assisted Reproductive Technologies have transformed veterinary practice and animal production, enabling rapid genetic improvement, controlled breeding cycles, and the conservation of rare or high value germplasm. In cattle alone, millions of inseminations and hundreds of thousands of embryo transfers are performed annually, supported by global networks of semen and embryo banks. Yet, each step of these pipelines, from semen collection and processing to embryo flushing, culture, freezing, and transfer represents a potential opportunity for pathogen entry or spread. Biosecurity, in contrast, has historically been framed as a set of farm level measures to prevent disease introduction and limit within herd transmission. When ART is superimposed on traditional biosecurity models, it

exposes gaps: a single batch of AI semen or an embryo shipment can introduce a systemic disease

into a previously naive herd, making the “farm” boundary less relevant than the integrity of the reproductive pipeline itself. This article therefore argues that ART must no longer be treated as a purely technical exercise, but as a high-risk biosecurity node that demands specialized protocols, culture, and continuous assessment.

## Assisted Reproductive Technologies: A practical overview

ART in veterinary medicine encompasses a range of techniques aimed at manipulating gametes and embryos to improve reproductive efficiency and genetic quality. The most widely used tool remains artificial insemination, in which

semen is collected from selected males, processed, cryopreserved, and inseminated into females at precisely timed intervals. In addition, embryo transfer, where embryos are collected from genetically superior donors and transferred to recipient animals that enables the multiplication of high value genetics at a much faster rate than natural breeding. In species such as cattle, fixed-time AI protocols and ovarian stimulation further intensify the use of ART, particularly in large scale cow-calf operations and pasture based systems. These protocols partially bypass the need for daily heat detection, but they also increase the number of animals handled, the frequency of procedures, and the volume of biological material moved through centralized facilities. As ART becomes more standardized and commercialized, reproductive units function as “hubs” where animals, personnel, and biological products converge, creating dense networks of contact whose biosecurity implications are often underappreciated.

#### **Biosecurity threats associated with ART**

From a biosecurity standpoint, ART can facilitate both horizontal and vertical transmission of pathogens. Semen and embryos may carry bacteria, viruses, and protozoa that are not always detectable at routine screening level, and these can be transmitted to recipients, offspring, and even indirectly to bystander animals via contaminated equipment or personnel. In cattle, for example, pathogens such as *Trichomonas foetus*, bovine viral diarrhoea virus (BVDV), and certain mycoplasmas can be transmitted through infected semen or contaminated AI equipment, leading to reproductive failure, abortion, and immunosuppression. Equally important are non-pathogen specific risks such as cross-contamination between animals during handling, reuse of non-sterile equipment, and inadequate disinfection of AI guns, catheters, and embryo transfer equipment. Even where the originating farm is officially disease-free, lapses in hygiene during collection or processing can introduce a new pathogen into the reproductive pipeline. Furthermore, international trade in semen and embryos multiplies these risks, as a single contaminated shipment can expose multiple herds across different production systems and countries.

#### **Integrating biosecurity into ART workflows**

To mitigate these risks, veterinary practitioners and reproductive units must embed biosecurity into every stage of the ART chain. At the collection stage, donor animals should be screened for key reproductive and systemic pathogens, and procedures should follow standardized operating procedures (SOPs) that define acceptable hygiene levels, equipment use, and waste disposal. Semen and embryo processing laboratories require physical containment, controlled airflow, and strict separation of “clean” and “potentially contaminated” areas to minimize cross-contamination. On farm, AI and embryo transfer procedures should be performed under conditions that mimic surgical asepsis as closely as possible. Each AI gun, catheter, embryo transfer device, and inseminating sheath should either be single-use or undergo validated cleaning and sterilization protocols; reusable equipment must be inspected after each use and retired when its integrity is compromised. Personnel should be trained not only in technical skills but also in biosecurity behaviors, including the use of dedicated outerwear, gloves, boots, and hand hygiene, and strict adherence to movement protocols that limit unnecessary contact between animals of different health or genetic status.

#### **Digital tools and monitoring for ART linked biosecurity**

Modern biosecurity in ART settings is increasingly supported by digital tools that enhance traceability and compliance monitoring. Electronic records can link each semen dose or embryo to its donor, collection date, pathogen screening results, and destination, enabling rapid traceback in case of disease detection. Radio frequency identification (RFID) tags and access control systems can be used to monitor staff movement, boot and hand sanitization compliance, and equipment use, thereby reducing the risk of cross contamination between buildings or units. Adenosine triphosphate (ATP) luminometry can provide immediate feedback on the cleanliness of equipment surfaces, helping units to verify that cleaning protocols are effective rather than merely followed. When combined with regular biosecurity audits and staff training, these tools create a feedback loop that identifies weak

points in ART related workflows and allows continuous improvement.

### **Practical recommendations for veterinary practitioners**

For veterinarians working with ART, three overarching priorities emerge. First, every ART procedure should be accompanied by a written biosecurity-oriented SOP that covers donor screening, equipment handling, hygiene, and waste management, and that is regularly reviewed and updated. Second, staff must receive periodic training in both ART techniques and biosecurity, with clear responsibilities defined for each role and opportunities for supervised practice of sterile procedures. Third, veterinary units should establish formal relationships with external laboratories and diagnostic services to ensure timely and standardized pathogen screening, while also maintaining internal quality control mechanisms for cleaning and equipment performance. At the farm level, veterinarians should advise clients to keep AI and embryo transfer related activities separate from routine herd management whenever possible, and to enforce strict visitor and vehicle protocols around areas where reproductive procedures are

performed. This includes limiting the number of people entering collection rooms, using dedicated transport routes for semen and embryo containers, and avoiding shared equipment between different farms or age groups without thorough disinfection.

### **Conclusion**

Assisted Reproductive Technologies are central to modern veterinary practice and animal production, but their benefits can only be sustained if they are firmly anchored in robust biosecurity. Semen, embryos, and the associated equipment and personnel form a dynamic network of contacts that can rapidly spread pathogens if not managed with discipline. By integrating standardized operating procedures, rigorous hygiene, clear responsibilities, and digital traceability and monitoring into ART workflows, veterinary practitioners can ensure that genetic progress goes hand in hand with disease prevention and herd health. In doing so, they not only protect individual animals and farms but also contribute to the broader goals of food security, animal welfare, and public health.

### **References**

- Baruselli, P. S., Reis, E. L., Ferreira, R. M., & Sá Filho, M. F. (2018). Advances in fixed-time artificial insemination in cattle. *Animal Reproduction*, *15*(2), 377–388.
- Bó, G. A., Adams, G. P., & Mapletoft, R. J. (2018). Fixed-time artificial insemination in cattle: A practical approach. *Theriogenology*, *112*, 1–7.
- International Embryo Technology Society. (2023). *Guidelines for good embryo-transfer practice*.
- Novak, E. (2025). The role of biosecurity and sanitation in livestock health management. *Journal of Veterinary Medicine and Allied Science*, *9*(1), 177.
- PIGEON-VET Biosecurity Network. (2026). *Animal biosecurity framework development, implementation and monitoring*. Veterinary Education Environment Unit.
- World Organisation for Animal Health. (2023). *Terrestrial animal health code: Artificial insemination and embryo transfer*.
- Zwald, N. R., & Ricke, S. C. (2024). Review of livestock biosecurity resources and training materials. *Preventive Veterinary Medicine*, *223*, 105987. <https://doi.org/10.1016/j.prevetmed.2024.105987>

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