# INDIRECT TRANSMISSION OF PATHOGENS VIA ANIMAL TRANSPORT AND ASSOCIATED BIOSECURITY MEASURES: A SYSTEMATIC REVIEW

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## 1. Introduction and Objective

Pig transport vehicles have been suggested as a route for **indirect disease transmission**.

Despite widespread implementation of **cleaning and disinfection (C&D)** practices, persistent contamination remain frequently reported.

This systematic review aimed:

- To evaluate evidence for **indirect pathogen transmission** to animals via transport vehicles.
- To assess the **effectiveness of biosecurity measures** designed to mitigate this risk.

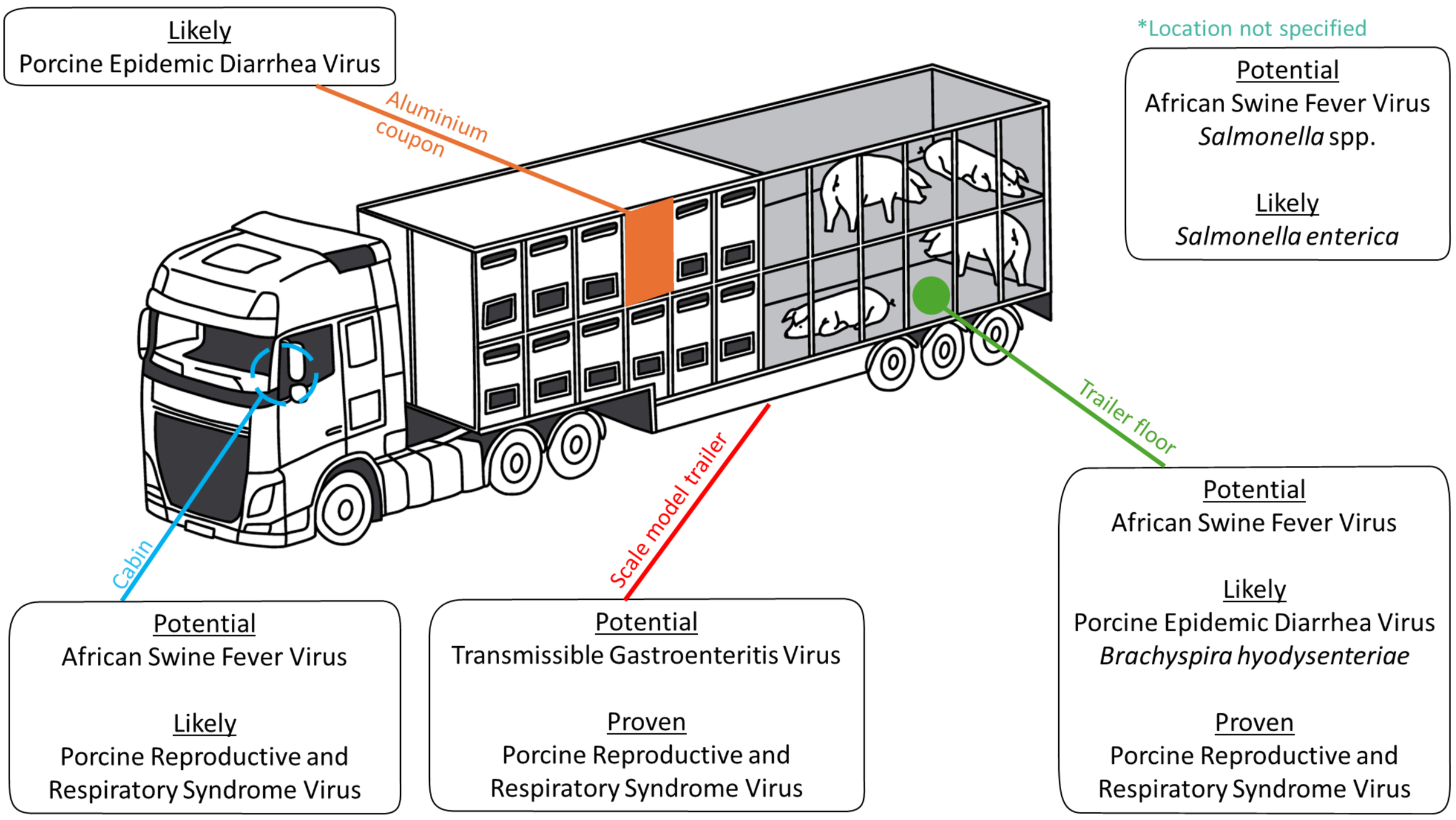
## 2. Materials and Methods

- A systematic review was conducted following **PRISMA** guidelines.
- **Peer-reviewed articles** published from 1990 onward written in English were eligible.
- Studies investigating **indirect pathogen transmission** via animal transport vehicles and/or associated **biosecurity measures** were included.
- **Evidence** was categorised as proven, likely, potential or unlikely based on study design, quality and outcomes.
- Search strategy:

[pigs] AND [transport vehicles] AND [pathogens] AND [biosecurity measures]

## 3. Results and Discussion

### Indirect transmission on pig trucks




*More articles investigated these pathogens but could not provide higher level of proof.

## Summary/Key Points

- Pig transport vehicles are a **biosecurity risk**.
- Research investigated **four viruses and two bacteria** as possible agents of mechanical transmission.
- Pathogens persist on multiple truck locations, including trailers, equipment and driver cabins.
- No single, universally effective **C&D protocol** can be identified.
- Effective pig transport biosecurity requires **standardized, practical protocols, improved compliance and objective monitoring.**

### Biosecurity measures on pig trucks

- Most identified biosecurity measures focused on **cleaning and disinfection (C&D)** of transport vehicles.
- Dry cleaning, washing and disinfection reduced contamination but were **ineffective in isolation**.
- **Disinfection efficacy** depended on organic matter, temperature, surface type and application method.
- **Drying** (natural or thermo-assisted drying and decontamination) emerged as a **critical** but often omitted step.
- Field studies reported **low compliance** due to practical constraints.
- Visual inspection was unreliable, whereas microbiological and molecular **monitoring methods** provided more accurate assessments.

## 4. Conclusion

- Pig transport vehicles are a biologically plausible and epidemiologically relevant route for **indirect pathogen transmission**.
- **Conclusive experimental evidence** exists only for **PRRSV**; for other pathogens (**PEDV, *B. hyodysenteriae*, *Salmonella* spp., ASFV**), evidence is limited to **likely or potential**.
- **No universally effective C&D** protocol was identified across studies.
- **Persistent contamination after C&D** is common, mainly due to incomplete implementation, lack of drying and field constraints.
- Improved biosecurity requires **standardised, practical protocols**, higher compliance, and objective monitoring beyond visual inspection.

## 5. Acknowledgements and References

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Illustration was created by Barbara Courtens.

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