# Exploring the Barriers to Artificial Intelligence Implementation in Food Safety Monitoring with Expert Interviews

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## Introduction

Food safety systems are under growing pressure from rising consumer expectations, recurring incidents, and slow, labour-intensive monitoring methods (1-2). While Industry 4.0 technologies, especially Artificial Intelligence (AI), offer promising solutions, their adoption in practice remains limited. This suggests that barriers go beyond technology, involving managerial/organisational and regulatory challenges (3-4). This study explores these barriers through in-depth expert interviews with researchers and industry practitioners.

## Methodology

Semi-systematic literature review (with 36 papers) and thematic analysis of data to identify the discussed barriers

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Expert selection based on involvement in food safety monitoring with AI (implementation or interest) through academic experience, or research on AI applications

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Designing semi-structured interview questions and conducting nine in-depth interviews

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Thematic analysis of transcripts to identify mentioned barriers

## Results & Discussion

The literature review identified mainly **technological/technical barriers**, including particularly data-related issues such as data availability, quality, and model overfitting, along with computational complexity and limited model adaptability (5-7). However, both literature and interviews highlight data imbalance and heterogeneity as limiting reliable pattern recognition and prediction (8).

Most of the experts further indicated infrastructure & integration-related technical barriers. Some experts addressed that disconnected and complex production data systems, including limited integration of manually handled data and variability across processes, constrain the effective implementation of AI. They also stressed tool fragmentation and misalignment between new and legacy systems.

Finally, the experts mentioned the lack of interpretability and explainability as an important technical barrier. Unlike human experts, AI models cannot be questioned or required to justify their conclusions. This makes it difficult to understand how decisions are reached.

**Managerial/organisational barriers** were not identified in the reviewed literature. The interviews identified several, with human-related barriers being the most prominent, followed by economic/resource and governance, coordination, organisation and collaboration-related barriers. These findings highlight the importance of managerial and organisational factors in implementation, which may be overlooked in the literature due to its predominant focus on lab-scale studies (9-10).

From a **regulatory perspective**, the literature primarily highlights the lack of standardisation as a key barrier (11), which was also most frequently mentioned by experts. Interviews further identified additional barriers, including a lack of harmonisation, regulatory lag, unclear requirements, and data ownership issues. Overall, experts not only confirmed the literature but also provided further regulatory insights.

### Technological/ Technical Barriers According to Experts

**Infrastructure & integration-related**
- Data integration and interoperability limitations
- Infrastructure requirements
- Fragmentation of digital tools and methods
- Misalignment between new and old systems

**Data-related**
- Requirement of reliable, high-quality and volume of data
- Imbalanced and heterogeneous data issues

**AI system-related**
- Interrogability, explainability and evaluation difficulties
- Black box models
- Lack of well-trained AI systems

### Managerial/Organisational and Regulatory Barriers According to Experts

**Human-related**
- Limited knowledge, awareness, and skills related to AI
- Insufficient AI training and literacy
- High workload in the implementation phase
- Limited involvement of end users and human intelligence

**Organisation-related**
- Lack of trust in AI
- Lack of acceptance of AI
- Change management and fear among individuals
- Data security requirements

**Economic and resource-related**
- Extensive investments and financial constraints
- Insufficient resources
- Dependency on technology suppliers

**Governance, Coordination, and Collaboration-related**
- Limited collaboration, coordination, and unclear responsibilities
- Reluctance in data sharing

**Regulatory and standardisation-related**
- Lack of standardisation and harmonisation
- Lack of clear regulatory criteria for AI
- Uncertainty in data ownership, access, and responsibility

**Conclusion**: While AI shows strong potential to improve food safety monitoring, its implementation is constrained by barriers. Addressing these requires coordinated efforts across technological/technical, managerial/organisational, and regulatory perspectives. This study contributes to a more holistic understanding of these barriers and offers insights to support more effective and responsible AI implementation in the future.

**Limitations**: The study is based on a small expert sample (n = 9), limiting generalisability. The broad categorisation of participants may oversimplify real-world roles, and regulatory barriers were assessed only indirectly, as regulators were not directly involved.

**Future Research**: Further studies should engage directly with regulators to clarify requirements and support standardisation. Larger-scale quantitative or mixed-methods research could also strengthen generalisability and help prioritise key barriers.

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