# CONSIDERATIONS REGARDING THE ONE HEALTH CONCEPT AND FOOD PRODUCT TRACEABILITY

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RESEARCH ARTICLE

**Abstract**

The *One Health* concept has gained prominence in recent years as an integrative framework for understanding the relationships between human health, animal health, plant health, and the state of ecosystems. In parallel, food product traceability has become a central instrument of food safety, sanitary-veterinary control, and risk management throughout the agri-food chain. This paper analyses the relationship between these two concepts, arguing that traceability is not merely a technical or administrative mechanism, but an essential operational component of the *One Health* approach. Through its capacity to connect data on production, processing, distribution, and risk, traceability contributes to the prevention of foodborne illnesses, the control of zoonoses, the monitoring of antimicrobial resistance, and the strengthening of transparency in agri-food systems. The paper highlights that integrating traceability into a *One Health* vision enables a more effective approach to food safety, as it correlates information on human, animal, and environmental health within a coherent surveillance and intervention system. The main implementation challenges are also discussed: institutional fragmentation, technological limitations, costs for economic operators, and the need for data interoperability. In conclusion, food product traceability must be understood as critical infrastructure for the practical application of *One Health* principles in modern food and public health governance. *One Health* is defined by WHO as an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals, and ecosystems.

**Keywords:** One Health, food traceability, food safety, agri-food chain, public health.

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## Introduction

The globalisation of food trade, the intensification of agricultural production, and the increasing complexity of supply chains have transformed food safety into a major public health issue. Food products move rapidly between regions and continents, and the risks associated with biological, chemical, or physical contamination can simultaneously affect humans, animals, and the environment. In this context, the One Health concept offers an appropriate explanatory and operational framework, as it recognises the interdependent nature of human, animal, plant, and environmental health. WHO and FAO emphasise that food safety must be addressed throughout the entire food chain, in line with the joint One Health action plan.

Food product traceability has established itself as one of the most important tools for managing these risks. In the European Union, the European Commission regards traceability as a “cornerstone” of food safety, as it makes it possible to track food and ingredients through every stage of the supply chain, facilitating the rapid withdrawal of unsafe products and an effective response to incidents.

The central idea of this paper is that food product traceability represents one of the

principal means through which the One Health concept can be concretely applied within agri-food systems. Without traceability, the relationships between the source of a risk, the circuit of the product, human exposure, animal health, and environmental factors remain fragmented. With traceability, these relationships become observable, analysable, and manageable.

The One Health concept starts from the idea that human health cannot be separated from the health of animals, plants, and ecosystems. WHO defines One Health as an integrated and unifying approach, while EFSA shows that this framework is essential for addressing challenges such as zoonoses, foodborne pathogens, and antimicrobial resistance.

In the food domain, the relevance of One Health is immediate. Numerous foodborne illnesses have a zoonotic origin, and contamination can occur at any stage of the chain, from farm to consumer. EFSA states that contamination risks are present “from farm to fork” and require prevention and control across the entire chain.

From this perspective, the food chain becomes a space of convergence between human health, animal health, and the surrounding environment. A food product is not merely an economic good, but also a potential vector of risk or, conversely, the outcome of a healthy and well-controlled system.

This is precisely where traceability comes in: it transforms the food chain into an intelligible system, in which the origin, circulation, and history of the product can be tracked and correlated with sanitary risks.

Traceability is defined within the European framework as the ability to track and identify a food, a feed, a food-producing animal, or a substance intended to be incorporated into a food or feed, throughout all stages of production, processing, and distribution. The European Commission and reference FAO documents emphasise that traceability is mandatory and plays an essential role in the rapid identification of risks and in facilitating withdrawals and recalls.

The Codex Alimentarius treats traceability as a tool used within food inspection and certification systems, and FAO includes it among the fundamental components of national food control systems. Traceability is directly linked to hazard control, the provision of reliable product information, and the guarantee of authenticity.

The main functions of traceability are: the rapid identification of the origin of contamination; limiting the spread of food incidents; facilitating the selective withdrawal of affected batches; strengthening the accountability of chain operators; supporting consumer confidence; and supporting official controls and epidemiological investigations.

From a strictly technical perspective, traceability may appear to be merely a documentation procedure. However, within the One Health logic, it acquires a deeper role: it becomes a mechanism linking data on the biological source of the product, production conditions, environmental risks, and the impact on population health.

## MATERIALS AND METHODS

This study was based on a qualitative and analytical research approach aimed at examining the relationship between the One Health concept and food product traceability within modern agri-food systems. The research relied primarily on documentary analysis and the review of scientific literature, international regulations, institutional reports, and policy documents related to food safety, public health, zoonoses, antimicrobial resistance, and traceability systems.

The bibliographic sources included publications and official reports issued by the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the European Food Safety Authority (EFSA), the European Centre for Disease Prevention and Control (ECDC), the European Commission, and the Codex Alimentarius Commission. In addition, recent scientific studies published between 2014 and 2025 were reviewed in order to identify current trends and developments concerning the integration of food traceability into the One Health framework.

The methodological approach involved the comparative analysis of definitions, concepts, regulatory frameworks, and operational mechanisms associated with food traceability and One Health governance. Particular attention was given to the role of traceability in preventing foodborne diseases, controlling zoonotic pathogens, monitoring

RESULTS AND DISCUSSION

The analysis demonstrates that food traceability represents one of the most effective operational tools for implementing the One Health concept within agri-food systems. The findings indicate that traceability contributes significantly to the integration of information originating from human health, animal health, food production, and environmental monitoring systems. Through its capacity to establish connections among these sectors, traceability facilitates a comprehensive understanding of food-related risks and supports coordinated responses to emerging threats.

One of the most important findings concerns the management of foodborne diseases. Traceability systems allow authorities to identify the origin of contamination rapidly and accurately, thereby reducing response times and limiting the spread of outbreaks. By linking contaminated food products to specific farms, processing facilities, transportation networks, or environmental sources, traceability provides essential epidemiological evidence that supports risk assessment and decision-making processes.

antimicrobial resistance, and improving transparency throughout the food supply chain.

The collected information was analysed using descriptive and interpretative methods. The relationships between human health, animal health, environmental health, and food safety were examined through the lens of systems thinking, which constitutes one of the core principles of the One Health paradigm. Furthermore, the study evaluated the opportunities and limitations associated with implementing integrated traceability systems in contemporary food production and distribution networks.

The research does not involve primary data collection or experimental procedures. Instead, it provides a conceptual and policy-oriented analysis intended to highlight the strategic importance of food traceability as a critical component of One Health implementation.

The study also highlights the crucial role of traceability in the surveillance and control of zoonotic diseases. Since many foodborne pathogens originate from animals, effective traceability systems create a direct connection between animal production systems and public health outcomes. This capability reflects the fundamental principle of One Health, according to which human, animal, and environmental health are interconnected and should be addressed through coordinated interventions.

Another significant result concerns antimicrobial resistance (AMR), one of the most pressing global public health challenges. The findings suggest that traceability facilitates the identification of production systems, supply chains, and food products associated with resistant microorganisms. By enabling the collection and integration of information from different stages of the food chain, traceability supports surveillance programs and contributes to the development of targeted risk management strategies.

The digital transformation of traceability systems represents an additional area of importance. Modern technologies such as blockchain, artificial intelligence, the

Internet of Things (IoT), and integrated databases increase transparency, improve data accuracy, and enhance the efficiency of monitoring activities. Digital traceability systems have the potential to strengthen cooperation among stakeholders and improve the effectiveness of One Health surveillance networks.

Despite these advantages, several challenges remain. Institutional fragmentation, limited interoperability between information systems, financial constraints affecting small-scale producers, and concerns regarding data governance continue to hinder the implementation of fully integrated traceability systems. Consequently, achieving the full benefits of One Health requires not only technological innovation but also improved coordination among institutions, harmonized standards, and stronger governance frameworks.

Overall, the results confirm that food traceability should no longer be regarded solely as a regulatory requirement or logistical tool. Instead, it should be recognized as an essential public health infrastructure capable of supporting the practical implementation of One Health principles across complex and globalized food systems.

The fundamental connection between One Health and food product traceability lies in the fact that both operate on interdependencies. One Health asserts that health is distributed among humans, animals, and ecosystems; traceability makes it possible to practically reconstruct these connections within the food chain.

When a foodborne disease outbreak occurs, traceability allows human cases to be correlated with specific product batches, then with processing units, farms, water sources, hygiene practices, or sanitary-veterinary issues. Thus, it is not limited to locating the product, but supports the epidemiological understanding of the risk. Recent literature shows that effective traceability systems enable faster and more precise identification of the origin of contamination, facilitating targeted recalls and limiting the spread of foodborne diseases.

This function is perfectly compatible with One Health. If food contamination is linked to a pathogen originating from animals, a contaminated environment, or the inappropriate use of antimicrobials, traceability provides the link between these levels. Without a traceable system, information remains fragmented across institutions and sectors; with a traceable system, it can be integrated into a unified response.

Another important aspect is that traceability provides support for risk-based surveillance. EFSA emphasises the role of data collection and analysis in the early identification of emerging threats in the field of zoonoses and food safety. In practice, this requires information systems capable of connecting data on animals, products, microbiological testing, the environment, and human cases.

One of the most evident areas of intersection is that of foodborne zoonoses. EFSA and ECDC show, in their One Health reports on zoonoses, that monitoring zoonotic agents in humans, food, animals, and the environment provides essential information for reducing human cases.

In such situations, traceability enables: the identification of the products involved in an outbreak; the delimitation of contaminated batches; the localisation of the production or processing units involved; the correlation of contamination with animal-related or environmental factors; and the rapid withdrawal of products to prevent further exposure.

This intervention logic clearly illustrates how traceability is a practical expression of One Health. For example, if a pathogen present in products of animal origin reaches the consumer, the investigation cannot stop at the level of the final product. It must trace herd health, farm biosecurity, slaughterhouse conditions, processing hygiene, transport, storage, and distribution. Traceability provides precisely this causal thread.

Moreover, the specialised literature reveals that food systems and the One Health approach must be articulated together in

order to more effectively prevent and manage zoonoses. A systematic review published in 2024 on the link between food systems and One Health argues that a concerted approach improves the capacity to prevent current and future zoonoses.

Antimicrobial resistance represents another domain in which the connection between One Health and traceability becomes very clear. AMR is not exclusively a human clinical problem; it circulates through complex interactions among humans, animals, food, and the environment. WHO, FAO, and WOAH treat combating AMR as a major priority of the One Health paradigm.

Within the food chain, resistant microorganisms can circulate through products of animal origin, through water used in production, through processing environments, or through cross-contamination. Recent literature shows that the AMR problem within the food chain requires a multifactorial approach under the One Health umbrella.

Traceability is essential here because it enables: the identification of batches and sources associated with elevated microbiological risk; the correlation of laboratory results with specific production sources; the tracking of supply-chain history; and support for integrated AMR surveillance programmes.

Without traceability, data on antimicrobial resistance remains dispersed and difficult to interpret at the system level. With traceability, it can be associated with antimicrobial-use practices, types of holdings, processing conditions, and commercial circuits, enabling more targeted and more effective interventions.

In recent years, food traceability has evolved from predominantly administrative records to complex digital systems based on unique codes, integrated databases, sensors, the Internet of Things (IoT), artificial intelligence, and blockchain. Recent analyses show that modern traceability systems can play a critical role in preventing food safety crises, reducing uncertainty, and improving transparency.

From a One Health perspective, the major advantage of digitalisation is interoperability. Data on animal health, product batches, laboratory results, environmental parameters, and public health incidents can be integrated more quickly than in traditional systems.

However, technology alone does not resolve the system's problems. A digital traceability system is useful only if the data are standardised, complete, verified, and shared among the relevant stakeholders. In the absence of clear governance, digitalisation can produce large volumes of data but little real coordination.

The connection between One Health and traceability also has an important normative dimension. At the European level, traceability is embedded within the general framework of food legislation, being indispensable for risk management and consumer protection. The European Commission emphasises that it enables rapid responses to risks and promotes transparency.

At the international level, Codex and FAO recognise traceability as a tool within official control systems and product recall mechanisms. At the same time, FAO indicates that the food safety action track within the joint One Health plan aims to strengthen the risk-analysis framework for food safety and the participation of a wide range of stakeholders.

This institutional convergence is significant: it shows that traceability is no longer merely a compliance requirement for industry, but an element of public health infrastructure. It supports cooperation among veterinary authorities, food safety authorities, laboratories, public health institutions, and environmental agencies.

Despite its benefits, integrating traceability into a One Health paradigm faces several obstacles. The first problem is institutional fragmentation. Data on animals, products, the environment, and human health are often collected by different institutions, in non-uniform formats, which hampers integrated analysis. The second problem is the inequality of technical capacities. Large

operators can implement sophisticated traceability systems, while small producers face high costs and difficulties in adapting. The third difficulty concerns data quality. A traceability system is effective only if the information entered is accurate and up to date. Recording errors, the lack of common standards, or the absence of verification reduce intervention capacity. The fourth problem concerns governance and data confidentiality. Within the One Health paradigm, maximum utility arises when data flow across sectors, but this requires clear rules on access, interoperability, and the protection of sensitive commercial information.

Finally, there is also a conceptual challenge: traceability is often perceived narrowly, as a logistical or commercial tool. In order to effectively serve One Health, it must be conceived as public health and prevention infrastructure.

**Conclusions**

The connection between the One Health concept and food product traceability is profound and structural. One Health provides the theoretical framework that explains why food safety cannot be separated from the health of animals, plants, and the environment. Traceability provides the practical instrument through which these interdependencies become visible and manageable.

The paper has highlighted that traceability: supports the prevention and control of foodborne illnesses; enables more effective management of zoonoses; contributes to the surveillance of antimicrobial resistance; facilitates rapid withdrawals and recalls; strengthens transparency and accountability within the food chain; and creates the informational basis necessary for One Health governance.

Food product traceability must be understood not merely as a technical or legal obligation, but as an essential condition for the practical application of the One Health paradigm. In a globalised, complex food system exposed to multiple risks, the capacity to track a product "from farm to consumer" also becomes the capacity to protect human, animal, and environmental health in an integrated manner.

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