Attributes and frameworks for surveillance evaluation in veterinary public health: a scoping review

L. Martella[1] (liliana.martella2@unibo.it), F. Scolamacchia[2], P. Mulatti[2], G. Cattoli[2], C. Lupini[1], M. De Nardi[1]

[1] *Department of Veterinary Medical Sciences, University of Bologna, Ozzano dell'Emilia, Italy*
[2] *Istituto Zooprofilattico Sperimentale delle Venezie, Legnaro, Italy*

Summary

Evaluating disease surveillance is essential to ensure that systems generate valuable information efficiently. This scoping review provides a global overview of the attributes and frameworks used to assess veterinary public health surveillance systems over the past 15 years. A literature search conducted on PubMed and Scopus (2010–2025) identified 125 eligible studies. The surveillance systems were implemented worldwide, reflecting region-specific priorities in species and diseases under surveillance. We identified and analysed 67 evaluation attributes covering both commonly used and underutilized measures of system performance. Eighteen evaluation frameworks were documented; however, their applications remain limited, particularly in the animal health domain. Surveillance evaluation emerges as a globally relevant topic across human, animal, and One Health (OH) domains. These findings offer practical guidance for selecting attributes and designing future assessments.

Introduction

In veterinary public health, surveillance is defined as the systematic, continuous or repeated, measurement, collection, collation, analysis, interpretation, and timely dissemination of animal health data from defined populations (1). Regular evaluation ensures surveillance systems remain effective and informative for decision-making (2). Surveillance evaluation attributes were reviewed in 2009 during a workshop at the International Symposium on Veterinary Epidemiology and Economics (3) and further discussed with key experts at the 2011 ICAHS workshop (1). Subsequent reviews in 2012 and 2015 examined evaluation attributes, methods, frameworks (2), and approaches (4), providing recommendations that guided the development of new evaluation frameworks. To our knowledge, since 2015 there have been no further attempts to comprehensively describe surveillance evaluation attributes and methodological frameworks in place to assess surveillance in veterinary public health at a global level. This review aims to address this gap by examining evaluations conducted over the past 15 years, focusing on attributes and frameworks while investigating their application in real-world settings.

Methods

This study aims to identify the attributes and evaluation frameworks used to assess the performance of surveillance systems targeting animal infectious diseases and zoonotic diseases. This review followed the methodological guidance for scoping reviews developed by the Joanna Briggs Institute and the PRISMA extension for Scoping Reviews. PubMed and Scopus were searched using strategies adapted from Drewe et al. (2) and Graziosi et al. (5), limited to English-language publications from 2010 to 2025. Studies were considered eligible if they evaluated surveillance system performance using defined evaluation attributes or presented a framework incorporating such attributes. Evaluations focusing on animal infectious diseases or zoonoses were included. Systems related to aquaculture, entomological surveillance without animal/human involvement, environmental pathogen circulation, or antimicrobial resistance were excluded. Eligibility was determined through abstract screening and full-text reading. If a study evaluated multiple systems, data were collected separately for each system.

Results

Literature search
A total of 554 records were retrieved from PubMed and Scopus. After duplicate removal, 452 abstracts were screened, 118 full texts assessed, and 69 studies deemed eligible. Manual reference screening added 56 publications, resulting in the inclusion of 125 papers: 116 reporting evaluations of 157 surveillance systems, and nine describing evaluation frameworks.

Characteristics of the included surveillance systems

The identified surveillance systems were implemented across Europe (40.8%), Africa (19.1%), North America (15.3%), Asia (14%), Oceania (3.8%) and South America (2.5%). A small proportion spanned multiple continents (1.3%) or represented simulation studies without a defined location (3.2%). The number of surveillance evaluations published annually ranged from 4 to 23 (mean 10.4), with fluctuating trends until 2021, followed by a decline. Approximately one-third of surveillance systems targeted humans (34.4%), and 12.1% targeted both humans and animals. Among systems focusing on animals, 7.6% targeted multiple animal species, while cattle and poultry were the most frequent individual targets. Articles on human health surveillance mostly focused on Africa, Asia, and North America, whereas veterinary public health systems were mainly reported in Europe. The most common scenario involved surveillance systems targeting multiple diseases. The individual diseases most frequently reported included avian influenza, bovine tuberculosis, rabies, zoonotic influenza and African swine fever, among others.

Attributes and methods applied to evaluate surveillance systems

A total of 67 evaluation attributes were identified and grouped into five classes: organization, implementation, performance, impact, and OH approach. The number of attributes assessed per evaluation ranged from one to 24: 30.6% used one attribute, 21.7% used two, 19.7% used three to five, 24.2% used six to 10, and 3.8% used more than 10. Sensitivity and timeliness were the most frequently assessed attributes.

Sensitivity (52.2% of the evaluations) was predominantly applied in the evaluation of animal health surveillance and across various contexts, including operational surveillance systems, systems developed and tested through simulation modelling, and epidemic intelligence frameworks. It was used to assess early detection capability, to demonstrate freedom from infection and to evaluate cost-effectiveness, combined with cost. Timeliness (47.1%) measured time to detect outbreaks or cases, the ability to identify health events within preset time limits, delays from detection to notification, delays from detection to specimen submission, or on time receipt of reports. Its use was more common in human health surveillance. Other commonly used attributes include simplicity, usefulness, flexibility, acceptability, representativeness, data quality, cost and completeness. Cost (19.1%) was mainly assessed in animal or combined animal-human surveillance, typically estimating direct and indirect expenses. Cost-effectiveness analyses occurred only in animal health.

A wide range of methods were used to assess the attributes. Qualitative approaches, including key informant interviews and participatory methods primarily assessed implementation attributes. Quantitative methods, incorporating a range of mathematical and economic models, were employed to assess mainly performance and impact attributes.

Frameworks for surveillance evaluation

In total, 60 (38.2%) evaluations used frameworks specifically designed for surveillance evaluation. The most frequently applied framework was the “CDC’s Updated Guidelines for Evaluating Public health Surveillance Systems” (2001), primarily used in human health surveillance, particularly in Africa and Asia. Other CDC frameworks included the 1998 guidelines and the “Framework for Evaluating Public Health Surveillance System for Early Detection of Outbreaks”, which complements the Updated Guidelines by emphasizing early detection. The WHO “Early Warning Alert and Response Network in Emergencies (EWARN) evaluation protocol”, based on CDC’s guidelines, was used to assess EWARN systems in Africa and Asia, designed for emergencies. Similarly, the WHO “Guidelines for Evaluating a National Surveillance System” and the “National Technical Guidelines for Integrated Disease Surveillance and Response (IDSR)” were applied alongside CDC guidelines to assess IDSR systems and surveillance in refugee settlements. The “Communicable disease surveillance and response systems – Guide to monitoring and evaluating”, was used to assess a pilot surveillance app in Africa. These public health surveillance evaluation frameworks provide structured guidance and share common components, including defining the health event and evaluation scope, describing the system and objectives, assessing performance attributes, engaging stakeholders, and summarizing findings with recommendations.

Seven studies employed frameworks specifically developed for animal and veterinary public health surveillance, with OASIS being the most common. Other frameworks included the RISKSUR EVA tool, SERVAL, and Grosbois et al.’s rationale (6). Additional frameworks targeted specific contexts, such as syndromic surveillance systems (7) and hazard-specific livestock surveillance (8). Four studies applied OH oriented frameworks, primarily the “Network for the Evaluation of One Health (NEOH)”. Rivers et al. (9) proposed a model for output-based surveillance of zoonotic threats, while Babo Martins et al. (10) developed a conceptual framework to quantify the economic value of OH integration. Among non-empirical studies, additional frameworks were identified, including SurF, supporting biosecurity and animal health surveillance evaluations, and OH-EpiCap, assessing OH surveillance capacity.

Discussion

This review provides a comprehensive overview of attributes and frameworks applied to surveillance systems evaluations between 2010-2025, highlighting how performance is assessed and where methodological gaps remain. Surveillance evaluations were unevenly distributed across regions and domains, reflecting differences

in surveillance objectives and socio-economic contexts. Many systems targeted multiple diseases or syndromes, consistent with integrated surveillance approaches, while others primarily focused on zoonoses due to their regulatory and public health relevance.
Sensitivity and timeliness were the most frequently assessed attributes, consistent with previous findings (2), confirming their central role in determining surveillance capacity to detect health events and respond promptly. Sensitivity was more commonly evaluated in veterinary public health, where surveillance often supports regulatory objectives such as disease freedom. In contrast, human health surveillance placed greater emphasis on timeliness, simplicity and usefulness, reflecting operational priorities. Economic attributes were rarely assessed, despite their importance, particularly in animal health decision-making. Sociological attributes, especially acceptability, are key to system performance (4) but were also inconsistently evaluated, suggesting that stakeholders' perspectives are not yet systematically included in evaluations.
A wide range of qualitative and quantitative methods were observed. Observed patterns were largely consistent with the nature of the attributes. Combining qualitative and quantitative approaches remains relatively uncommon but offers added value by allowing comparison between perceived and measured system performance.
Evaluation frameworks ranged from general-purpose tools to specialised approaches. The CDC's Updated Guidelines remained the most widely applied, particularly in public health, highlighting their continued influence. Frameworks developed within the veterinary domain, though flexible across species and diseases, were applied less consistently, possibly due to lower awareness, perceived complexity, or insufficient training and dissemination rather than lack of relevance. The most common attributes in evaluation frameworks mirrored those used in studies, suggesting a shared core set (i.e. sensitivity, timeliness, simplicity, flexibility, representativeness, acceptability, and data quality) widely relevant across surveillance contexts. Differences across frameworks mainly concerned how evaluation components were defined and grouped, particularly data-related elements. Several attributes, such as risk-based criteria definition, training and communication were rarely applied. This likely reflects feasibility constraints rather than limited relevance. While some attributes, such as communication, may be broadly applicable (as in SERVAL, which treats communication as a primary attribute across all surveillance objectives), others are more contexts-dependent and should be selected according to evaluation objectives and decision-making needs.
Overall, these findings confirm that surveillance evaluation is globally relevant and highlight opportunities to broaden attribute selection and strengthen methodological integration.

Keywords: Surveillance systems, Surveillance evaluation, Evaluation attributes, Surveillance evaluation frameworks.

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