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Overcoming Barriers to One Health Surveillance Implementation

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Abstract

The zoonotic origin of the COVID-19 pandemic renewed calls for establishing and improving One Health surveillance capabilities globally, yet a lack of universally recognized best practices and clear guidance on how to implement coordinated surveillance across multiple sectors has hindered progress. Without shared surveillance goals, multisectoral data sharing policies and standards, and interoperable tools to aid the establishment and implementation of coordinated surveillance using a One Health approach, many countries are left piecing together systems together without a way to measure success. We have identified 3 priority components that countries should consider addressing and publishing examples of in order to initiate and document examples of successful coordinated surveillance planning and implementation: (1) shared surveillance goals, (2) multisectoral data sharing policies and standards; and (3) interoperable tools. These 3 components could serve as building blocks for the development of regional and global minimal One Health data standards for collection, sharing, and use of multisectoral data to address health threats from a One Health collaborative approach that efficiently minimizes human, animal, and economic costs of epidemics such as COVID-19.

Keywords

One Health; Coordinated surveillance; Data sharing

INCREASED NEED FOR A ONE HEALTH APPROACH TO SURVEILLANCE

THE COVID-19 PANDEMIC HIGHLIGHTED THE vulnerability of human and animal health surveillance systems when faced with an emerging zoonotic pathogen. Renewed governmental and nongovernmental organizations' investment into early warning alert and response (EWAR) for future pandemics^{1–5} recognizes the need for a multisectoral, One Health approach to help prevent, detect, and respond to these complex health events.^{6,7} However, implementing effective EWAR systems to support regional and global disease notifications is reliant on the accessibility of robust national and subnational systems. Coordinated surveillance provides a potential solution through leveraging existing systems across human, animal, and environmental sectors already operating within a country and establishes data and information sharing to enable planning, coordination, and implementation of surveillance processes. However, multisectoral approaches for coordinated surveillance are often complex and not readily understood or easily established. The multifaceted needs for coordinated surveillance were documented throughout the COVID-19 pandemic.⁸ For example, the animal health sector and animal populations benefitted from an improved awareness regarding zoonotic disease spillback from the human population, while environment sampling like wastewater testing provided an early warning for outbreak resurgence through population-level trend monitoring of disease spread and variant emergence.⁹

While the emergence of SARS-CoV-2 highlighted the importance of early detection of pathogens with pandemic potential from zoonotic hosts, millions of people grapple with a slew of endemic zoonotic infections, resulting in over 2.7 million deaths each year. Reducing the impact of these diseases requires improved cross-sectoral coordination, especially for water-borne, vector-borne, and neglected tropical diseases that already have established endemic zoonotic disease control programs.^{10–12} Implementing coordinated surveillance between human, animal, and environmental sectors is a way that communities, countries, and global regions can better understand and address numerous shared health threats like antimicrobial resistance, climate change, food security, zoonotic disease control, and pandemic prevention.^{9,11,13} However, in order to effectively implement these approaches, critical gaps need to still be addressed.

BARRIERS TO IMPLEMENTING COORDINATED SURVEILLANCE

Despite global interest, few published examples exist of what coordinated surveillance between multiple sectors looks like in practice; guidance is limited for how to best establish these capabilities at the national and subnational levels.^{14–17} The foundation of strong surveillance systems is a clear case definition, yet basic terminology for describing cross-sectoral surveillance remains ill-defined, being interchangeably referred to as One Health,^{11,14,16} coordinated,¹⁷ collaborative,¹⁸ or even integrated¹⁹ surveillance. While

country capacity assessments like the World Health Organization (WHO) mandatory States Party Annual Reporting and the voluntary Joint External Evaluation tool and associated benchmarks^{20–22} suggest that coordinated surveillance capacity for zoonotic diseases should be in place, the lack of a standard definition or clear way to measure this capacity makes quantifying and interpreting these outcomes difficult. This lack of standard terminology and common implementation goals has complicated the establishment of an evidence base for best practices that could be used by countries attempting to implement coordinated surveillance systems.

For the purpose of this manuscript, we use the term “coordinated surveillance” and “coordinated surveillance system” defined in the Tripartite zoonoses guide and operational tools as “a platform or system that allows for the collection, aggregation, and analysis of surveillance elements across multiple sectors collaborating at the human–animal–environmental interface, to enable them to work effectively together toward their aligned objectives and goals.”¹⁷

The lack of coordinated surveillance standards, policies, tools, and guidance inhibits successful and measurable implementation.^{23–26} At a minimum, we propose that successful implementation cannot be achieved without ensuring the following core components are in place across a country’s human, animal, and environmental sectors: (1) shared surveillance goals, (2) multisectoral data sharing policies and standards, and (3) interoperable tools (Figure).

Identify Shared Surveillance Goals

While coordinated surveillance is strongly recommended in several global and regional guidance documents^{13,27–29} as an ideal approach for strengthening EWAR to detect outbreaks or events of public health importance, establishing coordinated surveillance for other conditions may not be that straightforward, as each country has unique needs, infrastructural capacities, and health priorities.

Prior to making major investments in coordinated surveillance systems, stakeholders should consider pursuing a needs assessment to identify relevant programs that would benefit from coordinated surveillance. After the selection of priority diseases or conditions, stakeholders should establish a shared goal for coordination that also identifies the potential impact of the coordination, justifies the need to allocate or divert resources to this activity, and supports the original sector-specific surveillance goals.^{17,30,31} There may be inherent disincentives for rapidly and widely disseminating surveillance data for certain diseases and conditions, particularly those that can impact trade and travel—2 drivers of many low- and middle-income country economies. For example, the detection of avian influenza can have drastic impacts on poultry producers, which creates both a disincentive to share data as well as increased pressure to validate data prior to cross-sectoral notifications. For many conditions, sector-specific hesitation to share data may be well-founded, but establishing coordinated surveillance goals and conditions of data sharing may help alleviate these hesitations.

Implementing coordinated surveillance requires sustained technical and financial support from sectors that often face resource limitations, even in the most developed of countries.

Thus, efforts to establish such systems must have clear objectives and intended impacts. Countries need to define key data elements that can be incorporated into multiple coordinated surveillance systems, assemble the system based on common goals of the participating sectors, establish infrastructural capacity to operate the systems, and secure financial means to assure sustainability.

In theory, a single repository for all data, accessible by all relevant health partners, and designed in a manner that allows for early recognition of shared health threats may offer programmatic and cost-effective advantages.³¹ However, in practice, there are very few published examples and implementation of such systems for coordinated surveillance remains limited by practical barriers. Disease surveillance ideally starts at the community-level where events emerge and can first be detected.³² The design of such systems, including cross-sector coordination, must consider the impact, benefit, and goals to those who are operating these systems. Attempts at establishing coordinated surveillance should also consider aspects of operational research to address these knowledge gaps.

Establish Multisectoral Data Standards and Data Sharing Policies

Data Sharing Policies: Previously published surveys^{16,33,34} highlight that information sharing and data access across sectors are some of the most frequent challenges faced and the most difficult to improve, especially for real-time sharing of electronic data. Also, establishing equitable data sharing policies between relevant sectors is critical for functional, coordinated surveillance systems.^{16,35} These policies must consider that surveillance datasets often include sensitive information or data that can impact disease declarations, thus adequate safeguards should be in place to protect sensitive data. Additionally, differences in how surveillance data are collected often result in incongruities or misinterpretations that may bias or limit what interpretations and recommendations can be made. Therefore, it is important to ensure that multisectoral data sharing governance frameworks and policies are established to clarify what data are collected and its intended uses.^{26,36–38}

Establishing a data governance policy and architecture is also needed to ensure stakeholder alignment across different administrative levels and the designation of unique roles and responsibilities (Table).^{37–39} A multisectoral data sharing framework could be used to address coordination and harmonization of regulations on the sharing of One Health-relevant data from the human, animal, and environment sectors and alleviate sector specific data ownership, sovereignty, and privacy concerns.^{40–42}

Data Standards: Where examples^{12,16,29,43–47} of coordinated surveillance systems exist, a lack of detail regarding what information, specifically data elements, is being shared between sectors makes it difficult for other countries to replicate these published examples.³³ Oftentimes, the lack of similar data elements and reporting structures across sectors pose a challenge in designing interoperable architectures for information exchange and use, which has been outlined as a barrier to coordinated surveillance in several countries.^{33,38} This emphasizes the need for addressing minimal data standards and organizational alignment as part of a data sharing policy.

WHO and the World Organisation for Animal Health (WOAH) have mandates to produce minimum data standards and case definitions for certain diseases and conditions. These global organizations also maintain disease notification systems, through which member countries are mandated to report data for over 100 agreed-upon diseases, including many zoonoses.^{22,48–50} However, these minimum data standards and case definitions are still sector-specific, typically not aligned across sectors, and are often missing critical input from other relevant health sectors like those responsible for collecting and managing environmental related data. One example of where this has been done well for a specific disease is the United Against Rabies (UAR) guidance for standardized data elements, which provides a comparison of WHO and WOAH case definitions and data standards and proposes alignment between the two organization's data systems.⁵¹

Much needed regional efforts have begun to establish a One Health codex, or common definitions, data standards, and interoperability approaches, for coordinated surveillance^{23,33}; however, this is yet to be adopted more broadly. Any global efforts to establish a codex should consider the role of key international agencies, confirm alignment with existing criteria established by WHO^{21,22} and WOAH⁵² for mandatory reporting purposes, and ensure there is ample global socialization, recognition, and integration into ongoing and developing coordinated surveillance initiatives.

Develop Interoperable Tools

Coordinated surveillance is challenged by a lack of or limited use of common or robust digital tools across different sectors and at all levels of surveillance, with significant technological gaps between multisectoral stakeholders interested in implementing coordinated surveillance. The extent of adoption and use of digital tools for surveillance data capture, transmission, and storage vary among sectors with more being documented in the human health sector.^{38,53} Lack of unified multisectoral information technology policies, funding strategies, and varying technical capacities further worsen the existing technological gaps between the human, animal, and environmental sectors. This inhibits timely data sharing between sectors.

A common dilemma for countries adopting electronic surveillance systems for coordinated surveillance is whether to utilize and link existing national systems by adopting a universal data system or develop a custom-built fully integrated system.

Universal data systems are those that are designed to be open-access and flexible to support numerous diseases and conditions, irrespective of the sector. Perhaps the most prominent example of a universal data system is the District Health Information System (DHIS2), an open-source software that some ministries of health in low- and middle-income countries have adopted to collect and share their public health surveillance data. DHIS2 utilizes a common coding language that supports interoperability with numerous in-country systems and has numerous data modules for diseases that are reportable to WHO.⁵⁴ While its developers, users, and various partners are looking at how to expand existing functionalities to be more inclusive of animal and environmental sectors, these examples are not well published or described at present.⁵⁵

An example of a custom-built integrated system is the Rabies Exposure and Contact Tracing (REACT) app developed by Mission Rabies and the US Centers for Disease Control and Prevention in 2019.⁵⁶ REACT is not open access, unlike DHIS2, which helps to ensure conserved data elements, case definitions, and alignment among programmatic areas that use the REACT app but may be deemed too “inflexible” for some users. Systems like REACT are often designed to meet disease-specific needs, and with the exponential increase in access to smartphone devices and coding languages, these systems have the potential to play a major role in the future of coordinated surveillance by enabling the rapid integration of multiple datasets.⁵⁷

There are few examples of truly integrated surveillance platforms. The Electronic Integrated Disease Surveillance System (EIDSS) is one that has been established in several countries throughout Eastern Europe and Asia to improve data sharing between human and animal health related ministries.⁵⁸ Georgia published on the success of EIDSS; however, only public health data have been included in these analyses.^{59–61} An evaluation in Azerbaijan notes the need to link the system between sectors to initiate integrated surveillance.⁶² These outcomes indicate that even with the intention of a fully integrated system, data sharing and use may still be impeded. Additional considerations regarding fully integrated systems include that they may not be as flexible or responsive as other sector or disease-specific systems.

It is unlikely that any singular tool will serve the data needs of all sectors, across all prioritized diseases. Investment in identifying tools that can facilitate the linkage of data from multiple data collection systems may prove to be a more universally adaptable approach. Regardless of the tools identified, consideration for the community, national priorities, and the objectives of coordinated surveillance should drive the systems and tools that are utilized.

A WAY FORWARD

There are several resources that will soon be available that can inform countries on how best to approach implementing various aspects of coordinated surveillance to assist with multisectoral challenges. One Health operational tools like the *Surveillance and Information Sharing Operational Tool: An Operational Tool of the Tripartite Zoonoses Guide*¹⁷ now exist to help national and regional bodies assess current coordinated surveillance capacity for zoonotic diseases and provide advice on which tools may be the most appropriate to help address gaps. The One Health Zoonotic Disease Prioritization workshops are one example of promoting cross-sectoral discussions and aligning disease priorities.⁶³

For event-based surveillance efforts, the Africa Centres for Disease Control and Prevention event-based surveillance framework²⁸ highlights examples of how to incorporate a One Health approach into activities like media scanning and community-level surveillance. The 3rd edition of the WHO Regional Office for Africa’s Integrated Disease Surveillance and Response (IDSR) technical guidance⁶⁴ supports taking a One Health approach but focuses narrowly on reporting diseases solely within the human health sector. An associated IDSR table from the 2nd edition, which outlines the core functions and activities important for

public health sector surveillance by health system level⁶⁵ provides a potential template that could be modified to support coordinated surveillance given the universal nature of these listed activities across health sectors.

While many tools are currently available and more will assuredly be produced, published examples of successful coordinated surveillance systems are desperately needed. Until it is documented that these systems can be developed, utilized, cost-effective, and sustainable, coordinated surveillance will be relegated to global guidance documents and theoretical discussion.

CONCLUSION

Our hope is that coordinated surveillance becomes a routine way of implementing surveillance for complex health problems that require multisectoral collaboration. With the renewed global interest in cross-sectoral data sharing and implementing surveillance systems that can serve as an early warning prior to the next pandemic, investing in multisectoral data sharing policy, standards, and interoperable platforms needs to be an immediate focus. Coordinated surveillance should also reflect the needs of multisectoral disease programs, aligning goals while also maintaining respect for disease- and condition-specific programmatic needs. The key aligning factor of a coordinated surveillance system is that it minimally aligns with international data standards and case definitions set by One Health organizations and collaborative agreements like the Quadripartite⁶⁶ as well as other relevant bodies. Data sciences are progressing at a rapid pace, creating ample opportunities for countries to attempt to develop coordinated surveillance systems. However, documented case studies and tangible examples of coordinated surveillance are needed to better understand and replicate successful approaches. Without strategic investment, governments and regional bodies will continue to face significant challenges in implementing the coordinated surveillance solutions needed for effective One Health preparedness and response.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the US Centers for Disease Control and Prevention.

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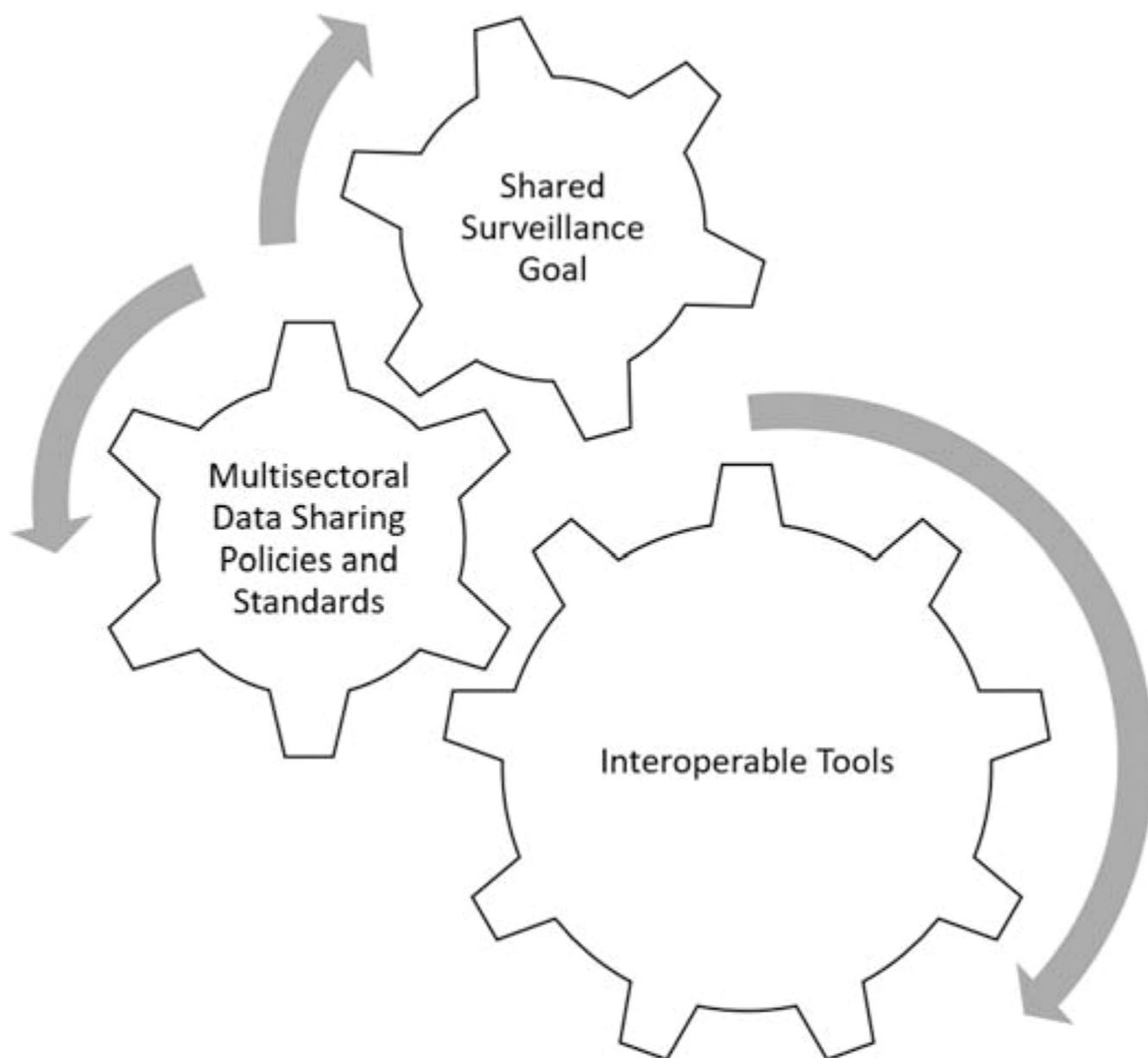


Figure.
Core components needed to establish a coordinated surveillance system.

Table 1.
Primary Roles of Key Stakeholders in Establishing an Effective Coordinated Surveillance Program

Coordinated Surveillance Hierarchy	Primary Role in Coordinated Surveillance
International agencies (eg. UNEP, WHO, WOA)H)	International agencies with the authority to establish case definitions and data elements should ensure case definitions are aligned across agencies (where applicable) and establish minimum data elements for international disease reporting.
Regional entities (eg. Africa CDC, AU-IBAR, ECDC)	Regional entities should support the dissemination of international standards and develop data platforms and guidance to reflect regional capacities and priorities. Additional data elements may be added, but international standard case definitions and data elements should be conserved.
National authorities (eg. government agencies responsible for human, animal, and environmental health; One Health coordinating bodies)	National authorities should establish data systems that facilitate the goals of the surveillance programs and, where applicable, enable timely and actionable coordinated surveillance across sectors. Additional data elements may be added, but international and regional standard case definitions and data elements should be conserved.
Subnational entities (eg. state, provincial, local, community)	Subnational entities should establish coordinated surveillance approaches that meet the goals of the surveillance system and ensure timely responses to qualifying events. Arguably, this is where surveillance starts and where the most important benefits of surveillance are seen. All higher-level entities in this hierarchy should consider the needs and abilities of subnational surveillance entities when developing recommendations and guidance. Additional data elements may be added, but international, regional, and national standard case definitions and data elements should be conserved.

Abbreviations: Africa CDC, Africa Centres for Disease Control and Prevention; AU-IBAR, African Union InterAfrican Bureau for Animal Resources; ECDC, European Centre for Disease Prevention and Control; UNEP, United Nations Environment Programme; WHO, World Health Organization; WOA, World Organisation for Animal Health.