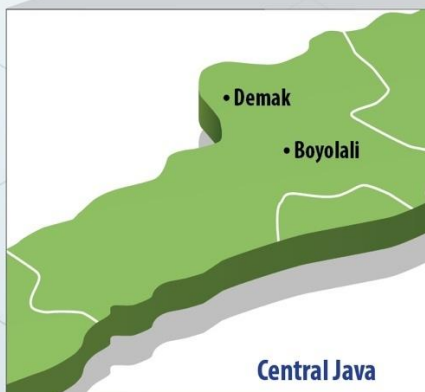


Community-based Surveillance (CBS) Review in Indonesia



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PREFACE

ABOUT AIHSP

The Australia Indonesia Health Security Partnership (AIHSP) is Australia's flagship bilateral program with the Government of Indonesia (GoI). AIHSP's overarching goal is to increase national health security in Indonesia so that women, men, and communities are at less risk of Emerging Infectious Diseases (EIDs), thereby contributing to Australian, regional and global health security as well as supporting sustainable economic development and food security in Indonesia. AIHSP works in partnership with the Indonesian Ministry of Health (MoH), Ministry of Agriculture (MoA) and other relevant agencies to achieve the following End-of-Program Outcomes: (i) stronger systems to prevent, detect and respond to public health and animal health emergencies and (ii) stronger coordination of responses to national, regional and global health threats. AIHSP promotes a One Health approach seeking to address risk at its core.

ABOUT THIS REVIEW

This review has been commissioned to inform Indonesia's future direction and implementation of community-based Surveillance (CBS). Its impetus was the issuing of Coordinating Minister for Human Development and Cultural Affairs' decree #7 in 2022, which instructed government agencies to extend the use of CBS to enhance the reach, outbreak detection and early warning function of national animal and human health infectious disease surveillance systems.

This review does not aim to evaluate the decree or any one CBS system. Rather, it aims to cast light on the utility of CBS as a surveillance strategy within the Indonesian context and provide advice for its future pragmatic, sustainable and scalable implementation. The report is intentionally succinct and recommendation focused. It is written with a decision-maker audience in mind. The review was conducted between September and December 2023 with field investigation undertaken in October and November.

AUTHORSHIP AND ACKNOWLEDGEMENTS

The authors of this report are Bambang Heryanto, Andrew Prasetya Japri and Adam Craig and the work was conducted on behalf of the Australia Indonesia Health Security Partnership (AIHSP).

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The authors wish to thank the numerous development agencies and government staff across Indonesia who so generously provided their time and insights during the consultation process. We make special mention of the contribution of John Leigh, John Weaver, Anung Sugihantono, Lea Suganda, Gita Nasution, Hartanto Hardjono, Agung Wahyuda, Denni Rajagukguk and Catherine Regina from the AIHSP team and Maggie Miller from The University of Queensland for their support.

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ACRONYMS

AIHSP	Australia-Indonesia Health Security Partnership
ASEAN	Association of South-East Asian Nations
CRBS	Community Reporting-based Surveillance
CBS	Community-based surveillance
COVID-19	Coronavirus disease
EBS	Event-based surveillance
FAO	Food and Agriculture Organisation of the United Nations
GoI	Government of Indonesia
G20	Group of 20
H5N1	Highly pathogenic avian influenza virus A(H5N1)
IBS	Indicator-based surveillance
IFRC	The International Federation of Red Cross and Red Crescent Societies
iSIKHNAS	Sistem Informasi Kesehatan Hewan Nasional
KEMENKO PMK	Coordinating Ministry for Human Development and Cultural Affairs
MoA	Ministry of Agriculture
MoH	Ministry of Health
MoHA	Ministry of Home Affairs
MoEF	Ministry of Environment and Forestry
PERMENKO PMK	Regulation of the Coordinating Minister for Human Development and Cultural Affairs
PeISa	Pelapor Desa
SATU SBM	Indonesian Red Cross community-based surveillance system
SIZE	Zoonoses and Emerging Infectious Diseases Information System
SKDR	Early Warning, Alert and Response System
TISIRA	Tim Siaga Rabies
WHO	World Health Organization

ABSTRACT

By engaging local communities, Community-Based Surveillance (CBS) aims to tap into firsthand knowledge and networks to quickly detect emerging infectious diseases at their source. This decentralised approach facilitates quicker responses, enabling the containment of outbreaks before they spread. Beyond its potential for early outbreak detection, CBS models can be leveraged to foster local responsibility for health security, leading to more engaged preparedness, prevention and responses.

The report's primary objective is to provide recommendations that promote the prudent and effective use of CBS to enhance animal and human health systems' capacity to detect events of outbreak potential (i.e., single, or small clusters of cases of concern) locally and quickly. It does this by assessing the adequacy of legislative instruments (i.e., laws, mandates, decrees and guidelines) that guide CBS in Indonesia, synthesising scientific literature on impactful and sustainable implementation and drawing insights from the field, identifying challenges and supporting factors for CBS implementation in Indonesia.

Recommendations for the effective implementation of CBS in Indonesia encompass several key considerations. First and foremost, it is crucial that CBS be positioned as an integrated extension of core all-hazards surveillance activities in Indonesia; this aligns with the One Health approach to which the Government of Indonesia (GoI) is committed and champions. This will require the dissemination of clear and practical guidelines to ensure consistent implementation of CBS strategies across Indonesia, with mechanisms to integrate data collected with routine surveillance practices, and clarify the delineation of ministerial roles and responsibilities. Additionally, these guidelines should comprehensively address the capacities, training and resource needs of CBS workers (whether they be volunteers, cadres, or others), coordinators and supervisors at the village level, while simultaneously ensuring that human resources within animal and human health agencies are adequately skilled and equipped to perform core surveillance tasks asked of them.

Moreover, the report advocates for the careful consideration and balance between 'preparedness' and 'response' with the 'detection' functions of CBS systems. It is imperative to clearly articulate and integrate the nationally mandated aims for CBS into the design of surveillance systems from villages right through to the national levels of government while also allowing local contextualisation and priority setting. The report also encourages the embrace of technology to expand the reach, stability and timeliness of CBS surveillance activities. The use of technology must consider end users' access and experience while guaranteeing interoperability and smooth integration of data collection with the government's broader health information management architecture.

The study concludes with a call for ongoing investment in coordinating efforts between central and sub-national government levels and across sectors to ensure that CBS implementation reflects the broader national health protection and One Health goals advocated for by the GoI.

BACKGROUND

WHAT IS CBS?

Epidemics begin and end in communities. Often outbreaks go unnoticed until many people in the same community become seriously ill. Community members are usually the first to know when a suspicious or unusual health event has occurred and so enabling and empowering communities to recognise and report public health threats earlier can save precious time, allowing responses to be mounted faster and potentially mitigate the impact of outbreaks through limiting their spread.

The World Health Organization (WHO) defines CBS as, ‘the systematic detection and reporting of events of public health significance within a community by community members [1].’ The Government of Indonesia (GoI) uses a much broader definition that encompasses community engagement for both the ‘detection’ of and ‘response’ to outbreaks and other public health events of concern [2].

The GoI’s intention for CBS is that it will (i) enhance existing human and animal health surveillance approaches and (ii) serve as a mechanism of ‘all-hazards’ and ‘new and emerging infections disease’ detection [2]. And that it will also (iii) engage and empower communities to take action to prevent, detect, report and respond to infectious disease threats. This report focuses on the core function of CBS; that is its function to ‘detect’ events of animal and human public health significance.

The review considers the application of CBS in both animal and human health domains. Despite clear distinctions between these contexts, points of intersection are evident. The term “surveillance systems” (plural form) describes both animal and human health surveillance activities, while differences are elaborated upon in the report. Moreover, the authors acknowledge that terminology used to describe similar activities and roles varies across sectors and locations. In this report, the term “CBS” denotes a systematic approach involving members of civil society for the collection and reporting of data, regardless of sector and the term “CBS worker” means community members (whether these are paid, receive a small stipend for their work or are volunteers)¹ engaged in CBS activities.

THE RATIONALE FOR THIS REPORT

Disease surveillance in human and animal health domains involves systematically collecting, analysing, interpreting and promptly communicating data to decision-makers and responders. Surveillance aims to monitor endemic diseases, assess control measures and identify emerging threats that could impact public health, animal health, welfare and trade. In animal health, surveillance extends to conditions threatening human health, even if not visible in the animals. Surveillance results should guide priority setting, shape prevention and control strategies and help assess the success of interventions. In animal health, they also verify the infection-free status of animals and their products. Ensuring that surveillance programmes are fit for purpose, sensitive and specific (i.e., can detect true outbreaks without excessive incidences of false positives), stable and timely is therefore paramount.

In the wake of COVID-19, the GoI reaffirmed its commitment to a whole-of-government and whole-of-community approach to bolster national preparedness for new and emerging infectious disease (EID)

¹ It is of note that in Indonesian, volunteerism manifests in various forms. These span from selfless donations of time without financial compensation – as exemplified by the Jogo Tonggo initiative in Central Java, where neighbourhood networks were established to coordinate the monitoring of health and social needs during the COVID-19 pandemic, and where religious organisations provide the motivation and mechanism for community-led service delivery – through to formalised roles within communities that are accompanied by a stipends – such as the network of task-oriented Cadres operating in villages and hamlets across the country. Regardless of monetary involvement, volunteerism, in all its forms, flourishes in Indonesia, serving a pivotal role in community cohesion and making a significant contribution to the nation’s development through the delivery of essential services and programs at the grassroots level, including those related to animal and human health surveillance and environmental protection.

threats. Central to this agenda was the development of legislative instruments (see below) that aim to stimulate activity and achieve a coordinated approach to human and animal health surveillance, placing communities at the heart of the issue. Specifically, the Coordinating Minister for Human Development and Cultural Affairs' decree #7 of 2022 [3] instructed government agencies to extend the use of CBS to improve the reach and timeliness of human and animal health infectious disease surveillance systems.

CBS is a surveillance strategy that has been widely promoted to enhance early outbreak detection goals. While, in theory, CBS seems straightforward, it is complex to implement and sustain and requires considerable investment to ensure its stable and smooth operation. Further, it must be noted that CBS is not a panacea for surveillance-related health protection. Due to the method's inherent lack of sensitivity and specificity, it should not be solely relied upon for detecting cases or outbreaks in animal or human populations. Rather, CBS should be seen as a supplementary surveillance approach that supports more robust and comprehensive surveillance strategies.

Drawing on evidence collected through document review, scientific literature review, field visits and key informant interviews, this report provides guidance for the prudent use of CBS in Indonesia. Specifically, the report aims to:

- Assess the adequacy of legislative instruments that guide the design and use of CBS in Indonesia.
- Synthesise evidence in the scientific literature related to what supports high-impact and sustainable CBS.
- Identify factors that challenge and support the implementation of CBS in Indonesia.
- Provide recommendations that support the prudent use of CBS in Indonesia.

METHODS

This review was conducted between September and December 2023.

Four strategies were used to collect data to inform the review. These were a review of scientific literature, policy analysis, field visits and interviews with key informants.

LITERATURE REVIEW

First, an unstructured thematic review of scientific literature using operators related to 'infectious disease,' 'surveillance,' 'outbreak response,' and 'community-based' was performed. Two databases - PubMed and Embase - and Google Scholar were searched for articles published between 2013 and 2023. The titles and abstracts of retrieved articles were reviewed and those relevant retained. Data was extracted from articles that were retained about the factors that enable and inhibit successful CBS implementation.

POLICY ANALYSIS

A systematic approach was used to identify and evaluate laws and regulations designed to govern CBS implementation in Indonesia. Firstly, consultation was held with ministries and their development partners to identify and obtain relevant CBS-related policy instruments. Subsequently, a predefined coding scheme was developed to support the extraction of content relevant to the review's aims. The selected policies were then reviewed, and data extracted. These data were explored using conceptual analysis to identify explicit content relevant to the review. When required, a checking back process with key informants to clarify meaning was undertaken.

FIELD AND REMOTE CONSULTATIONS

Field activities were conducted in Central Java and South Sulawesi (both AIHSP-supported provinces) with designers and implementers of six distinct CBS systems (**Table 1**). In addition, online interviews were

conducted with field operators of the Tim Siaga Rabies (TISIRA) CBS system operating in Bali. Four of the CBS systems were human health-focused, and three were animal health-focused.

KEY INFORMANT INTERVIEWS

In addition to interviews conducted during field activities, semi-structured informant interviews were held with key government and non-government stakeholders. This included representatives of AIHSP, WHO, the United Nations Food and Agriculture Organisation (FAO), International Federation of the Red Cross (IFRC), United States AID (USAID), US CDC, MoH, MoA, Ministry of Environment and Forestry (MoEF) and KEMENKO PMK.

ANALYSIS

Data collected was analysed using an inductive approach based on the work of Terry et al [4]. The approach involved iterative coding and categorisation of themes that emerged from the data. NVivo software was used to support this process. Findings that emerged from the analysis were validated through a 'check-back' process with informants.

LIMITATIONS

The report is not without its limitations. First, the review is based on data collected from CBS projects in provinces supported by AIHSP, potentially missing insights from other locations. Second, the lack of universally available and validated quantitative data led the review team to rely on qualitative views from project stakeholders, introducing possible bias. Third, due to logistical constraints, interviews with stakeholders from Bali were conducted via videoconference, potentially resulting in some overlooked nuances. Fourth, the CBS projects observed were initiated before the dissemination of some national guidelines. This timing might mean that these projects don't completely align with the national vision for CBS. These limitations should be kept in mind when interpreting the findings.

Table 1. Locations and summary of community-based surveillance projects visited during the review.

Province	District	Name of the system	Animal/human health	Summary
Central Java	Provincial level	Jogo Tonggo (Looking after your neighbours)	Human	Jogo Tonggo is a program instigated by the Central Java Province during the COVID-19 pandemic. It encouraged residents to return to traditional community support values and work together to support each other during the pandemic. It served as a key risk communication and social support strategy during the Pandemic. The Provincial Health Office in Central Java proposes to use this model as the basis for CBS.
	Demak	CBS for Leptospirosis vector control	Animal/Vector	The CBS system implemented by the District Health Office in Demak focused on community awareness raising and vector control to prevent transmission of leptospirosis, a priority disease for the community. The system does not include routine environmental monitoring (of mosquito prevalence/hotspots) or systematic cardinal sign/symptom monitoring and reporting mechanisms.
	Boyolali	Red Cross CBS initiative	Human	This CBS system was established in Siswodipuran Subdistrict before the COVID-19 pandemic and involves village volunteers actively seeking and reporting cases that display signs/symptoms of four priority zoonotic diseases. Surveillance data are routinely reported through a village coordinator to the Red Cross using a dedicated phone application SATU SBM. If required, the coordinator informally shares information with the village leader and puskesmas verbally or through a WhatsApp group. The volunteers also report unusual events and provide border community welfare support. The program is implemented by the Indonesian Red Cross with support from various donors.
South Sulawesi	Maros	Cadre-led CBS Puskesmas Tompobulu	Human	Villages cadres report suspected cases of noteworthy diseases to village midwives or the Puskesmas <i>Pembantu/Pustu</i> , who assess the information and, if deemed necessary, report it to Puskesmas Tompobulu. None of the cadres have received training and there is no evidence that case definitions are being used. While reporting processes seem well understood protocols or standardised procedures to guide reporting were not evident.
		Red Cross CBS initiative	Human	Two villages, Tanete and Semangki, implement a simpler CBS system than that seen in Siswodipuran Subdistrict, Boyolali, but with a broader range of diseases under surveillance. Volunteers report CBS data using the Red Cross's SATU SBM phone application. We learnt that the same CBS model is being applied in 101 other villages in Maros by the District Health Office and leveraging health cadres. These cadres report the data they collect through a MoH phone-based application (not SATU SBM).
		PelSa/ <i>Pelapor Desa</i> (village reporter)	Animal	Community PelSa volunteers undertake active and/or passive surveillance for animal diseases near their villages. They report disease incidents to the sub-district health office assess and respond. Puskesmas staff in the site visited report being outside of the PelSa reporting system.
Bali	Buleleng	TISIRA (rabies preparedness team)	Animal	TISIRA was established in response to the high incidence of rabies in Bali. The TISIRA system engages community members to report rabid dog sightings to a puskesmas, who may then request the community member to track and/or monitor dogs' health. After liaison between the local puskesmas and puskesmas, the community members may also be engaged to support public risk awareness raising, dog vaccination promotion and the encouraging of prompt action after a dog bite. The activities are supported using village budgets.

RESULTS

INDONESIAN LAW AND REGULATIONS REGARDING CBS

Indonesia has long shown leadership in advancing national, regional and global health security. The GoI has played a pivotal role for decades, contributing significantly to the revision of the International Health Regulations in 2005, taking a leading role in the south-east Asian region's battle against avian influenza since the 2000s, leading the design and execution of the Global Health Security Agenda's action packages in 2016, championing the G20 Lombok One Health policy brief of the Indonesian G20 presidency in 2022 and chairing the ASEAN One Health agenda in 2023, among other notable achievements. Throughout this period, the evolution of laws and regulations concerning health security, particularly surveillance for new and emerging diseases, has been marked by a concerted effort to enhance capacity to prevent, detect and respond to emerging threats at the provincial and sub-provincial levels. The tragedies of the COVID-19 pandemic underscore the need for persistently investing in health security and has served as a catalyst for substantial reforms seen in this area in Indonesia in recent years.

Figure 1. provides a timeline of milestone events that have shaped Indonesia's health security (specifically new and emerging disease surveillance) frame.

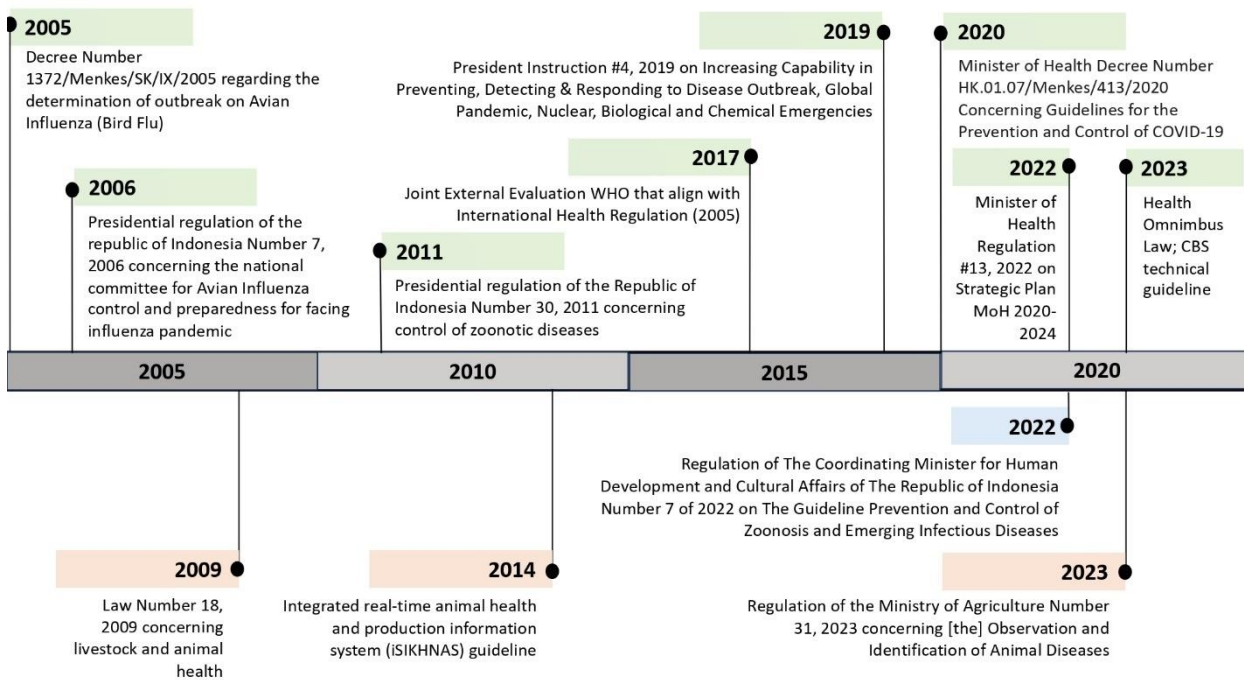


Figure 1. Timeline of milestone events that have shaped health security in Indonesia, 2005 to 2023.

Through consultation with relevant ministries and their development partners, we identified eight key national governance instruments that direct the implementation of CBS in Indonesia. These are:

- Health Omnibus Law, 2023 [5].
- President Instruction #4, 2019 on Increasing Capability in Preventing, Detecting and Responding to Disease Outbreak, Global Pandemic, Nuclear, Biological and Chemical Emergencies [6].
- Regulation of Coordinating Ministry for Human Development and Culture (PERMENKO PMK) #7 (2022) on Guidelines for the Prevention and Control of Zoonoses and Emerging Infectious Diseases [3].

- Law of the Republic of Indonesia on Livestock and Animal Health, #18, 2009 [7].
- COVID-19 Transition Plan (draft) [8].
- CBS Guidelines for Public Health, 2023 [2].
- Regulation of the Ministry of Agriculture #31, 2023 concerning [the] Observation and Identification of Animal Diseases [9].
- iSIKHNAS Guidelines, 2014 [10].

These legal instruments are operationalised locally by community stakeholders including district and sub-district health and agriculture authorities, Puskesmas and Puskesmas staff, local governments, heads of villages and implementing partners.

HEALTH OMNIBUS LAW OF 2023

On 11 July 2023, Indonesia's House of Representatives (*Dewan Perwakilan Rakyat Indonesia*) approved a new draft health law. A month later, the President enacted Law #17 of 2023 on Health (known as the Health Omnibus Law). The Health Omnibus Law broadly contains provisions on pharmaceutical preparations, medical devices, healthcare services, healthcare technology and research and development. The Health Omnibus Law supersedes 11 previous laws and introduces several new provisions.

In relation to CBS, at least six articles of the law instruct central and local government agencies to engage the community in implementing health programs and activities, including those designed to prevent, control and eradicate infectious disease, and to be responsible for the consequences they cause. Specifically, the law requires "systematic surveillance and continuous observation" to be undertaken and that funding for such be provided by central and local governments.

PRESIDENTIAL INSTRUCTION #4 OF 2019

Presidential Instruction #4 of 2019 aims to enhance Indonesia's capabilities in preventing, detecting and responding to a spectrum of challenges, including diseases, outbreaks, global pandemics and nuclear, biological and chemical emergencies, all of which bear implications for both national and global security. This directive designates KEMENKO PMK to lead coordination among relevant ministries and agencies at the national level. On the operational front, the instruction tasks the MOH with augmenting surveillance capacities to identify potential health emergencies, including enhancing scrutiny of international points of entry. Additionally, the directive prompts the MoH and MoA to conduct surveillance for antimicrobial resistance and food safety. Addressing the fiscal dimension, the instruction mandates the Ministry of Finance to allocate budgetary resources to ensure the effective realisation of its objectives [4].

The National Action Plan for Health Security (NAPHS, 2020-2024) [11] was developed as a recommendation for implementing the Joint External Evaluation and as an effort to implement Presidential Instruction # 4 of 2019. The Action Plan includes guidelines for collaboration across relevant ministries' health security programs. The NAPHS is an important strategic document as a seminal reference used by Governors, Mayors and Regents when preparing their health security development action plans, as per the requirement to do so outlined in Presidential Instruction #4 of 2019.

PERMENKO PMK #7 OF 2022

Following the drafting of the NAPHS KEMENKO PMK released Guidelines for the Prevention and Control of Zoonoses and Emerging Infectious Diseases #7 in 2022 [5]. These guidelines mandate collaborative efforts among KEMENKO PMK, relevant ministries (notably the MoH, MoA, Ministry of Villages and Ministry of Home Affairs [MoHA]), sub-national governments (province/district/municipality) and communities to enhance the control of zoonoses and emerging infectious diseases (EIDs). The guidelines align with the National Health System Reformation Agenda (BAPPENAS) [12] and the primary healthcare

strengthening objective outlined in the MOH Health Transformation Plan [13]. KEMENKO PMK proposes that puskesmas be the focal point for coordinating One Health activities at the local level.

LAW OF THE REPUBLIC OF INDONESIA ON LIVESTOCK AND ANIMAL HEALTH #18 OF 2009

The Law of the Republic of Indonesia on Livestock and Animal Health #18 of 2009 was issued during a time when Indonesia faced numerous H5N1 (avian influenza) outbreaks. The law stipulates the need for observation, identification, prevention and implementation of biosecurity, for the eradication of infectious animal diseases and for the prevention of priority zoonotic diseases. The law mandates central and local governments to work together to empower communities to improve farming practices and disease reporting with the intent of improving health and economic security for all. This law serves as the legal foundation for TISIRA and PelSa, respectively [7].

GUIDELINES FOR IMPLEMENTING COLLABORATIVE SURVEILLANCE AFTER THE COVID-19 PANDEMIC

As COVID-19 became endemic in Indonesia and the national response shifted from a focus on containment to the promotion of safe continuity of social functions, outbreak early warning surveillance systems recommenced all-hazards reporting, primarily through the Early Warning, Alert and Response System (SKDR). Guidelines for implementing collaborative surveillance after the COVID-19 pandemic include specific objectives for community participation for localised risk assessments and control of risk at the source. These guidelines reference the Law of Health #17, Presidential Instruction #4 and Permenko PMK #7 [8].

MINISTRY OF HEALTH CBS GUIDELINES

The Ministry of Health issued CBS guidelines in 2023. These guidelines promote CBS as a strategy to enhance SKDR by increasing the reach, volume and timeliness of data being captured. The guidelines emphasise the role communities play in implementing surveillance, highlighting the need to be mindful of local context, insights and wisdom in the design of community-focused interventions.

The guidelines describe the roles, responsibilities and core competencies village CBS workers ought to have, and the training and supervision they ought to receive. It is noted that the guidelines were released in 2023 (relatively recently) and hence have not influenced the formulation or implementation of all CBS projects—including those examined as part of this review—in Indonesia. The guidelines are expected to become a seminal reference for the operationalisation of CBS at the local level [2].

REGULATION OF THE MINISTRY OF AGRICULTURE #31 OF 2023 CONCERNING OBSERVATION AND IDENTIFICATION OF ANIMAL DISEASES

In relation to animal surveillance, MoA Regulation #31 of 2023 states that efforts to detect cases of outbreak-prone, new and re-emerging animal diseases, and exotic animal diseases should be carried out continuously and, if such diseases are identified, immediate action be taken. Surveillance methods proposed include community-based reporting, negative reporting, routine syndromic surveillance and zero reporting, sentinel surveillance and aggregation hot-spot cluster surveillance.

Specific to community-based reporting, attachment 1 to the Regulation describes the method of Community Reporting-based Surveillance (CRBS) with incidence of disease in animals expected to be reported by the public, breeders, business owners in the marketing chain and veterinary authorities [9].

iSIKHNAS

iSIKHNAS was established in 2014, before the issuing of MoA's regulation #31 of 2023. However, most technical aspects of the surveillance, including the iSIKHNAS reporting system, have been accommodated

into the MoA's regulation #31, 2023. The CBRS guidelines provide direction for policymakers, veterinarians and health workers engaged in surveillance activities under the iSIKHNAS framework. PelSa serves as the manifestation of animal health CBS in Indonesia, with surveillance signals generated to animal health authorities after receipt of an alert by a community member/farmer/local authority [10].

WHAT THE LITERATURE SAYS ABOUT CBS

This section of the review synthesises scientific literature to identify what has been written about making CBS for monitoring infectious diseases in human and animal populations successful. The factors for success generally fall into four categories: (i) CBS workers, (ii) community engagement, (iii) case detection and reporting and (iv) integration with wider surveillance systems.

CBS WORKERS

The literature reveals that CBS workers play a multifaceted role, not only responsible for active case detection and reporting but also - on occasions - engaged in tasks such as referrals, follow-ups, health promotion and even physical examinations and testing [14, 15]. The success of CBS is closely tied to community acceptance of CBS worker and that workers are nested within an existing emergency response system that, itself, had good acceptability [16].

Success was also attributed to maintaining high motivation among CBS workers who described their motivation in terms of 'contributing to the health of the people' and 'the giving of service to the community' [14, 17-19]. While the provision of material incentives (in the form of funds to cover time and out-of-pocket expenses) [14] was noted as important for motivation, so too was access to opportunity to increase knowledge through training [15], a sense of camaraderie among CBS workers, a shared sense of responsibility for outcomes [17] and program ownership [14]. Understanding deterrents to report is not straightforward and differs across sectors. In the animal health domain, for instance, the literature reports that concern for the social and/or economic consequence associated with reporting sick animals was a major deterrent for farmers to raise an alert, whereas stigma and social isolation was seen as an issue in the human health systems.

The depth of relationship and proximity of CBS workers to their communities was noted as beneficial, contributing to increased disease cluster detection in Vietnam [19] and improved overall case detection in the Dominican Republic [17]. Similarly, CBS workers' proximity to pastoralist communities in Ethiopia was cited as advantageous allowing them to spend time where pastoralists congregate (e.g., wells or water collection areas, mosques and marketplaces) to build trust and collect intelligence [20].

Dedicated supervision and mentoring of CBS workers are identified as key influencers of success in both animal and human surveillance systems [15, 21-23], as is the provision of training [15, 18, 19, 21, 24, 25], impacting both worker motivation and the overall quality of data collected. Frequent training was noted as especially important in low transmission settings where opportunities for skill application and the feeling of making a meaningful contribution, as a result, are limited [15].

Allport and colleagues (2005) reported that the shift to engage and support community-based animal health workers in disease surveillance in Tanzania resulted in a 49% to 118% increase in case reporting in intervention regions and a 17% increase nationally, and that the national epidemiology unit was able to achieve the World Organisation for Animal Health's surveillance target [26]. A similar picture was seen in Indonesia after introducing the iSIKHNAS system [27].

COMMUNITY

Several success factors are associated with the interaction between the CBS system and the community. Communication, engagement and community ownership are the most frequently mentioned elements

contributing to CBS's success [16, 25, 28]. Notably, community ownership [21] and involvement were reported as essential to ensure reliable, stable and complete reporting [17, 19, 21, 22]. The adoption of context-appropriate communication and case reporting strategies was noted as important to both build trust for reporting and to facilitate timely data collection and transfer [16, 25, 28]. In Ethiopia, for example, CBS workers facilitated village coffee ceremonies to solicit reports of Acute Flaccid Paralysis and discuss related signs, symptoms and reporting procedures [20]. Moreover, the engagement with community leaders in the design and implementation of CBS was associated with various programs' success, including programs in Vietnam [19], South Sudan [21], the Dominican Republic [17] and Sierra Leone [22].

The active involvement and encouragement of diverse community informants, such as money lenders, insurance agents, teachers, landlords, factory managers and community leaders were viewed as advantageous for human health [19], and the engagement of experienced farmers, animal health workers (whether volunteers or private providers) and animal stock agents benefited animal health CBS systems [29]. This approach broadened the sources of reporting, leading to the identification of signals that might have otherwise been overlooked. In Nigeria, a substantial positive correlation was observed between CBS workers satisfaction and the completeness of disease notification [20]. Additionally, Field interviews conducted in South Sudan highlighted the value of having a critical mass of community volunteers to their sense of purpose and motivation [21].

CASE DEFINITIONS AND REPORTING

Achieving success in data collection demands that: clear and implementable surveillance case definitions are in place [24]; CBS workers are trained; data quality assurance procedures are in place [30] and the practical utilisation of CBS data for swift, real-time, data-driven decision-making is evident [19, 30, 31]. Crucially, a system's effectiveness hinges on ensuring that the collected data brings tangible value to those who are collecting and reporting it (i.e., CBS workers and officers of local animal and human health agencies). For facility-based staff, this entails processing data in a way that allows them to do their jobs more efficiently (i.e., providing localisable dashboards and trigger-based decision support/advice), while community members may seek additional non-surveillance-related information, such as treatment advice for sick animals or guidance on home-based care.

It is important to highlight that the most frequently observed driver of CBS's success in both animal and human health domains was the simplicity of data collection and reporting processes [18, 24]. Emphasising simplicity, tools that collect a minimal set of data required, applying obvious case definitions and having clear and simple reporting processes that didn't overburden CBS workers tended to be associated with streamlined reporting, enhanced case identification and a reduction in the proportion of false alerts [18, 30].

While acknowledging the challenges associated with technology in data collection and reporting, it is noteworthy that technological solutions have been recognised as effective to reduce reporting obstacles [32-34]. The World Health Organization (WHO) also emphasises technology as a critical factor for enhancing the early detection of suspected cases in a CBS system [30]. It is essential to highlight that technological systems employed for CBS require substantial external support for both establishment and maintenance [25, 30] and that there is a paucity, particularly in the animal health sector, of information technology expertise [32, 35].

INTEGRATING CBS WITH BROADER SURVEILLANCE ACTIVITIES

Efficient vertical integration (i.e., integration of the reporting pathway from communities to local animal or human health facilities and into a regional/national surveillance system) and lateral integration (i.e., between a CBS system and other infectious disease/early alert surveillance systems at or near the same

operational level [laboratory systems, rumour surveillance systems] are identified as critical to long-term success.

In terms of vertical integration, the establishment of clear reporting pathways from communities to CBS has demonstrated improvements in timeliness, completeness and stability in diverse regions such as Cameroon [16], Ethiopia [23] and Vietnam [19]. The importance of widespread mobile phone coverage and the proximity of health posts to communities has ensured the regular reporting of suspect cases by CBS and health extension workers [23]. The COVID-19 situation underscored the value of leveraging pre-existing and functional vertical surveillance integration, avoiding the structural challenges of establishing a de novo reporting process during an emerging crisis [36]. While this is an example from the human health sphere, the principles are equally relevant to the animal health sector, where friction-free data transfer between levels of animal health has aided timely analysis and response to emergent issues.

Lateral integration, characterised by collaboration between CBS and other locally implemented surveillance processes and systems, has proven to be more manageable, sustainable and effective. A successful One Health surveillance system in Ghana is attributed to close collaboration between the Ghana Health Service and the Veterinary Services Directorate [16]. Similarly, the simplicity of the CBS system in Cox's Bazar, Bangladesh, reportedly facilitated easy integration with other aspects of the surveillance system, such as the World Health Organization's Early Warning, Alert and Response System [31]. Notably, the dedication of human resources to manage integration is recognised as a key enabling factor [31].

CHARACTERISTICS OF INTEGRATED 'ONE HEALTH' SURVEILLANCE

The concept of One Health (OH) promotes the decompartmentalisation of human, animal and ecosystem health for the more efficient and sustainable governance of complex health issues [37, 38]. This means that traditional boundaries between disciplines and sectors must be transgressed and that all relevant stakeholders must be involved in the definition and management of health problems.

International efforts have been made to strengthen collaboration across sectors and disciplines and One Health surveillance is strongly encouraged to efficiently manage hazards involving humans, animals and ecosystems. Nevertheless, uncertainty regarding the practical application, outcomes and impacts prevail. Bordier and colleagues (2020) suggest that this is due to the lack of a conceptual and methodological framework to define the characteristics of OH surveillance and to provide advice on appropriate mechanisms for inter-sectoral and multi-disciplinary collaboration to ensure that the surveillance system performs well and meets all parties' needs. Using literature, the authors define the organisational and functional characteristics of a One Health surveillance systems, and factors that may obstruct or support their implementation and performance [29].

Bordier et al (2020)'s review of 41 different systems found that collaboration takes place at the governance level for the coordination and management of surveillance systems and at the operational level for the implementation of surveillance activities.

Factors that positively influenced the implementation and functioning of a collaborative surveillance system included: the existence of an over-arching framework to ease collaboration across sectors (such as a law governing collaboration and an inter-ministerial working party to guide action); the existence of an appropriate legal or institutional framework (such as an inter-ministerial circular that describes the roles and responsibilities of each party and provides a legally binding agreement between sectors for data sharing); preferential relationships between individuals working in different sectors; and the supervision, by the same authority, of sectors in charge of surveillance components. Other favourable factors include: a high level of commitment from stakeholders at the political and operational levels; appropriate communication and consultation channels to maintain broad engagement in and enthusiasm for the system; demonstrable evidence of the efficiency and effectiveness of the approach; and technical factors

– such as joint databases, ease of data exchange, common dashboards and access to functional laboratory services – that facilitate quality surveillance practice.

Conversely, lack of structure and mandate, lack of standardisation and harmonisation for data collection, incomplete data, difficulties sharing data across sectors, incomplete multi-domain data analysis and ambiguous interpretation were highlighted as barriers to collaboration.

The review also found evidence of collaborative One Health surveillance through use of public-private partnership models within, but also across, sectors. For instance, in Canada, veterinary pharmaceutical companies, as well as private veterinarians, collaborate within the national surveillance system for antimicrobial resistance monitoring among animals [39, 40].

FINDINGS FROM FIELD VISITS, STAKEHOLDER DISCUSSIONS AND KEY INFORMANT INTERVIEWS

The review team had the privilege of meeting staff and stakeholders of seven CBS projects (four human health and three animal/vector health focused) during field visits to Central Java and South Sulawesi and during extensive (1.5 days) videoconference meetings from one CBS project (TISIRA) from Bali (**Table 1**). All the CBS projects examined were implemented prior to the dissemination of MoH’s CBS Guidelines 2023 and the MoA’s Regulation #31 of 2023 and hence tended to take direction from other sources. The national dissemination and orientation to PERMENKO PMK #7 of 2022 is due to occur in 2024.

This section of the report summarises insights derived from the field activities. The section is presented as 11 emergent themes. This content relates with aim two of this review and, together with the above-reported findings, has informed the recommendations.

THEME 1. WHILE EXISTING LEGAL INSTRUMENTS (THE LAWS, REGULATIONS AND GUIDELINES) HAVE PROVIDED THE IMPETUS AND SCAFFOLDING FOR CBS THERE REMAINS A GAP IN GUIDANCE FOR THE CONSISTENT OPERATIONALISATION OF THE APPROACH

In the broadest context and while still in the nascent phase, the laws and decrees associated with CBS are pivotal in establishing a structured framework and driving collaborative and common health protection goal-oriented action at higher government echelons. These instruments have been crucial in structuring Indonesia’s overarching CBS principles and governance architecture. Notably, leaders down to the sub-district level rely on these legal frameworks for direction, displaying a reluctance to deviate from the stipulations outlined in them. We found that the national intention for CBS has not always been effectively disseminated to (or translated into practical guidance for) technical and implementing agencies at the sub-national level, and that knowledge of the legal instruments that are intended to frame the CBS system’s roll-out are scant at the local level. This lack of familiarity was observed among puskesmas and puskesmas staff and village administrators, who cite that they rely on guidance provided by their counterparts at the sub-district level or from technical partners for design guidance. This observation is pertinent as it highlights the need to supplement national laws and directions regarding the use of CBS as a strategy to enhance all-hazards responses with practical guidelines (directives, guidelines, procedures) that are both operational and relevant at the local level.

Further, our field observations reveal that the orientation of a local CBS system is driven by three other factors: the mandate of the ministry leading the CBS intervention; the interests of local stakeholders; and the willingness of village administrators to engage in the project. While these drivers are perhaps expected, the fact that they were repeatedly reported to the review team is further evidence that suggests that the overarching aims for CBS as an all-hazards health security measure may have been lost. This observation was particularly conspicuous in human health-related CBS systems, where a significant portion of the systems observed focus on specific or restricted disease categories. Authorities recognise this limitation, as evidenced by a statement from an employee of the Directorate of Surveillance at the Ministry of Health: “... ideally, CBS workers would be trained to use broad all-hazards unambiguous

syndrome-based case definitions and report the number of observations that meet each case definition on a routine basis; I don't think this is what is happening."

A passive surveillance system relying on voluntary community or farmer-based reporting of illnesses cannot be solely steered by top-down legislative or government-run programs. It must actively enable and empower, substantiating its value to those pivotal to its operation—community members, farmers, village volunteers and local staff responsible for data collection and reporting. Understanding, enhancing and emphasising the professional (such as improved data quality for decision-making and attainment of local health protection goals) and personal benefits (including safeguarding family health and social recognition) to individuals is crucial for a CBS system's success. This may be done through the distribution of aggregate reports that include data provided by CBS workers, contacting CBS workers to verify and seek clarification, instigating investigations stemming from CBS workers' notifications and linking reporting with practical and relevant clinical, animal health or behavioural advice. In essence, it's about ensuring that those reporting comprehend and witness the tangible benefits arising from their effort.

THEME 2: THERE IS A NEED TO ENSURE CBS SYSTEMS ARE DESIGNED TO BE AN EXTENSION OF CORE GOVERNMENT-LED ANIMAL AND HUMAN HEALTH SURVEILLANCE ACTIVITIES AND ARE NOT STAND-ALONE PARALLEL ACTIVITIES

Through our extensive interviews with stakeholders across all levels, a consistent message emerged: passive surveillance cannot be driven from the top down and any initiative to broaden surveillance through CBS must augment the capacity of national systems and should be sustainable within budgetary, human resource and logistical constraints without imposing undue burdens on potentially fragile surveillance mechanisms. Despite this imperative, our findings highlighted instances of CBS initiatives inadvertently bypassing national surveillance governance, surveillance priority setting, funding and data transfer and reporting processes.

For instance, we uncovered situations where parallel phone applications were concurrently employed in the same district to report CBS data. One application transmitted data directly to local authorities, while the other, routed through an implementing partner, introduced delays to the system's timeliness, assumed responsibility for analysis and sidelined local health authorities. In another case, a CBS system primarily focused on behaviour change communication and disease prevention activities rather than early event detection, potentially missing the point of CBS. Parallel reporting is not unique to CBS or the human health sector and is ubiquitous throughout Indonesia. Its importance lies in the complications and susceptibility to data loss that arise from parallel reporting, making data collation and curation more cumbersome and delaying the production of useful information. Moreover, the practice of parallel reporting poses a potential threat to the authority of the national government-led information management systems and potential violations of national data stewardship and confidentiality laws.

The constrained animal health workforce and infrastructure at the community level, especially in contrast to human health resources (illustrated by, for instance, a ratio of approximately one puskesmas for every six puskesmas, although this varies greatly across Indonesia depending on human and animal population densities, government strategy and resource availability [41]) underscores the distinct operational landscapes of each sector. This disparity brings into focus the need for divergence in the functioning dynamics across the sectors. For animal health and human health sectors alike, this observation underscores the necessity for top-down regulations and standards to establish a framework for CBS operations while emphasising that this model must be inherently collaborative and adaptable to ensure that implementation is practical and valuable for those in the field.

THEME 3: WORKFORCE AND DATA SYSTEMS ARE AT THE CORE OF FUNCTIONAL CBS SYSTEMS AND THEIR DEVELOPMENT SHOULD BE A FOCUS OF FUTURE EFFORTS

WORKFORCE

As the literature emphasises, CBS workers (whether paid, assigned additional duties as part of another role, or volunteers) are pivotal contributors to a system's functionality, stability, sensitivity and overall success. Consequently, comprehensive training and ongoing support are imperative for CBS workers to execute their responsibilities rigorously. This sentiment echoed in our field observations and interviews, where participants consistently underscored the need for structured, tailored training for CBS workers and continuous mentorship to ensure adherence to best practices. One interviewee articulated, "we want to do the right thing and report what is correct and useful. But we need more training in how to do this, and to have someone to whom we can go to ask for clarification."

Our findings indicate that while the initial training provided to CBS workers was beneficial, it needs to be repeated regularly as CBS worker turnover is high. It was noted by CBS worker that there was a lack of external mentorship and monitoring to verify the appropriateness of their practices. Illustrating this, one interviewee remarked, "It can be a bit like the blind leading the blind here. We do what we think is right but don't know and no one seems to check up on us." Further investigation is required to determine if this is a common experience.

Critical to effective training is understanding the tasks, methods and responsibilities that parties are expected to perform; this, as discussed elsewhere, is not always clear. Clarity necessitates developing and implementing well-articulated and agreed-upon implementation protocols for surveillance and reporting, communications and joint (i.e., animal-human health sector) investigations.

Workforce development needs to extend beyond data collection, with CBS coordinators - village workers, puskesmas or puskesmas staff, or an NGO - currently required to perform relatively complex tasks to screen reports received from CBS workers to determine whether they should be escalated. Some consider it inappropriate for a non-professional to be expected to perform this task, suggesting that CBS workers' responsibilities be limited to applying basic case definitions and reporting count data to a relevant agency (such as a sub-district animal or human health officer) who is skilled and able to perform the required analysis. This is exemplified by the comment of a cadre interviewee who said, "we are not professionals and shouldn't be expected to carry the responsibility of making clinical decisions about whether a person or animal has a disease. This is too much responsibility; what if we get it wrong."

All suggest that CBS activities should be protocol-driven and not rely on individuals' judgement.

DATA SYSTEMS

Our investigation identified various data collection and reporting systems, with a notable preference for digital reporting through phone-based apps and mass interpersonal communication via commercial platforms like WhatsApp. These technologies have democratised data collection, enabling citizen participation in surveillance activities and enhancing data transfer and communication. If designed to allow automated data integration with national human and animal health information systems and automated analysis and the generation of decision support, CBS data collected through electronic means offer immense potential. Though not flawless, it is worth considering the structure and function of the iSIKHNAS platform as an illustrative example.

As mentioned earlier, instances of parallel reporting were noted, which, if unaddressed, may result in confusion, redundancies and unnecessary manual processes. Additionally, a growing demand for more sophisticated data integration allows various jurisdictions to combine their data for joint risk assessment, planning and response activities. A puskesmas staff member expressed, "It would be wonderful to integrate our animal surveillance data with human surveillance data to identify correlations. This could

help us pinpoint hotspots and predict risks.” Regarding this and in accordance with KEMENKO PMK regulation #7 of 2022, KEMENKO PMK is actively working towards the integration of human, livestock and wildlife data from existing government surveillance systems. The *Sistem Informasi Zoonosis dan Penyakit Infeksius Baru* or the Zoonoses and Emerging Infectious Diseases Information System (SIZE) initiative was officially launched in December 2023 with MoH, MoA and MoEF endorsing the approach. SIZE is the realisation of the Presidential Instruction No. 4, 2019. It aims to integrate human, livestock and wildlife data from existing government surveillance systems to improve risk assessment, disease detection and timeliness of responses. SIZE also aims to provide the impetus for enhanced cross-sector collaboration for zoonosis and EID control. Leveraging insights gained from initial pilot initiatives, SIZE is poised to be operationalised from 2024 [42, 43].

THEME 4: ANALYSIS SHOULD BE PERFORMED AT THE DISTRICT/SUB-DISTRICT LEVEL WHERE OUTBREAKS OCCUR AND THERE IS A NEED TO SUPPORT THE DATA ANALYSIS/INTERPRETATION SKILLS OF LOCAL ANIMAL AND HUMAN HEALTH STAFF

Analysis at different spatial scales (granularity) is crucial to extracting meaningful insights from CBS data. To achieve this, it must be identified where, when and by whom analysis is best performed as well as what analysis ought to be performed. Outputs of analysis should provide a measure of statistical certainty.

Our fieldwork found that while puskesmas typically had an officer assigned to manage surveillance data (both routinely collected syndromic surveillance data collected through the SKDR system, event-based reports and CBS-derived data), they did not always have the knowledge required to interpret CBS data or integrate it with routine surveillance reports. Further, we found that surveillance data analytical skills were scarce among puskesmas staff, who tended to see their roles and responsibilities as clinically focused.

Building robust CBS systems emphasises the need to bolster local contextual understanding and data analysis and interpretation capabilities at the district/sub-district level (where epidemiological analysis is most likely to be conducted) and interpretation and utilisation skills of staff at puskesmas and puskesmas. This is a strategic imperative for several reasons. Firstly, local context intricacies, nuances and dynamics can influence the interpretation of surveillance data. Local analysts intimately familiar with the community and setting are better positioned to derive meaning from the data, ensuring its relevance, practicality and accuracy. Secondly, local analysis capability contributes to timeliness in response with rapid identification of emerging health trends or potential outbreaks contingent upon the ability to analyse incoming data promptly. Further, decentralising the analysis process aligns with community engagement and participatory surveillance principles. Thirdly, involving locals will not only foster a sense of ownership but also drive demand for analysis outputs and value placed on quality data and data systems.

Furthermore, data collected by CBS systems should be utilised to conduct temporospatial analysis of trends and patterns in disease. This analytical approach aids in identifying new and evolving patterns across populations over time.

THEME 5: THERE IS NEED FOR PROTOCOLS TO GUIDE THE OPERATIONALISATION AND INTEGRATION OF CBS WITH EXISTING SURVEILLANCE SYSTEM PROCESSES

The operationalisation and integration of CBS into existing surveillance systems (i.e., SKDR, iSIKHNAS) necessitate developing transparent, clear and standardised protocols and procedures. These guidelines are vital to streamlining the roles and responsibilities at various levels, ensuring a cohesive and efficient surveillance ecosystem and that CBS builds on (and does not operate in parallel with) core surveillance practices. Protocol-driven practice will also aid the consistent and reproducible expansion of CBS to other

settings and allow data comparison across time and place. Key protocols and procedures to consider include:

ARTICULATING ROLES AND RESPONSIBILITIES

Establishing well-defined roles and responsibilities is fundamental for the smooth functioning of CBS. Clear delineation of tasks at different levels, from community CBS workers to facility staff up to the district, provincial and national levels, ensures transparency and accountability and will aid effective communication and collaboration.

ROLE-SPECIFIC TRAINING

Competency-based and role-specific training is required to build the skills and confidence necessary to perform assigned CBS tasks with rigour. For example, training programs must equip village CBS workers with an understanding of the surveillance case definitions used, how to consistently apply them and where and how to report data. These skills are quite different to those required by the recipient of CBS data (e.g., a puskesmas or puskesmas staff member, or a district or sub-district-based analyst) who will need to understand how to manipulate data, understand local context and the epidemiology of outbreak-prone diseases, and know when and how to perform follow-up investigations.

In addition to technical skills, capacity to engage and maintain community involvement in a coordinated system is needed. This will require strong social connections, interpersonal skills, communication skills and local authority.

CONSISTENT DATA COLLECTION

Providing clear guidance on what qualifies as a reportable case, whether through indicator-based or event-based reporting, is crucial. It ensures consistent data collection that is comparable across time and locations, striking the right balance between system sensitivity and specificity.

Indicator-based surveillance (IBS) involves the routine collection, monitoring, analysis and interpretation of data using standardised case definitions. The MoH identified 24 priority diseases for human surveillance [44] and MoA 15 for animal populations [45].

While intricate case definitions designed for use by clinically trained staff may not be suitable for lay CBS workers, it is crucial that the definitions employed in a CBS system align with those used for priority disease detection within Indonesia's broader surveillance framework. Authorities must consider how many syndromes and what cardinal signs and symptoms are feasible to include in a CBS system. To optimize effectiveness, syndromes under CBS surveillance should be limited in number and their case definitions (standard criteria used to identify cases) should encompass person, place, time and clinical feature components, adhering to standard practices. Clinical features should entail changes caused by a disease that CBS workers can easily detect, such as visible signs. For instance, a syndrome category like "any person who has developed diarrhea and visible blood in the last 24-hours" can indicate potential Salmonella, Campylobacter, Shigella or Shiga toxin-producing escherichia coli O157 infections in humans. In animal health surveillance, reporting criteria are likely to be more straightforward, such as "unexpected death of an animal." The integration of case definitions into CBS practices is crucial for maintaining focus on diseases of interest, ensuring data quality and facilitating data comparisons over different places and times.

One approach suggested by an interviewee to navigate the delicate balance between designing a comprehensive surveillance system with many syndrome categories and practical feasibility on the ground is to distinguish between 'core' (non-negotiable) syndromes that must be included in all CBS systems and 'optional' syndrome categories that local authorities/communities may choose to apply based on their specific needs.

As implied by its title, event-based surveillance (EBS) involves the reporting of unusual events or patterns of illnesses that signal a potential concern. EBS reporting is typically immediate and unstructured, and CBS emerges as a valuable source of EBS. During site visits, effective yet ad-hoc EBS reporting mechanisms were observed, primarily utilizing WhatsApp group chats. There are opportunities to formalize and promote EBS as a core component of CBS.

EBS also offers a clear opportunity to embrace a One Health approach, as it is more likely to detect disease events occurring at the animal-human-environment interface. It was observed that many zoonoses are asymptomatic in animals, necessitating the detection of human cases and the sharing of information across sectors for joint risk assessment and action to address the courses of infection.

WHEN AND HOW TO REPORT DATA

We noted variations in the methods used to report Event-Based Surveillance (EBS) data. In some instances, the official reporting mechanisms required supplementation through informal means, resulting in inefficiencies, a lack of transparency and heightened vulnerability in data reporting processes—mainly because informal channels relied on interpersonal relationships. It is imperative to establish clearly defined reporting mechanisms, whether through digital platforms, mobile applications, or other channels, ensuring alignment with urgency to respond.

Additionally, protocols must stipulate when and how information should be shared with relevant authorities, extending beyond the initial ministry to include coordination with external entities. This ensures a cohesive and prompt response to potential outbreaks or emerging health trends. Both human and animal health officers interviewed strongly advocated for implementing such protocols. While routine engagement may not be necessary, protocols serve as a critical framework to govern the dissemination of information in a structured and effective manner.

QUALITY ASSURANCE

A notable deficiency identified and reported was the absence of continuous quality assurance and feedback systems to enhance ongoing improvement in CBS practices. A village leader succinctly expressed this gap: “We do what we think is right, but we are not sure, and no one tells us otherwise.”

Integrating quality assurance measures into the regular maintenance and support of the CBS system will instil rigour and a sense of value among participants. Delegating responsibility for quality assurance activities to officers at the sub-district level is a prudent approach, ensuring focused oversight and effective implementation of these crucial measures. When establishing a quality assurance system, designers must carefully contemplate the added value they intend to provide to those tasked with implementation. Ensuring a tangible “value add” for the time invested will cultivate a sense of ownership and worth among individuals crucial to the success of these activities.

THEME 6: CBS AND GENDER EQUITY

Women are at the core of CBS activities typically fulfilling CBS worker roles. During our field visits, we also observed that many of the professional roles with CBS systems (i.e., puskesmas and puskesmas leads, directors at sub-provincial and provincial level) were female, indicating that there is a strong female representation amongst implementers of CBS in Indonesia.

Beyond representation, through considered design, CBS can play a role in addressing gender equity by incorporating specific considerations and strategies that promote equality between men and women. This may include through:

- the incorporation of inclusive language in CBS policy, guidelines and training materials, and in any risk communication resources developed for use by CBS workers in the field.

- providing training programs that are sensitive to gender differences, addressing the unique needs, roles and responsibilities of both men and women in surveillance activities.
- being aware and respectful of cultural norms that may impact the participation of men and women and tailoring CBS implementation to align with local customs and beliefs.
- collecting and analysing data with a gender lens to identify disparities and specific health concerns affecting each gender and use this data to inform tailored interventions.
- implementing initiatives that empower women within the community, as empowered women are more likely to actively participate in surveillance activities and influence health-related decisions.
- ensuring that surveillance services are easily accessible to both genders, considering factors such as geographical location.
- using CBS platforms to raise awareness about gender-based violence, encouraging reporting and support for survivors.
- using CBS platforms to provide health education that addresses the unique health needs of both men and women. This can include reproductive health information, family planning and maternal health.
- working towards the development and implementation of policies that prioritise gender equity in health surveillance and related services.

By incorporating these strategies, CBS can contribute to creating a more equitable and inclusive health system that benefits everyone in the community.

THEME 7: CLARITY ABOUT THE GOVERNANCE AND FINANCING ARRANGEMENTS FOR CBS IS REQUIRED

The intricate division of responsibilities between ministries, coupled with a blend of operating mandates, directives and perspectives, underscores the need for coordination. While Kemenko-PMK has been tasked with this responsibility, the agency lacks presence at the sub-national level and lacks the required technical expertise or authority to guide CBS. To operationalise, integrate and sustain CBS at the community level, coordination by local governments is essential. The MoHA is well-positioned to provide the mandate for this.

Simultaneously, the MoA, MoH and the MoEF, serving as co-technical leads responsible for realising Indonesia's One Health ambitions, need to coordinate with each other on matters of technical standards, interoperability, integration, operationalisation, training and quality assurance.

Funding for village-level CBS activities poses a challenge, with differing opinions on whether CBS workers should be financially compensated and where funding should come from. While there's no clear answer, it is evident that CBS costs, requiring dedicated budgets for implementation, scaling and maintenance. In the decentralised governance model adopted by Indonesia, local governments are mandated to deliver most services, including health services, and there's no compelling reason why CBS should be treated differently. MoHA is well-placed to assess costs, assign budget and direct local governments to allocate funds for CBS activities. Central financing streams like Health Operational Assistance/BOK may also be considered. Local funds, typically *dana desa*, could be used for community-based activities, following the model of the TISIRA initiative. Of note is the MoHA's direction regarding CBS, such as their Circular Letter to all local governments regarding the requirement to implement KEMENKO PMK's Guidelines for the Prevention and Control of Zoonoses and Emerging Infectious Diseases [5].

THEME 8: RECOGNITION AND COMPENSATION OF CBS WORKERS

During our field visits, the question of whether cadres/CBS workers, the driving force behind CBS, should receive financial compensation for their service emerged. This matter is intricate and subject to ongoing debate, with evidence pointing to various considerations. Volunteers are often motivated by a sense of purpose and altruism, finding intrinsic rewards in contributing to their community. Introducing financial incentives may jeopardise these intrinsic motivations and impact the dynamics of volunteerism.

Moreover, the economic sustainability of volunteer-based CBS is paramount, requiring authorities to explore alternative recognition and reward models, such as public accolades, training opportunities and honour rolls. Studies on the impact of financial compensation on volunteers' motivation, satisfaction and retention yield varied results and emphasise the influence of factors like the nature of the volunteer work, local cultural norms and the accessibility of opportunities that may flow from volunteering. Conversely, monetary remuneration fosters validation and a sense of pride in one's contribution to community wellbeing and, potentially, plays a modest yet meaningful role in advancing the financial independence of CBS workers, a significant portion of whom are women who are more likely to be economically dependent.

Striking a balance between acknowledging the value of volunteers and preserving intrinsic motivation to contribute raises an interesting policy challenge, especially when considering the long-term financial sustainability of CBS, particularly if the Government of Indonesia intends to expand the initiative's use more broadly.

THEME 9: CBS AS A STRATEGY FOR ALL-HAZARDS DISEASE REPORTING

Most CBS systems scrutinised by the review team were found to engage in surveillance for a particular set of diseases, a situation attributed to the influence of vertically funded initiatives that were initiated before the enactment of national laws governing CBS. While these disease-specific approaches may contribute to achieving outcomes in their targeted areas, they fall short of fully embracing the all-hazards approach to surveillance promoted by the GoI. Moreover, they do not align seamlessly with the priority outbreak-prone diseases outlined by the MoH and the MoA. This observation is not intended to dismiss the relevance of disease-specific initiatives; instead, it underscores the need to assess their role within the broader context of national health security and local capacity to conduct CBS. Evaluating the balance between disease-specific objectives and the overarching goals of national and local CBS systems becomes imperative in optimising their effectiveness.

THEME 10: THE DETECTION PERFORMANCE OF CBS SYSTEMS REMAINS ANECDOTAL AND ROBUST METHODS TO MEASURE PERFORMANCE (AND COST-BENEFITS) ARE NEEDED

This decentralised CBS approach is designed to enhance the detection of potential outbreaks, minimise response time and strengthen the overall resilience of public health systems. While the concept is promising, and we heard some anecdotal examples of improved performance, the absence of rigorous data hampers the ability to measure its actual impact and effectiveness.

One fundamental aspect that demands evaluation is the accuracy and reliability of the data collected through CBS. Anecdotal evidence suggests that community-based reporting can be swift and responsive for high-impact/unusual events but lacks sensitivity and specificity, particularly for endemic and familiar illnesses. As such, questions linger about the precision of the information CBS can feasibly collect and, hence, the opportunity costs that may be incurred.

That being said, comparing the costs of training, infrastructure and ongoing support required to implement CBS with the benefits gained is crucial for judicious, justified and sustainable implementation. An economic evaluation that considers both the direct and indirect costs and benefits can offer valuable insights into the economic viability of CBS, assisting policymakers in optimising resource allocation and scaling up successful models.

Furthermore, evaluating the community's perception and acceptance of CBS is crucial for its long-term success. Understanding the factors influencing community engagement and ownership, and CBS workers' willingness to perform surveillance activities with rigour, will inform program improvement.

The impact of CBS on the broader health system is another facet that merits consideration. Does the integration of CBS enhance the overall efficiency of existing health systems and national health security? These questions underscore the need for a comprehensive evaluation framework that goes beyond anecdotal success stories.

THEME 11: SCALING CBS ACROSS INDONESIA

Scaling CBS to a national level necessitates a multifaceted strategy encompassing policy development, standardised protocols, technological infrastructure, community engagement, resource allocation, monitoring and evaluation, collaboration, adaptability, communication and strong government commitment.

As outlined in the themes above, establishing a robust policy and legal framework is paramount, and national guidelines and policies should be refined to explicitly outline CBS's role, objectives and integration within existing human and animal health structures. Creating (and familiarising stakeholders with) a well-established legal framework will help ensure CBS activities align with national regulations, fostering accountability and regulatory compliance.

Further, standardised protocols and comprehensive training programs are crucial in achieving scalability and data quality and – ultimately – the reliability of information generated by CBS. Developing uniform data collection, reporting and response protocols will foster consistency across diverse regions.

Appropriate technology is a linchpin for scalability. Implementing digital data collection, reporting and analysis platforms enhances efficiency and accuracy in surveillance processes. Exploring technological solutions suitable to various geographical and infrastructural contexts will be required.

Community engagement and ownership are at the heart of effective CBS. As demonstrated in the example CBS systems visited, community sensitisation will enhance understanding, trust and participation in CBS activities. The engagement of community leaders and influencers in the implementation of CBS, as well as the positioning of local CBS activities within a broader national agenda (national movement) for enhanced health security, has, and will, foster motivation and local ownership.

Adequate resource allocation and funding mechanisms are fundamental to CBS's scalability. As discussed above, governments must allocate sufficient financial resources to establish, maintain and scale CBS. This encompasses funding for training, technology implementation, field visits and support.

A robust monitoring and evaluation system is critical for continual improvement and scalability. Implementing impact assessments at local and national levels will allow authorities to measure and track CBS's effectiveness, efficiency and overall impact on health security.

Ensuring collaboration among various ministries, including health, agriculture and environment authorities, and with local government, will help align CBS to broader local and national objectives. Additionally, seeking opportunities to share experiences fosters the exchange of best practices, enriching the CBS framework.

Adaptability and flexibility are critical considerations in designing a scalable CBS model. Establishing minimum standards and protocols for CBS practices while allowing flexibility to tailor programs to meet local needs/local capacity is essential.

RECOMMENDATIONS

RECOMMENDATION 1: POSITIONING CBS AS AN EXTENSION OF CORE ALL-HAZARDS SURVEILLANCE ACTIVITIES IS CRITICAL

CBS constitutes an extension component of Indonesia's outbreak and EID surveillance architecture and should be conceptualised as such. **Consequently, CBS ought to be recognised as a strategic tool that augments the efficacy of SKDR and iSIKHNAS.** In practical terms, this will require aligning syndromes under surveillance with priority diseases that are scrutinised by SKDR and iSIKHNAS. Moreover, case reporting should seamlessly integrate into the established national health information management processes and systems.

RECOMMENDATION 2: HARMONISED LAWS, REGULATIONS AND GUIDELINES FOR THE CONSISTENT IMPLEMENTATION OF CBS ACROSS INDONESIA ARE NEEDED

To enhance national health protection legislation, it is recommended that **guidelines be refined and harmonised to ensure the streamlined, uniformed and coordinated implementation of CBS across Indonesia.** These guidelines may articulate the capacities, training and resource needs for CBS workers operating at the village level, and the roles and responsibilities of surveillance staff who receive, process and analyse CBS data to produce information. Additionally, the guidelines may provide processes for cross-sector coordination at all levels, offer appropriately worded syndromic case definitions for priority diseases and establish event-based reporting protocols that facilitate data integration within national health information systems.

Guidelines should be adequately flexible to allow local contextual nuances, needs and wisdom to be incorporated into CBS system implementation.

RECOMMENDATION 3: CLARIFICATION AND COMMUNICATION ABOUT MINISTERIAL AND AGENCY ROLES AND RESPONSIBILITIES WITH REGARD TO CBS TECHNICAL OVERSIGHT AND ADMINISTRATION IS NEEDED

The intricacies arising from the involvement of multiple ministries in the technical, administrative and financial facets of CBS implementation have led to some confusion at the operational level. To address this issue, there is a **need for clear delineation of ministerial roles and responsibilities and who has technical and administrative oversight for CBS implementation.**

Given the technical nature of CBS, it is logical for technical line ministries, MoH, MoA and MoEF, to: guide CBS strategy and system design; set and ensure standards are met; provide training, mentoring and quality assurance services; and – in the spirit of One Health – lead inter-agency coordination and joint activities. In the decentralised governance of Indonesia, local governments are mandated to deliver most services, including health. MoHA is well-placed to direct local governments to allocate funds for CBS activities through established financing streams. Use of central funding mechanisms, like BOK, may also be considered. Local funds, typically dana desa, could be used for community-based activities.

RECOMMENDATION 4: ADEQUATE NUMBERS OF APPROPRIATELY TRAINED PEOPLE AT THE OPERATIONAL LEVEL IS CENTRAL TO CBS' SUCCESS

To maximise the impact of CBS, **it is crucial to ensure there are sufficient human resources available at the district, sub-district and local (including field and outreach) levels** that are skilled and equipped to undertake the core surveillance functions required of them. These include ensuring the effective and consistent collection, management and integration of CBS data with surveillance mechanisms and analysing these data to generate trustworthy and actionable data-driven intelligence. Having a well-trained workforce will provide manpower to support CBS system maintenance, including training and mentoring and data quality assurance.

The investment in people will not only strengthen CBS activities at the local level but also optimise the overall functionality of early warning surveillance in Indonesia. In addition, directing resources towards human capital can enhance individuals' prospects and serve as a strategic approach to mitigate economic and social inequities.

RECOMMENDATION 5: BALANCING THE 'DETECTION' FUNCTION OF CBS WITH THE 'PREPAREDNESS' AND 'RESPONSE' ACTIVITIES IS IMPORTANT

While CBS's inherent emphasis must be on the 'detection' aspect of the health security paradigm, we acknowledge that Indonesia has adopted a more expansive and community mobilisation-focused approach that encompassing elements of 'prepare' and 'respond' through health promotion and community empowerment. While adopting a holistic approach is commendable, it introduces complexity. Therefore, **it is imperative that the core aims of CBS activities are articulated and reflected in systems' design.**

Given the pivotal role of CBS workers, careful consideration of their capacity to undertake a diverse range of activities is essential for the stability and sustainability of a CBS strategy. Striking the right balance between comprehensiveness and feasibility is crucial.

Further, ongoing investment in strategies, such as SIZE, to integrate data sets for enhanced evidence generation is warranted and should be a focus of future development efforts.

RECOMMENDATION 6: THROUGH CONSIDERED DESIGN, CBS CAN SUPPORT INDONESIA'S EFFORTS TO ADDRESS GENDER INEQUITY

CBS presents a distinctive opportunity to foster gender equity in the provision of essential animal and human health services. Concretely, efforts to address gender inequity can be advanced by CBS through **advocating for gender (and social) diversity among those spearheading the design and implementation of CBS systems; using inclusive language and formulating training programs that are attuned to gender sensitivities; and by being aware of gender norms and their impact on surveillance practices.** Considering how CBS may be structured to **address stereotypes that disenfranchise women is also important.**

Furthermore, authorities are encouraged to **collection and analysis of sex-, disability- and equity-disaggregated data** to allow the generation of evidence required to identify, quantify and address gender and social inequity. Embracing this practice may transform CBS into a multifaceted tool, not only monitoring diseases but also contributing to overarching societal objectives of inclusivity and equity.

RECOMMENDATION 7: TECHNOLOGY AND CBS

Recent advances in information and communications technology and the rise of digital health tools are reshaping healthcare. **Using technology can simplify CBS processes, enhancing their reach, stability and timeliness.** This includes basic case reporting via email, SMS, or phone apps, as well as automated or semi-automated analysis, data integration, data visualisation, automated alerts and algorithm-based decision support. When choosing technology, it's crucial to consider end users' access and experience and ensure that data captured using new technologies are interoperable and integrate smoothly with the government's broader health information management architecture. It's important to note that while digital tools are said to offer resource-efficient solutions, evidence for this is limited, especially in settings with high transaction costs. Therefore, decision-makers should weigh the costs and benefits based on local needs and context, considering the impact in the presence or absence of alternatives.

RECOMMENDATION 8: SUSTAINING AND SCALING CBS

For the sustainable integration of CBS, it is **imperative to position it as an integral component within the national early warning outbreak and EID architecture** rather than implementing it as a standalone project. Recognising that CBS involves substantial costs for worker training, support, data reporting system development and quality assurance—especially when envisioned at a large scale by the Government of Indonesia (GoI)—a strategic embedding within the national framework is essential.

Given Indonesia's vast and decentralised governance structure, establishing **national mandates and providing clear implementation guidance becomes paramount**. Considering the multifaceted involvement of various ministries in CBS, effective cross-ministerial communication and coordination are key elements for success.

While external funders have played a crucial role in advocating CBS initiatives, relying on them and on project-based approaches to CBS implementation may prove challenging to coordinate and scale, and may result in national systems becoming dependent on international agency support.

Development assistance that is focused on enhancing the core functions of the national surveillance system, including workforce skills, data systems, technologies, policies, processes, leadership and governance, are more likely to foster context-relevant, system-wide, national authority-led initiatives.

RECOMMENDATION 9: CBS PROCESS, QUALITY MONITORING AND IMPROVEMENT

The effectiveness of any surveillance system is dependent on the quality of the data that is captured; therefore, **it is suggested a monitoring and evaluation framework for CBS be developed** and implemented. The monitoring and evaluation framework may include indicators related to: (i) adherence to data collection, reporting and communication protocols/standard operating procedures; (ii) the sensitivity of data collected (i.e., proportion of suspected cases reported that are truly cases); (iii) the timelines and stability of reporting; (iv) level of community participation and empowerment; (v) resource utilisation; (vi) adaptability to new situations; and (vii) - ultimately - ability to detect events of public health concern earlier that would not otherwise have been possible.

Well-designed and used monitoring and evaluation leads to refinement and – ultimately – best practice. Building evidence about what makes CBS optimal has broader research, policy and program value.

CONCLUSION

The opportunity CBS offers to elevate public health security in Indonesia is undeniable. Its merits, including early disease detection, heightened local engagement and cost-effectiveness, underscore its value as a supplementary surveillance tool. Nevertheless, to realise its potential, addressing associated challenges such as human resources, data quality and organisation and governance is imperative. Collaboration among ministries and levels of government and with the community is essential to refine and craft a CBS model tailored to the need and feasible in the unique contexts of Indonesia. Through such endeavours, CBS has the potential to enhance the country's core early warning outbreak and EID surveillance architecture, contributing significantly to better health protection outcomes for Indonesia and beyond.

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APPENDICES

APPENDIX 1: PEOPLE CONSULTED IN THE DEVELOPMENT OF THIS REPORT

No	Institution	Department	Total (person)	Female	Male
Government of Indonesia (Central)					
1	Ministry of Health	Directorate of Infectious Disease Prevention and Control	2	1	1
		Directorate of Surveillance and Health Quarantine	3	3	-
2	Ministry of Agriculture	Directorate of Animal Health	1	-	1
		Directorate of Veterinary Public Health	1	1	-
3	Ministry of Forestry and Environment	Directorate of Conservation of Species and Genetic Biodiversity	2	-	2
4	Coordinating Ministry of Human Development and Cultural Affairs	Deputy for Coordination of Health Quality Improvement and Population Development (Deputy III)	1	-	1
Government of Indonesia (Sub-national)					
5	Central Java	Province Health Office	4	1	3
		District Health Office, Demak	5	2	3
		District Health Office, Boyolali	7	3	4
		Puskesmas Bonang 1, Demak	8	4	4
		Puskesmas Boyolali 1, Boyolali	6	4	2
		Purwodipuran subdistrict	1	-	1
		Indonesian Red Cross, Boyolali	4	1	3
6	South Sulawesi	Province Animal Health and Livestock Office	5	4	1
		Province Health Office	5	3	2
		Province Agency for Regional Development Planning, Research and Development Office	3	-	3
		District Agriculture and Food Security Office, Maros	4	1	3
		District Health Office, Maros	5	1	4
		Puskesmas Maros, Maros	5	4	1
		Indonesian Red Cross, Maros	1	1	-

	Puskesmas Maros, Maros	2	-	2
	Puskesmas Tompobulu, Maros	7	7	-
	Puskesmas Bantimurung, Maros	1	1	-
	PelSa, Maros	4	1	3
7	Bali			
	Province Health Office	1	-	1
	Province Agriculture and Food Security Office	2	1	1
	District Health Office, Buleleng	1	-	1
	District Agriculture Office, Buleleng	3	2	1
	District Village Community Empowerment Office, Buleleng	1	-	1
	Puskesmas Buleleng 1, Buleleng	1	1	-
	Puskesmas Sawan 1, Buleleng	1	1	-
	Puskesmas Tejakula 1, Buleleng	1	-	1
	Puskesmas Sukasada 1, Buleleng	1	1	-
	Puskesmas Sawan, Buleleng	1	-	1
	TISIRA, Mayong	1	-	1
	Banyuasri subdistrict	1	-	1
International Agencies				
8	World Health Organization, Indonesia	1	-	1
9	Food and Agriculture Organisation of the United Nations, Indonesia	1	-	1
10	International Federation of the Red Cross	2	2	-
11	United States Agency for International Development	3	2	1
12	United States Centres for Disease Control and Prevention, Indonesia	1	1	-

APPENDIX 2: LIST OF PRIORITIES FOR POTENTIAL OUTBREAK DISEASES IN HUMAN AND ANIMAL HEALTH

No	Human Health [44]	Animal Health [45]
1	Acute diarrhea	Avian Influenza
2	Confirmed malaria	Rabies
3	Suspected dengue fever	Anthrax
4	Pneumonia	Brucellosis
5	Bloody diarrhea OR dysentery	Leptospirosis
6	Suspected typhoid fever	Japanese encephalitis
7	Acute jaundice syndrome	Bovine tuberculosis
8	Suspected chikungunya	Salmonellosis
9	Suspected avian influenza in humans	Schistosomiasis
10	Suspected measles	Q Fever
11	Suspected diphtheria	Campylobacteriosis
12	Suspected pertussis	Trichinellosis
13	Acute flaccid paralysis	Paratuberculosis
14	Cases of animal bite with rabies transmission	Toxoplasmosis
15	Suspected anthrax	Cysticercosis/taeniasis
16	Suspected leptospirosis	
17	Suspected cholera	
18	Cluster of unusual diseases	
19	Suspected meningitis/encephalitis	
20	Suspected neonatal tetanus	
21	Suspected tetanus	
22	Influenza-like illness	
23	Suspected hand, foot and mouth disease	
24	Suspected COVID-19	