Sustainability of Sub-Regional Disease Surveillance Networks

Melinda Moore, David J. Dausey, Bounlay Phommasack, Sok Touch, Lu Guoping, Soe Lwin Nyein, Kumnuan Ungchusak, Nguyen Dang Vung, and Moe Ko Oo

Sub-regional disease surveillance networks are an emerging trend in global public health. The Mekong Basin Disease Surveillance cooperation (MBDS) is one such network, which despite notable successes over the past ten years faces challenges in sustainability. We created a sustainability framework comprising strategic and tactical sustainability-enabling factors that can be used to characterize networks and orient planning for their sustainability into the future. We applied the framework to MBDS as a proof of concept. Sub-regional infectious disease surveillance networks contribute importantly to regional and global health, yet they may face challenges in sustainability as they mature. Our framework, based on a data-driven virtuous cycle and systematic use of sustainability-enabling factors, can guide monitoring of and planning for sustainability of these networks.

INTRODUCTION[1]

Public health surveillance is a vital element of global health. Globalization of trade and travel have brought globalization of infectious diseases, especially new "emerging" infectious diseases (EIDs), and the increased need for global cooperative approaches to detect, prevent and control them.[2] The outbreaks of Severe Acute Respiratory Syndrome (SARS) in 2002-2003 and avian influenza H5N1 since late 2003 reminded the world that infectious diseases can cause significant impact on national economies and that global transparency and cooperation in disease detection and control are critical to protect populations and economies.[3] The Mekong Basin area in Asia is considered a "hotspot" for the emergence of new EIDs.[4] In this context, six Mekong Basin countries organized themselves into what we call a "sub-regional" network more than a decade ago to cooperate in border health and public health surveillance for diseases of shared concern. The Mekong Basin Disease Surveillance cooperation (MBDS) comprises Cambodia, China (Yunnan and, since 2008, Guangxi Provinces), Lao PDR, Myanmar, Thailand, and Vietnam. In 2001, their respective Ministers of Health formalized the cooperation the countries had initiated in 1999 by signing a six-year Memorandum of Understanding (MoU); they renewed this commitment in an open-ended agreement signed in 2007.[5]

Sub-regional infectious disease surveillance networking—distinct from national, regional, or global surveillance and control—is an important emerging trend in global public health because such cooperation is transnational but organized and governed by member countries and directly addresses their shared priorities. MBDS is one of the longest standing current examples of self-organized sub-regional infectious disease surveillance networking.[6] Its members have carried out joint training, planning, exercising, outbreak investigations, disease control responses, capacity building, and surveillance information sharing, focusing their efforts on a growing number of paired

local cross-border sites in strategic locations. However, as of 2011, MBDS is at an important crossroads as its longstanding principal source of external funding is phased out, raising questions of whether and how the cooperation can be sustained.

In this paper we examine public health surveillance, sub-regional surveillance networks, and challenges related to sustainability. We then offer a new sustainability framework and apply it to MBDS. We drew from the literature and first-hand experiences with public health surveillance, sub-regional surveillance, and response networks in general and MBDS in particular. Our sustainability framework encompasses a number of "sustainability-enabling factors" that can be used to characterize networks in terms of strategic attributes (governance, relationships, orientation, alignments, and priorities) and tactical achievements (related to infrastructure, activities, and visibility), and to orient their planning for future sustainability. We created matrices based on these factors and applied them to MBDS as a proof of concept. Planning for future sustainability is based on identifying successes to maintain, areas to improve, and opportunities to innovate.

PUBLIC HEALTH SURVEILLANCE

Public health surveillance has been defined as "the ongoing systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health,"[7] or more simply, "systematic information for public health action."[8] The World Health Organization (WHO) has similarly defined surveillance as the "systematic ongoing collection, collation and analysis of data for public health purposes and the timely dissemination of public health information for assessment and public health response as necessary."[9] All these definitions address the importance of data analysis, interpretation and presentation as well as the intention to link public health surveillance data to action.[10]

There is wide consensus that public health surveillance is a cornerstone of public health systems and action, including the global prevention and control of EIDs.[11] The specific purposes of surveillance are to measure the need for intervention including early warning of emerging events, empower decision makers on the basis of timely and reliable information, and measure the effects of intervention.[12] Information obtained from surveillance data is used for immediate detection and response, and for planned management responses.[13] Surveillance systems require epidemiology, laboratory, information technology, and other communications capacities and the capacity to collect, analyze, and use timely surveillance information.[14] National surveillance is a necessary component of global surveillance. There is recognition that "weakness in the surveillance system in one part of the globe is a weakness for the entire globe, and every nation needs the infrastructure to prepare for, respond to, and recover from health emergencies."[15] Moreover, all events begin locally, so national surveillance systems must ensure surveillance capabilities beginning at the front lines—the local level (Figure 1).

The WHO's revised International Health Regulations (IHR) provides a unifying—and legally binding—framework for countries to undertake transparent disease surveillance and reporting to prevent and control the cross-border and broader global spread of disease.[16] The IHR requires all countries to (a) build and maintain a set of core capacities to enable timely detection, assessment, notification, reporting of public health emergencies of international concern and to enable prompt and effective response to such events; (b) build and maintain these core capacities beginning at the local level; and (c) cooperate with WHO and, for those countries that can, provide technical assistance to help countries build their core capacities and respond to such events.

With public health surveillance as a cornerstone of modern global public health in the context of globalization of disease and the new IHR, it is especially important to ensure the performance of surveillance systems at all levels: both within and across countries.

Experiences to date suggest a number of challenges (gaps and impediments) to public health surveillance systems at the local, national and global levels.[17] An overarching challenge is the absence of clear linkages between surveillance data and public health action—absence of a "data use culture" in many settings, including lack of feedback from local to national levels, across sectors, or to external partners.[18] Another challenge is the sheer complexity of surveillance systems—the many moving parts representing multiple dimensions of engagement: local to provincial and national levels, the numerous required forms and various steps between collection and use of surveillance data, the multiple support functions required, and alignment of human and animal surveillance "across geographic, institutional, disease, and host boundaries," to name just a few.[19]

If national surveillance systems are challenged by their complexity, the complexity becomes even greater as surveillance becomes transnational, beyond national to sub/regional and global levels (Figure 2). Moreover, many national surveillance systems are already fragmented because they are developed in parallel for different diseases—the "vertical" orientation that is typically contrasted with a "horizontal" orientation, which is focused on health systems rather than on specific diseases. The multiplicity of global health initiatives supported by donors, each often with its own data requirements, only adds to the fragmentation and complexity of surveillance systems within countries.[20]

Surveillance system performance can be hampered by challenges to governance and logistics, as well as human, technical, and financial resources.[21] A problem-solving approach can be taken to help improve surveillance system performance. For example, one framework for assessing surveillance system performance was based on identifying a number of potential problems in the literature and examining them systematically in four countries, where evaluators tried to identify underlying or contributing factors to those problems.[22] Many of these potential challenges and problems identified by other authors correspond to the "moving parts" portrayed in Figure 2. Overarching problems identified include overly complex systems (including burden on data collectors),[23] siloed vertical surveillance systems,[24] concerns about interference by or disruptions to

international trade, travel and security,[25] lack of trust and transparency,[26] and insufficient political commitment.[27] Specific problems related to public health surveillance systems include inadequate data collection systems and limited or poor data analysis skills, data inaccuracy (including incomplete reporting and lack of reliable case reports), and lack of timeliness, dissemination, and feedback.[28] Problems related to support functions include a lack of sufficiently trained and supervised personnel with appropriate motivation and interest,[29] limited health information infrastructure,[30] insufficient funding to support surveillance,[31] and limited access to adequate diagnostic laboratories.[32]

Five broad lessons can be derived from the problems highlighted above: (1) Data should be "owned" and used at all levels including local; (2) decision makers and technical staff must understand how to interpret and use quantitative data/information; (3) information must be relevant to local decision makers and needs to take into account the social and political context of the problem to be solved; (4) technical support/supervision must be ongoing and regularly reinforced; and (5) training programs should be institutionalized.[33]

Opportunities to "transform" global public health surveillance have been identified. The goal is to "transform surveillance from dusty archives of laboriously collected after-the-fact statistics to meaningful measures that provide accountability for local health status or that deliver real-time early warnings…."[34] Three modern-day drivers of such a transformation include the recently revised WHO IHR, the rise and penetration of public health informatics, and growing alignment of health and security.[35] Also required are global mindsets and commitment to global financial, human, and technical resources.[36]

THE RISE OF SUB-REGIONAL INFECTIOUS DISEASE SURVEILLANCE NETWORKS

Sub-regional infectious disease surveillance networks are manifestations of the need to develop surveillance networks capable of spanning borders while maintaining relative managerial simplicity. This type of transnational cooperation can help to ensure a coordinated and expedited response to emerging public health threats. We specifically distinguish between sub-regional and regional disease surveillance networks. As Table 1 demonstrates, sub-regional networks differ from regional networks along a number of functionally significant dimensions.

In the last decade a number of sub-regional infectious disease surveillance networks have been organized. Along with MBDS, these networks include the Pacific Public Health Surveillance Network (PPHSN, founded in 1996),[37] the East Africa Integrated Disease Surveillance Network (EAIDSNet, founded in 2000),[38] South-Eastern Europe Health Network (SEEHN, founded in 2001),[39] the Middle East Consortium on Infectious Disease Surveillance (MECIDS, founded in 2003),[40] and the Southern African Centre for Infectious Disease Surveillance (SACIDS, founded in 2007).[41] Taken together, these networks span three continents, five of the six WHO regions, and 48 countries.

The unique structure of sub-regional networks gives them autonomy to more nimbly establish a bottom-up agenda to address shared priorities. They provide representatives from member countries with more opportunities to closely interact with their peers from other member countries. In the case of MBDS in particular, this includes interactions of local counterparts at cross-border sties. These interactions build trust, mutual respect and transparency among country members. For example, the successful response of MECIDS countries to the H1N1 pandemic was aided by a "remarkable level of trust has been built between senior officials and ministers through the cross-border collaborations."[42]

In December 2007, the Nuclear Threat Initiative's (NTI) Global Health Security Initiative held a conference in Bellagio, hosted by the Rockefeller Foundation, which resulted in a "Call to Action for Public Health Surveillance Networks."[43] This conference recognized the importance of sub-regional disease surveillance and called on the international community to "actively support current networks and efforts to develop and promote new cross-border networks." In 2009, NTI launched Connecting Organizations for Regional Disease Surveillance (CORDS) as a non-governmental global platform to link regional and sub-regional infectious disease networks to build a social fabric of experts who can communicate with one another and with global partners.[44]

HISTORY AND EVOLUTION OF MBDS

The overarching goal of the MBDS cooperation is to reduce morbidity and mortality caused by outbreak-prone diseases in the sub-region. MBDS cooperation began in February 1999 when senior health officials from all six Mekong countries informally agreed to collaborate on disease and outbreak management. They formalized their cooperation in November 2001 through a six-year Memorandum of Understanding, thereby creating the first sub-regional disease surveillance network to span across multiple WHO regions. This MoU was renewed and expanded in May 2007 to continue the cooperation indefinitely.

MBDS technical activities have evolved over the years, always addressing capacity building through training, communication, and joint activities coordinated both within and across countries. The initial focus was at the national level, followed by focused programming at designated "cross border" sites—paired localities on each side of the national border—at key locations. These sites have provided countries with a tangible mechanism to cooperate in joint disease surveillance and joint outbreak investigation, allowing them to develop real relationships built on mutual understanding and trust. The first cross-border site was created in 2003, and the number of sites grew to approximately 25 as of May 2011. Local cross-border cooperation is a particular hallmark of MBDS, and is not typical of other sub-regional surveillance networks.

An initial MBDS Action Plan for 2008-2013 was developed and subsequently replaced by the current MBDS Master Plan 2011-2016.[45] The plan describes seven strategic priorities identified by MBDS leaders in 2008: (1) maintain and expand cross-border cooperation and information exchange; (2) improve human-animal sector

interface and strengthen community-based surveillance; (3) strengthen epidemiology capabilities; (4) strengthen information and communications technologies capabilities; (5) strengthen laboratory capabilities; (6) strengthen risk communications; and (7) conduct and apply policy research (see Figure 3). As described below, MBDS has attempted to develop a system to monitor the achievement of objectives related to these priorities, but with only limited success.

MBDS Governance

The MBDS governance structure has been stable for over a decade. It is designed to build mutual trust, transparency, and cooperation. MBDS communications and operations are managed by a central coordinating office in Bangkok with four technical and administrative staff, including the Coordinator.[46] An executive board comprised of one senior health official from each member country establishes major policies and oversees the activities of the cooperation. The chair of this board rotates annually (in alphabetical order by country) to ensure equal roles and responsibilities across all member countries. Each country has a "country coordinator" who provides operational oversight for country level activities. Cross-border sites also have coordinators responsible for managing cross-border relations and activities.

MBDS Strategic Achievements and Challenges

Because it has been in place longer than most sub-regional disease surveillance networks, MBDS has been ahead of the learning curve for these networks. Perhaps its most important strategic achievement is the mutual respect and trust among members that has developed over the years. Such relationships can mean the difference between success and failure in responding to EIDs, and to sustaining cooperation as the intensity of external support declines. Other significant achievements are the predominantly horizontal orientation of the MBDS cooperation and the "owner-driven" nature of its technical agenda. Cross-border sites have focused on high-priority activities such as the training and deployment of rapid response teams for investigation of cross-border disease outbreaks. MBDS has worked with external partners to develop a tool to monitor progress on each of the core strategies. MBDS countries have also actively engaged multiple sectors in some of their work. For example, each country held a pandemic preparedness tabletop exercise at provincial or national level, which involved senior leaders from multiple sectors in their respective governments. These culminated in a regional tabletop exercise that included active participation by senior leaders from multiple sectors across all MBDS countries.[47]

Despite its many successes, MBDS still has many areas for continued growth. The limited focus of MBDS on accountability is a major challenge. Uptake has been slow the for monitoring tools that would allow local, provincial, and national managers and MBDS leadership to concretely measure progress, identify targets for improvements, and ultimately assess success of program operations. MBDS could also do a better job at

leveraging the specific strengths of each member country as a means to disseminate best practices—despite the fact that there are large socioeconomic differences across MBDS countries, each country has been innovative and has something to offer to other MBDS partner countries. Finally, MBDS planning and programming has been integrated into national health systems and aligned with the IHR to only a limited extent.

MBDS Tactical Achievements and Challenges

MBDS also has numerous tactical achievements that have been grounded in their bottom-up approach. Such successes include joint planning, exercising and outbreak investigations at local to provincial and national levels. These activities have been carefully held together by a series of regular meetings of paired cross-border sites as well as meetings across all member countries. The meetings present MBDS members with an opportunity to present findings from cross-border surveillance, joint disease outbreak investigations, tabletop exercises or recent training. They also provide members with the ability to network with one another and build relationships with a foundation of trust. Given these achievements, MBDS has attained a fair amount of visibility in the global community. The MBDS coordinator and other senior representatives have actively participated in a number of important initiatives including the CORDS initiative.[48] However, despite this, MBDS still faces a number of tactical limitations. The largest of these limitations are weaknesses in infrastructure and limited technical capacity that span nearly all MBDS countries to some degree.

ANALYSIS OF ISSUES RELATED TO SUB-REGIONAL SURVEILLANCE NETWORK PERFORMANCE AND SUSTAINABILITY

The complexities and challenges of public health surveillance and multi-country surveillance networking reflect tensions that create barriers to performance and sustainability—they impede the development, strengthening, and maintenance of core capacities as required by the IHR. Experiences from MBDS and other global health initiatives shed light on these tensions and inform opportunities relevant to sub-regional surveillance network performance and sustainability. The sections that follow examine several of these areas.

Vertical versus Horizontal Orientation

Over time there have been major swings in domestic health programming and global initiatives oriented around specific diseases ("vertical") versus systems strengthening ("horizontal") (Figure 4). Traditional wisdom is that vertical initiatives more easily attract funding, especially from external donors, but may lead to duplication, fragmentation and draining of—or extra burden on—human health resources in fragile national public health systems.[49] In contrast, horizontal initiatives are considered more difficult to implement and are less attractive to donors, and thus

enjoy only fleeting periods of prominence, but they are a surer pathway to sustainability.[50] However, the evidence base for the effect of vertical programs on horizontal efforts is "thin and conflicting."[51] The past decade has seen major vertical initiatives, oriented especially around HIV/AIDS, tuberculosis, malaria, and influenza, and also major horizontal initiatives, including the WHO Global Outbreak Alert and Response Network, IHR, Health Metrics Network and commitments of such major leaders as the G8 countries and the Asia Pacific Economic Cooperation.

Despite the apparent relative balance between vertical and horizontal global initiatives in recent years and the assertion that focus is shifting toward systems-oriented programming,[52] most development assistance funding has been for vertical initiatives.[53] Sub-regional disease surveillance networks are a good example of a horizontal initiative, but they also address vertical issues of mutual interest; capacity building within such initiatives (e.g., outbreak investigation and response) can help build broader system capacity to respond to outbreaks of other diseases.[54]

"Data" versus "Information" and Information for Dissemination versus Action

The various definitions of public health surveillance over the years (Table 2) are largely similar, yet they are subtly but significantly ambiguous on two key points. First, all definitions allude to "data" and none to "information." Second, most of the definitions call for "dissemination" of data and signal the intent that data be used to drive action, but they do not actually embody action within the definition itself. The WHO Health Metrics Network (HMN) notes that "much of the material [data] remains unprocessed, or, if processed, unanalyzed, or, if analyzed, not read, or, if read, not used or acted upon."[55] Only the 2003 Institute of Medicine (IOM) definition explicitly links surveillance data to prevention and control. Surveillance may not be linked systematically to action in some countries because the health system is organized with surveillance operated by staff not linked to response teams, and also because information collected is outdated and fragmented.[56] A number of authors have offered clarity on both the "data versus information" and "information for action" points.[57] They distinguish between "data" and "information," describe the process "to transform what is perceived as 'merely data' into information and evidence for action,"[58] and note the far greater value of information that is analyzed, interpreted, presented effectively, and ultimately used by public health officials. Others also explicitly link surveillance to response, whether or not action is literally embodied within the definition of surveillance itself.[59]

Surveillance data must be transformed into information that is presented effectively and used for public health action, and these points must be explicit and commonly understood. Definitions and usage should distinguish between the terms "data" and "information," and the framework offered by McNabb and the HMN should be adopted to explicitly note the process of converting data to information.[60] Rather than changing the definition of "public health surveillance" or assuming that everyone will simply assume that the definition of surveillance embodies action, we suggest that

the term "surveillance and response [systems]" be used. The HMN elaborates further on the importance of using data for action: "The availability alone [of information] does not guarantee that it will be used for improved decision-making… information produced should be used regularly at meetings and displayed where staff and the public can see it… country information should be made a core part of the day-to-day management of health system planning and delivery."[61]

Health Sector versus Multi-Sector Engagement

Public health surveillance requires the expertise of and linkages between multiple disciplines—clinical practice, epidemiology, laboratory, information technology, and others. For the past two decades, the importance of zoonotic diseases, and by implication, the agriculture sector and veterinary medicine, has been recognized as critically important to human public health, including public health surveillance in the context of global prevention and control of EIDs.[62] However, the multi-sector net actually must be cast more widely, to include the foreign policy, economic, security and related sectors—for example, trade, tourism, immigration, labor.

Experience has clearly demonstrated the link between EIDs and the economic sector.[63] The Rockefeller Foundation succinctly captures this connection: "[EIDs] threaten not only the health, but also the livelihoods of the world's poorest people."[64] In recent years, the foreign policy sector has engaged actively in the global health agenda, demonstrated aptly by several Ministers of Foreign Affairs (of Brazil, France, Indonesia, Norway, Senegal, South Africa and Thailand) who issued an agenda for shared action in their "Oslo Ministerial declaration: global health—a pressing foreign policy issue of our time."[65] They noted the "unprecedented convergence of global health and foreign policy" in the early 21st century and the interdependence of health with environmental, trade, economic, social development, national security, and human rights concerns. While not necessarily intending to do so, their declaration included several statements directly relevant to cross-border cooperation and sub-regional surveillance networks such as MBDS. For example, it articulates "the need for cooperation and collaboration, a respect for national sovereignty, a sense of shared responsibility, and the attributes of transparency, trust, accountability, and fairness." The Ministers recognized that "no country can isolate itself from cross-border risks and threats to their national health security" and called for "new mechanisms" and "new paradigms" for cooperation.

Recent EIDs have heightened concerns about global health security.[66] The WHO initiated the "Global Health Security: Epidemic Alert and Response" initiative a decade ago, based on the 2001 World Health Assembly Resolution 54.14 of the same name.[67] This resolution supported the subsequent revision of the IHR and was the first explicit connection of health to security by WHO and the first step toward linking health security to IHR compliance. The subsequent 2007 WHO World Health Report connected the dots between sectors further in asserting, "successful implementation of the IHR (2005) serves the interests of politicians and business leaders as well as the health, trade and tourism sectors."[68] Views about the links between health and security

are mixed. On one hand, the link is viewed favorably,[69] with scholars arguing regional disease surveillance networks "[promote] health security and cooperation";[70] on the other hand, some voice concerns about "hidden agendas" that could potentially harm international cooperation.[71]

National versus Local, Front-Line Surveillance Capabilities

Local public health surveillance is the cornerstone to national, regional, and global surveillance and response (see again Figure 1). The WHO IHR reinforces the importance of building and maintaining required core capacities, beginning at the local level, to detect, report, and respond to public health events within borders and events of broader international concern.[72] The local level must not only have the needed capabilities to carry out disease surveillance, but local managers must also feel a sense of ownership of locally-produced data and use these data for their own management and action.[73]

Reasonable Expectations (Responsibilities) of Countries versus Their External Partners

Sustainability is "the major research question for surveillance—how to maintain capable, motivated workers and an adequate system."[74] The performance and sustainability of public health surveillance systems requires long-term efforts including collaborative partnerships and sustained investments.[75] Within this framework, it is important to clarify the roles and responsibilities—i.e., reasonable expectations—for both countries and their external partners ("donors," including both funding and technical partners).

Countries have a major set of responsibilities: "At the end of the day, it is governments that have to sustain any reforms."[76] While the 2005 Paris Declaration focuses heavily on the responsibilities of donors, it also calls for "partner countries [to] commit to intensify efforts to mobilize domestic resources."[77] It is the responsibility of countries to ensure that they build and maintain the core capacities required by the IHR and to develop their internal resource base in at least the medium term:

> In principle the intent of [global health initiative] financing is to provide access to resources in the short- to medium-term that will allow provision of services until such time as these services can be paid for from domestic resources" and "at the national level… long-term financing strategies for health are needed.[78]

Empowerment, leadership, and ownership are important underlying principles to guide system reform and are important underpinnings to sustainability.[79] Active involvement of Ministries of Health improves the sustainability of health information system reform because it enhances ownership, acceptability and relevance.[80] However, the health infrastructure in many countries remains weak, and such countries rely heavily on external technical and financial support.[81]

External partners also have major responsibilities with regard to global public health surveillance capacity. There is no formal organization or funding stream in place to support global public health surveillance.[82] However, both by obligation, for example based on the IHR, and through long-standing voluntary initiatives, external partners can help countries develop their system capacities through sustained funding and technical support. Experts have offered a number of important principles or lenses through which to view the responsibilities and actions of external partners to help countries build sustainable core capacities, strengthen weak links in the global surveillance system, and thereby sustain global health and global health security:

- ***Mutual Interest—Sharing Solutions to Shared Problems*** The global nature of disease threats today means that all countries share a stake in the success of every country's surveillance and response system. This is a fundamental incentive for sustained support from external funding and technical partners to help countries build needed core capacities.[83]
- ***Investment*** A number of experts use the term "investment," some quite explicitly recommending that external financial and technical support be viewed as "investments," with expectations of "return on investments" that range from satisfaction in doing the right thing to actual health and economic benefits that extend beyond the borders of countries helped to improve health and health security regionally and globally.[84]
- ***Accountability*** Accountability means linking inputs to quantifiable results and requires accurate information at each stage of global health initiatives.[85] There has been an increasing trend in recent years toward "conditionality"[86] and "performance-based financing." Conditionality is "funding dependent on a government completing an agreed task, such as enacting a new health law or spending a certain share of its budget on health activities."[87] Note the aim to increase financial engagement by the countries themselves as part of such an arrangement. Hecht emphasizes both the benefits to countries and the importance of donor discipline in enforcing such an approach if implemented.
- ***Country Ownership*** A number of experts have advocated that external funding and technical partners support countries' own health agendas.[88] We have coined the term "owner-driven agenda" and contrast it with the traditional "donor-driven agenda" which remains in several forms today. The implications of an owner-driven agenda include coherence at the strategic and financial levels—alignment of donor contributions with national development strategies, institutions and procedures;[89] integration of data collection within countries' own information systems;[90] pooling of donor funds and decreased fragmentation and burden associated with countries needing to meet multiple independent donor requirements for scarce health personnel resources and administrative reporting.[91]
- ***Donor Harmonization*** The Paris Declaration calls for "donors [to] base their overall support on partner countries' national development strategies, institutions and procedures" and specifically for them to align with a single

national strategy/plan and single evaluation framework. Complementing this, Hecht also calls for pooling of donor funds and a limited number of coordinating bodies.[92]

- ***Aid Effectiveness*** This is an ongoing focus within the donor community. Donor alignment with national priorities and better coordination across donor organizations contribute to the ultimate effectiveness of donor aid.[93] There has been some debate, and ongoing examination, of the effects of global health initiatives on domestic spending for health, but data in this area remain inconclusive.[94]
- ***Commitment to Horizontal Investments*** G8 leaders have addressed health issues at every summit since 1996 and have recently committed to help strengthen country health system capacity.[95] In the Paris Declaration on Aid Effectiveness, Foreign Ministers of developed and developing countries committed to "harmonize and align aid delivery" with countries including efforts to build country capacities, simplify and coordinate donor requirements, and provide more predictable and multi-year support."[96] Moreover, even vertically-oriented global health initiatives such as the Global Fund to Fight AIDS, Tuberculosis and Malaria and GAVI have recently increased funding specifically for capacity building, i.e., "horizontal" investments.[97]

Kimball argues that external support for regional partnerships/networks, contrasted with support to individual countries, is efficient for external funding partners.[98] Experiences from health development assistance efforts in past decades have pointed to several lessons with regard to roles and responsibilities of countries and their external partners that are also relevant to sub-regional surveillance. Strong leadership is needed on the part of both countries and their external partners, all relevant stakeholders must be effectively involved from design through implementation, funding support must be consistent and predictable, technologies must be appropriate to the setting, and attention must be paid to infrastructure development, especially human resource development.[99] WHO also calls for the same (high) level of ambition and speed for horizontal efforts as for vertical initiatives, inclusion of indicators related to systems strengthening in (mostly vertical) global health initiatives, greater alignment of planning and resource allocation between global health initiatives and partner countries and across initiatives and donors; expansion of the evidence base for the costs and benefits of health systems strengthening, to inform increased investment in horizontal efforts, and ensuring a rise in both domestic (national) and external (global) financing for horizontal efforts—health system capacity building.[100]

A MODEL FOR SUSTAINABILITY

The preceding discussion suggests some guiding principles and a framework for sustainability that embodies what we term a "data-driven virtuous cycle"—an upward and self-perpetuating spiral—toward sustainability. This framework includes what we

term "sustainability-enabling factors." A matrix of these factors can be used to assess current progress and orient planning for future network sustainability. We apply this framework to MBDS as an initial proof of concept, as MBDS considers its own progress to date and opportunities to ensure long-term sustainability.

Guiding Principles

The model for sustainability presented here is based on two simple principles: do the right thing, and do the right thing right. Drawing from the preceding discussion, doing the right thing involves the following:

- ***Self-organized sub-regional networking*** is appropriately bottom-up in nature and feeds into larger regional and global networks, which in turn support the broader notion of global partnerships (and global solidarity) for global solutions to global problems. Self-organized networks should also be created through an appropriate (flexible) agreement and be self-governed.
- ***"Horizontal" health systems strengthening*** programs and initiatives should be an area of focus either alone or in the context of "vertical" programs and initiatives.
- ***Attention to the front line—building local level capabilities*** should be a key focus of capacity building by countries and their external partners.
- ***Integration of network programming*** into national health systems and integration of both into the framework provided by the IHR will create cohesion across multiple domestic and global health initiatives and stakeholders and will ultimately improve efficiency and effectiveness of local, national, regional, and global public health surveillance and response.
- ***Coordination*** of donor efforts with partner countries and with one another will contribute to efficiency and likely also effectiveness of capacity building efforts.
- ***Strategic priorities*** should include critical public health surveillance and response infrastructure elements and the capacity to advance knowledge to improve sub-regional networking.
- ***Joint activities*** represent the operational arm of sub-regional cooperation in disease surveillance and response and the practical implementation of strategies defined by the network itself.
- ***Shared commitment*** of political and health leaders within countries and of donor organizations is critical to the long-term efforts required to build and maintain effective health systems, in accordance with countries' own desires and the obligations of the International Health Regulations. This means long-term commitments by countries to mobilize and manage internal resources needed to build and maintain their core capacities and long-term commitments by external funding and technical partners to support such efforts for a sufficiently long time.
- ***Promoting network visibility—sharing experiences and lessons learned*** is important both to network members, to ensure comprehensive dissemination and learning across the network itself, but also to others, including

other sub-regional networks and to external partners and other stakeholders with vested interest in local, provincial, national, regional, and global disease surveillance, prevention and control.

"What is worth doing is worth doing right. Managers who decide to use public health surveillance as a management tool must recognize that they will need to commit political support and human and financial resources."[101] For sub-regional disease surveillance networks, doing the right thing right involves the following:

- ***Owner-driven agendas*** should underlie alignment of domestic and external efforts around one national strategy, one evaluation framework, and harmonization with and across donors.
- ***Data, information and action*** should drive the development, improvement and maintenance of public health surveillance. Data should be transformed into information and presented in an effective way to managers and decision makers at all levels. Public health surveillance is thereby closely connected with public health action.
- ***Accountability***, a culture of responsible stewardship and quality data should become the normative standard within sub-regional networks.
- ***Leveraging strengths across countries*** should be systematically practiced.
- ***Effective multi-sector engagement*** reflects not only current reality/need in today's world but also an important orientation to leverage strengths and resources across numerous relevant sectors beyond the health sector—foreign affairs, security, finance, agriculture, trade, tourism, and others.
- ***Relationships*** based on mutual respect, trust, and a shared sense of responsibility underpin successful sub-regional cooperation and public health surveillance system performance, and they are ultimately also an important foundation for sustainability.

Framework

Four connected pillars, drawn from the entire preceding discussion, anchor our framework for sustainability (Figure 5). First, data must be transformed into usable information and then into effective messages so that information can be used for public health action and is actually used for this purpose. Accountability derives from the responsible collection, analysis, interpretation, dissemination, and use of surveillance data, and feeds into what we call a "data-driven accountability cycle," which helps to create a data use culture.[102] Second, data-driven accountability contributes to, and is in return enhanced by, motivation and performance of health professionals involved in public health surveillance and thereby the performance of the system itself. Sustained training and supervision further strengthen worker motivation and performance.[103] Third, creating performance-based financing systems links investment to documentation of successful performance.[104] Whether or not financial investments are literally based on performance, intuition suggests that an effective data-driven

accountability cycle will contribute to motivation and performance, which will in turn enhance the likelihood of future investments. The basic concept of attracting "investment" is based on the expectation of generating returns on those investments—for example, timely and accurate information that is used responsibly by decision makers at all levels, from local to national to international, to detect, prevent, and control the spread of disease within and across borders. Thus, the very notion of investment in public health surveillance and response points toward the need to sustain such systems, since everyone has a stake in their quality, predictability, and stability. This leads to the fourth pillar, sustainability, which results from a set of sustainability-enabling factors, one of which embodies the data-driven accountability cycle.

Taken collectively, these four pillars form the data-driven virtuous cycle for sustainability shown in Figure 5, which encompasses the sustainability-enabling factors listed above and described in more detail below. These factors are the basis for matrices that can be used to characterize networks and to guide planning for their sustainability.

Sustainability-enabling Factors

Analysis of experiences with public health surveillance from around the world and of MBDS experiences to date informed the guiding principles which are the basis for our sustainability-enabling factors. In Table 3, we organize these factors into broad categories at the strategic and tactical levels.

Characterizing Networks Based on Sustainability-enabling Factors

These sustainability-enabling factors can be used to qualitatively characterize a sub-regional surveillance network in many different dimensions, which suggests where the network is positioned on a continuum toward sustainability. In Table 4, we present a detailed matrix for characterizing such networks. The general notion is that a larger number of factors characterized *toward* the right of the matrix or as "yes" suggests greater progress toward achieving sustainability of surveillance networking.

As a proof of concept, representatives from all six MBDS countries (co-authors BP, ST, LG, SLN, KU, NDV) independently completed this matrix. Table 5 presents the collective results of their assessments of the current status of the MBDS network for each factor. There was some divergence in perspectives across the different sustainability factors, yet the general direction of the assessments was similar. Converging assessments tended to be in the categories related to relationships, network priorities and network activities. Diverging views tended to be in the categories of governance, orientation and alignment, perhaps in some cases reflecting the different situations in the individual countries.

Planning for Network Sustainability

Based on the notional characterization of a network as organized and presented in Table 5, using MBDS as an example, it is clear that MBDS has achieved a significant number of sustainability-enabling factors. Specific planning toward sustainability should both acknowledge strengths and achievements while also identifying opportunities to improve—to further enable sustainability. Using MBDS again as an example, Table 6 offers a framework for such planning, based on classifying action for each factor as "maintain" (what is already good), "improve" (in those same areas), and/or "innovate." The first action category (maintain) needs little further elaboration. MBDS improvements are suggested by the characterization in Table 5. Improvements related to *governance* are to establish a foundation that is integrated into the established democratic MBDS structure already in place which will enhance administrative autonomy and facilitate acceptance and transfer of external funds; add to the value already provided by the Coordinating Office, for example by enhancing the information provided on the MBDS website. Improvements to MBDS *relationships* involve, to the degree possible, ensuring the ability of all MBDS countries to fully participate in, contribute to, and benefit from network cooperation. Improvements related to MBDS *orientation* are to focus specifically on transforming "data" to "information" and actionable messages from local cross-border sites to provincial and national levels across all countries; use monitoring more systematically at all levels, especially for local cross-border management and response; continue to strengthen links between the health sector and other relevant sectors to leverage strengths and resources and promote national and sub-regional policy coherence. Improvements related to *alignment* are to better integrate MBDS programming and monitoring into national health systems and align both MBDS and national programming with IHR obligations; and ensure smooth alignment and coordination across MBDS external partners. Improvements to MBDS *priorities* involve building upon activities associated with current (appropriate) strategic priorities, especially to build countries' IHR core capacities and to increase attention to policy research by carrying out and publishing results from studies aimed at improving any infrastructure element or process related to MBDS cooperation. *Infrastructure* improvements relate to achieving IHR core capacities in all MBDS countries—surveillance, response, preparedness, risk communication, human resources, laboratory, zoonotic diseases, and points of entry. Improvements to *network activities* involve ensuring that exchange of experiences and lessons learned can be continued through regular periodic meetings, online communications, or other channels; and considering opportunities to develop common laboratory protocols, equipment, and/or reagents. Improvements in MBDS *network visibility* involve enhancing visibility across the health sector and across sectors within countries, sharing experiences with other sub-regional networks and other relevant stakeholders (for example through active participation in CORDS), increasing attention to publication of relevant MBDS experiences, and considering development of MBDS as a center of excellence for sub-regional disease surveillance and response and related policy research.

CONCLUSION

This paper sought to facilitate sustainability of sub-regional disease surveillance networks through systematic examination of public health surveillance and experiences with MBDS, analysis of issues related to surveillance network performance and sustainability, and development of a model for sustainability. We offered a list of sustainability-enabling factors that can be used both to assess current status and orient planning for future network sustainability, and we applied them to MBDS as proof of concept. This paper is relevant to MBDS and to other sub-regional disease surveillance networks that may face their own challenges to sustainability as they mature, as well as to public health professionals involved in disease surveillance and the broader global health and development communities. Sub-regional infectious disease surveillance networks complement existing national and international/regional networks in important ways, and attention to their sustainability is critical if they are to continue to grow and thrive.

Figure 1: Surveillance Is the Cornerstone of Public Health, from Local to Global Level

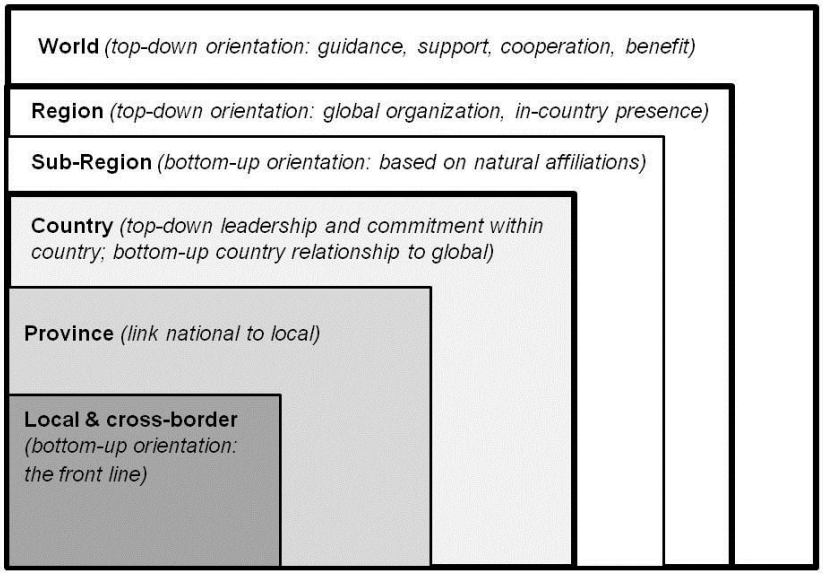
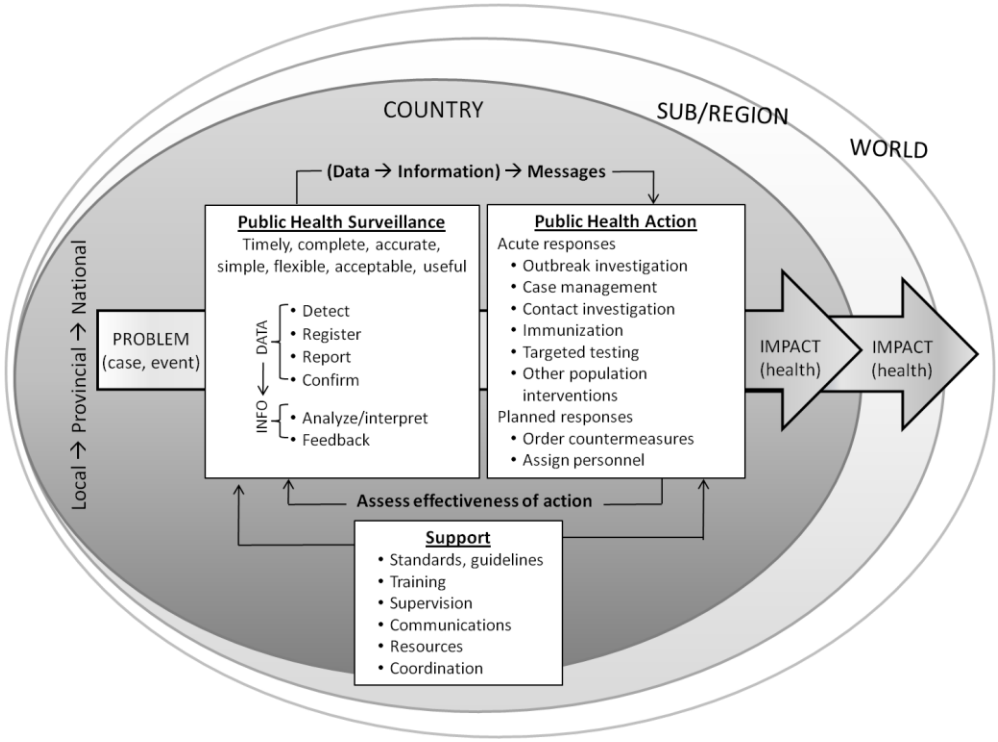


Figure 2: The Complexity of Surveillance Increases as National Surveillance Systems Feed into Regional and Global Surveillance*



*Adapted from McNabb et al. 2002 and HMN 2008

Figure 3: MBDS Strategic Priorities

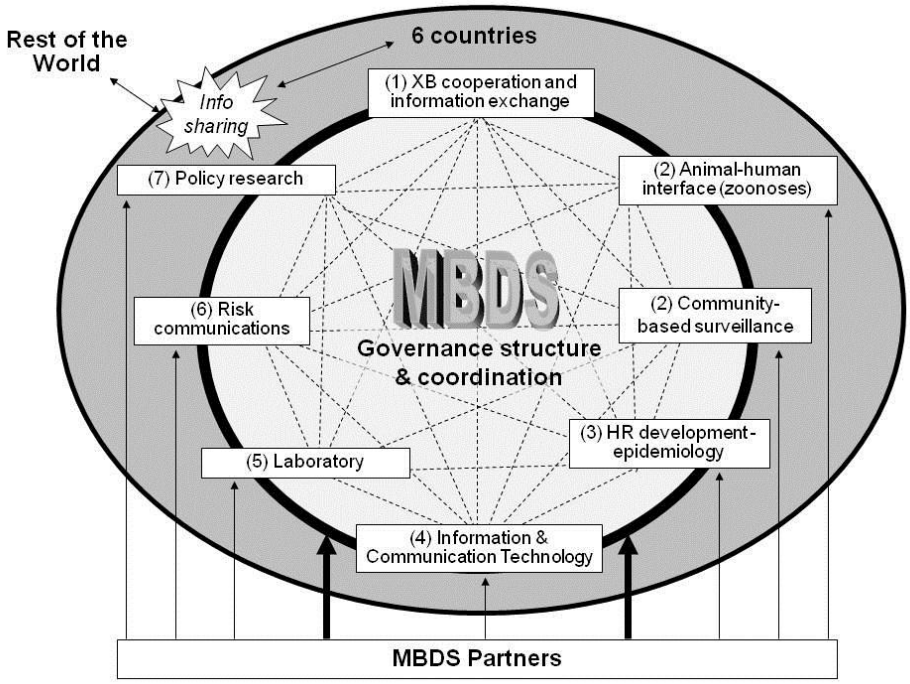


Figure 4: "Vertical" and "Horizontal" Global Health Initiatives Have Evolved over Time

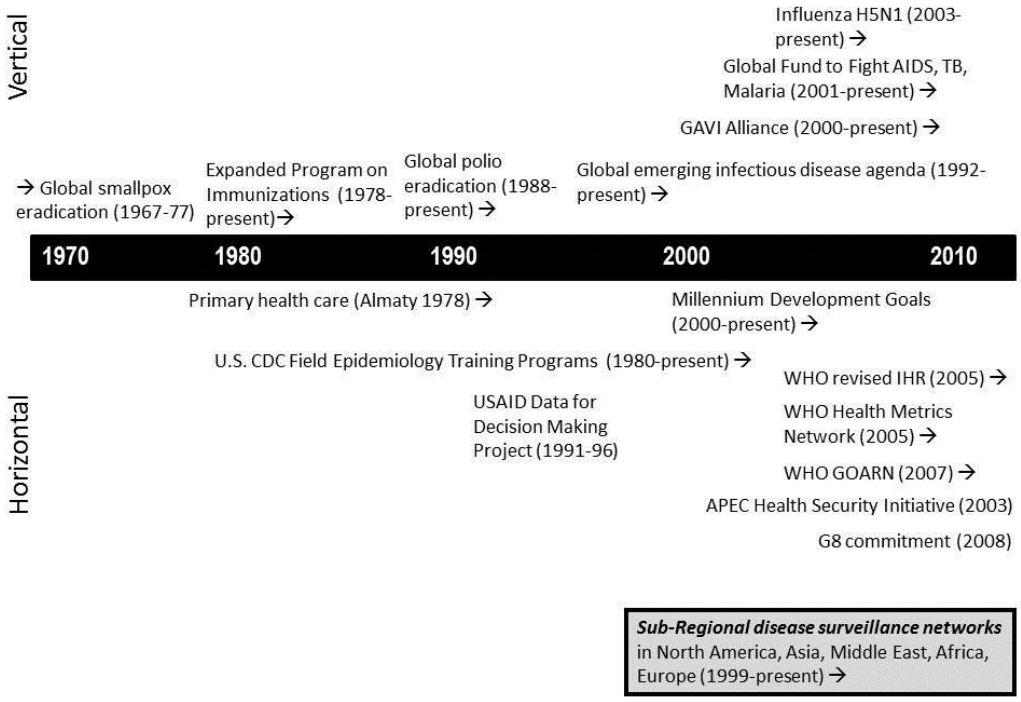


Figure 5: Framework for Sustainability: A Data-Driven Virtuous Cycle

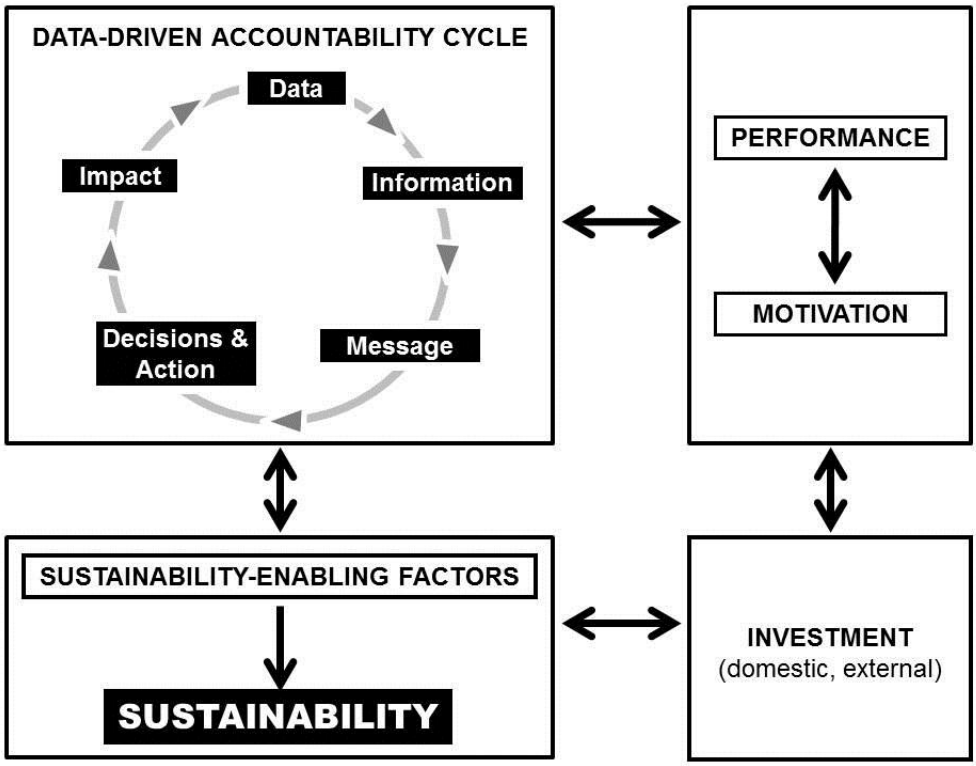


Table 1: Comparison of Characteristics of Regional and Sub-Regional Infectious Disease Surveillance Networks

Characteristic	**Regional Infectious Disease Surveillance Networks: WHO**	**Sub-regional Infectious Disease Surveillance Networks: MBDS and Others**
Organization	Large, multilateral, long-standing	Small, self-organized, recent
Agenda	Top-down: driven by the full set of Member States	Bottom-up: driven by a small number of member countries
Governance	Broadly self-governed: decisions made by consensus of all Member States at regional and global levels (World Health Assembly)	Narrowly self-governed: decisions made by consensus of a small number of member countries
	Partially representative executive board: includes representation from a small rotating subset of Member States	Fully representative executive board: includes representation from every member country
Legal basis	Constitution agreed upon by Member States IHR is a legally-binding treaty	Typically "soft," non-binding legal tools -- Memorandum of Understanding or other network-designed agreement
Affiliation	Large number of members: based on geography	Small number of members: based on natural affiliations, usually sharing borders

Table 2: Definitions of Public Health Surveillance

Date (Source)	**Definition**
< 1963 (Reported by Calain 2007)	"the continued watchfulness over the distribution and trends of incidence through the systematic collection, consolidation and evaluation of morbidity and mortality reports and other relevant **data**. Intrinsic in the concept is the regular **dissemination** of the basic data and interpretations to all who have contributed and to all others who need to know"
1963 Langmuir	"the collection, analysis, interpretation, and **dissemination** of (health outcome specific) **data** to those who need to know"
1988 Thacker and Berkelman	"ongoing systematic collection, analysis, and interpretation of outcome-specific **data for use** in the planning, implementation, and evaluation of public health practice" , closely integrated with the timely dissemination of these data to those responsible for preventing and controlling disease and injury
2000 Thacker	"the ongoing systematic collection, analysis, interpretation and dissemination of **data** regarding a health-related event **for use** in public health action to reduce morbidity and mortality and to improve health"
2000 WHO	"Surveillance means the systematic ongoing collection, collation and analysis of **data** for public health purposes and the timely **dissemination** of public health information **for assessment and public health response** as necessary." (proposed in World Health Assembly Resolution 58.3, as reported by Calain 2007 and Castillo-Salgado 2010)
2003 IOM	"ongoing systematic collection, analysis, and interpretation of health **data**, essential to the planning, implementation, and evaluation of public health practice, closely integrated to the dissemination of these data to those who need to know and **linked to prevention and control**"

Table 3: Sustainability-Enabling Factors for Sub-Regional Disease Surveillance Networks

Category	**Factors**
STRATEGIC LEVEL	
Governance	Agreement, structure, coordination, ease of funds transfer
Relationships	Shared commitment, shared responsibility, mutual respect, trust, transparency, fairness, empowerment, perceived mutual benefit, respect for national sovereignty
Orientation	Vertical versus horizontal, ownership, accountability, leveraging strengths and technical assets across network member countries, multi-sector engagement
Alignment	Alignment across member countries, with external partners, integration of network programming into national systems, alignment of network and national systems with IHR, alignment/coordination across partners
Priorities	Core strategies consistent with global priorities (cross-border cooperation, animal-human health interface, community surveillance, epidemiology capacity, information and communications technology capacity, laboratory capacity, risk communications, policy research)
TACTICAL LEVEL	
Infrastructure	Achievement of IHR core capacities: surveillance, response, preparedness, risk communication, human resources, laboratory, zoonotic events, points of entry
Activities	Joint: planning, meetings, exercising, outbreak investigation, response/prevention/control; surveillance information exchange; common protocols
Visibility	Recognition internally within and across countries, awareness from external partners, awareness beyond external partners

Table 4: Matrix for Characterizing Sustainability-Enabling Factors within Sub-Regional Surveillance Networks

Factor	**Status**				
STRATEGIC LEVEL					
GOVERNANCE					
Agreement	None	Unwritten	Written, informal	Written, formal (MOH)	Formal (above MOH)
Structure	None	Executive and/or country level	Also cross-border level	Fully integrated within countries	Fully integrated across countries
Coordination	None	Part-time coordinator	Full-time coordinator	Coordinator with staff	Respected, effective
Ease of funds transfer	Only within countries	No legal entity to receive-transfer funds; most external funding directly to countries	No legal entity but network coordinator can transfer external funds to countries for limited activities	Legal entity can receive-transfer external funds to countries	Legal entity efficiently receives and transfers external funds for all programming
RELATIONSHIPS					
Shared commitment	None	Low	Moderate	High	Sustained
Shared responsibility	None	Low	Moderate	High	Sustained
Mutual respect	None	Low	Moderate	High	Sustained
Trust	None	Low	Moderate	High	Sustained
Transparency	None	Low	Moderate	High	Sustained
Fairness	None	Low	Moderate	High	Sustained
Empowerment	None	Low	Moderate	High	Sustained
Shared responsibility	None	Low	Moderate	High	Sustained
Perceived mutual benefit	None	Low	Moderate	High	Sustained
Respect for national sovereignty	None	Low	Moderate	High	Sustained
ORIENTATION					

Factor	Status				
Horizontal (systems) versus vertical (disease) focus	No explicit horizontal focus	Some horizontal focus	Horizontal focus, not integrated with vertical programming	Horizontal focus, integrated with some vertical programming	Horizontal focus, well integrated with vertical programming
Ownership: Owner-driven versus donor-driven agenda	None: all donor-driven	Some: heavy donor influence	Moderate: largely owner-driven	Substantial: mostly owner-driven	Normative: well-balanced, sustained network ownership
Accountability: Data → Information → Action	Weak data collection	Weak link between data → information	Data → information linked at some levels	Data → information → action link moderate to strong local to national in some or all countries	Data → information → Action links strong at all levels across all countries
Leveraging technical strengths across countries	None	Occasional, ad hoc	Frequent, ad hoc	Systematic	Systematic, robust, sustained
Multi-sector engagement	None (health only)	Some links to animal health and/or other sectors at local, provincial and/or national level	Moderate links to animal health and/or other sectors at local, provincial and/or national level	Strong links to animal and other relevant sectors at all levels (local to national)	Strong, sustained links across relevant sectors

Factor	Status				
ALIGNMENT					
Across countries	Very poor	Poor	Medium	Good	Very good
With external partners	Very poor	Poor	Medium	Good	Very good
Integration of network programming into national systems	None	Some	All countries	Systematic across network	Sustained, systematic across network
Alignment of network and national systems with IHR	None	Some	All countries	Systematic across network	Sustained, systematic across network
Alignment/coordination across external partners	None	Some partners	Some or all partners, ad hoc	All partners, systematic	Sustained all partners, systematic
PRIORITIES					
Cross-border cooperation	No	Yes			
Animal-human interface	No	Yes			
Community surveillance	No	Yes			
Epidemiology capacity	No	Yes			
Laboratory capacity	No	Yes			
ICT capacity	No	Yes			
Risk communications capacity	No	Yes			
Cross-border/country communications capacity	No	Yes			
Research capacity	No	Yes			

Factor	Status				
TACTICAL LEVEL					
INFRASTRUCTURE	*Number of member countries achieving IHR core capacities (characterization pending required 2012 reporting to WHO)*				
Surveillance	None	One	>1	All	Effective networking
Response	None	One	>1	All	Effective networking
Preparedness	None	One	>1	All	Effective networking
Risk communication	None	One	>1	All	Effective networking
Human resources	None	One	>1	All	Effective networking
Laboratory	None	One	>1	All	Effective networking
Zoonotic diseases	None	One	>1	All	Effective networking
Points of entry	None	One	>1	All	Effective networking
ACTIVITIES					
Joint planning	No	Yes			
Joint exercising	No	Yes			
Joint outbreak investigation	No	Yes			
Joint response prevention/control	No	Yes			
XB surveillance information exchange	No	Yes			
Common protocols or resources across countries					
• Outbreak investigation	No	Yes			
• Response	No	Yes			
• Laboratory protocols	No	Yes			
• Laboratory equipment	No	Yes			
• Laboratory reagents	No	Yes			
Meetings					
• XB pairs	No	Yes			
• XB clusters	No	Yes			

Factor	**Status**				
• Full network	No	Yes			
• Full network + external partners	No	Yes			
VISIBILITY					
Recognition internally within member countries	Very low	Low: MOH aware, limited active engagement	Medium: Some MOH departments aware, limited engagement	High: MOH fully aware, engaged	Very high: Other ministries also aware, engaged
Media visibility in countries	Very low	Low	Medium	High	Very high
Awareness from external partners	Very low	Low	Medium	High	Very high
Awareness beyond external partners	Very low	Low	Medium	High	Very high

Table 5: Initial Characterization of MBDS Sustainability-Enabling Factors: Combined Survey Results from Six MBDS Countries

Factor	**Status (and number of countries assessing at this level)**				
STRATEGIC LEVEL					
GOVERNANCE					
Agreement				Written, formal (MOH) **(5)**	
Structure			Also cross-border level **(1)**	Fully integrated within countries **(1)**	Fully integrated across countries **(4)**
Coordination				Coordinator with staff **(2)**	Respected, effective **(4)**
Ease of funds transfer		No legal entity to receive-transfer funds; most external funding directly to countries **(1*)**	No legal entity but network coordinator can transfer external funds to countries for limited activities **(2*)**	Legal entity can receive-transfer external funds to countries **(1)**	Legal entity efficiently receives and transfers external funds for all programming **(3)**
RELATIONSHIPS					
Shared commitment			Moderate **(2)**	High **(4)**	
Shared responsibility			Moderate **(2*)**	High **(5*)**	
Mutual respect				High **(4*)**	Sustained **(3)**
Trust				High **(4)**	Sustained **(2)**
Transparency				High **(6)**	
Fairness		Low **(1*)**	Moderate **(2*)**	High **(4)**	
Empowerment		Low **(1)**		High **(5)**	
Shared responsibility			Moderate **(1)**	High **(4)**	Sustained **(1)**
Perceived mutual benefit			Moderate **(1)**	High **(2)**	Sustained **(3)**

Factor	**Status (and number of countries assessing at this level)**				
Respect for national sovereignty				High **(2)**	Sustained**(4)**
ORIENTATION					
Horizontal (systems) versus vertical (disease) focus			Horizontal focus, not integrated with vertical programming **(1)**	Horizontal focus, integrated with some vertical programming **(2)**	Horizontal focus, well integrated with vertical programming **(3)**
Ownership: Owner-driven versus donor-driven agenda				Substantial: mostly owner-driven **(3)**	Normative: well-balanced, sustained network ownership **(3)**
Accountability: Data → Information → Action		Weak link between data → information **(2*)**	Data → information linked at some levels **(3*)**	Data → information → action link moderate to strong local to national in some or all countries **(3)**	
Leveraging technical strengths across countries		Occasional, ad hoc **(2)**	Frequent, ad hoc **(2)**	Systematic **(2)**	
Multi-sector engagement		Some links to animal health and/or other sectors at local, provincial and/or national level **(2)**	Moderate links to animal health and/or other sectors at local, provincial and/or national level **(1)**	Strong links to animal and other relevant sectors at all levels (local to national) **(3)**	

Factor	**Status (and number of countries assessing at this level)**				
ALIGNMENT					
Across countries				Good **(3)**	Very good **(3)**
With external partners			Medium **(1)**	Good **(4)**	Very good **(1)**
Integration of network programming into national systems		Some **(3)**		Systematic across network **(2)**	Sustained, systematic across network **(1)**
Alignment of network and national systems with IHR		Some **(2)**	All countries **(1)**	Systematic across network **(1)**	Sustained, systematic across network **(2)**
Alignment/coordination across external partners		Some partners **(1)**	Some or all partners, ad hoc **(2)**	All partners, systematic **(3)**	
PRIORITIES					
Cross-border cooperation		Yes **(6)**			
Animal-human interface		Yes **(6)**			
Community surveillance		Yes **(6)**			
Epidemiology capacity		Yes **(6)**			
Laboratory capacity		Yes **(6)**			
ICT capacity		Yes **(6)**			
Risk communications capacity		Yes **(6)**			
Cross-border/country communications capacity		Yes **(6)**			
Research capacity	No **(1)**	Yes **(5)**			
TACTICAL LEVEL					
ACTIVITIES					
Joint planning		Yes **(6)**			
Joint exercising	No **(1)**	Yes **(5)**			
Joint outbreak investigation	No **(2)**	Yes **(4)**			
Joint response prevention/control	No **(1)**	Yes **(5)**			
XB surveillance information exchange		Yes **(6)**			
Common protocols or resources across countries					

Factor	**Status (and number of countries assessing at this level)**				
• Outbreak investigation		Yes **(6)**			
• Response	No **(2)**	Yes **(4)**			
• Laboratory protocols	No **(3)**	Yes **(3)**			
• Laboratory equipment	No **(5)**	Yes **(1)**			
• Laboratory reagents	No **(5)**	Yes **(1)**			
Meetings					
• XB pairs	No **(1)**	Yes **(5)**			
• XB clusters	No **(1)**	Yes **(5)**			
• Full network		Yes **(6)**			
• Full network + external partners		Yes **(6)**			
VISIBILITY					
Recognition internally within member countries			Medium: Some MOH departments aware, limited engagement **(2)**	High: MOH fully aware, engaged **(4)**	
Media visibility in countries		Low **(1)**	Medium **(4)**	High **(1)**	
Awareness from external partners			Medium **(3)**	High **(3)**	
Awareness beyond external partners		Low **(1)**	Medium **(2)**	High **(3)**	

* Indicates that one or more countries rated the factor at two different levels

Table 6: Matrix for Planning Network Sustainability and Initial MBDS Planning

Factor	Maintain	Improve	Innovate
STRATEGIC LEVEL			
GOVERNANCE			
Agreement	X		
Structure		X (integrate foundation into established governance principles)	
Coordination		X (add to the value already provided by Coordinating Office)	
Ease of funds transfer		X (establish legal entity to enhance ability to receive and transfer external funds)	
RELATIONSHIPS			
Shared commitment	X	X (shared commitment to sustain cooperation even in the face of limited external financial support)	
Shared responsibility	X	X (shared responsibility to continue network cooperation)	
Mutual respect	X		
Trust	X		
Transparency	X	X (ensure awareness and transparency at all levels across all countries)	
Fairness		X (ensure ability of all member countries to participate fully in network cooperation)	
Empowerment		X (ensure at all levels across all countries)	

Factor	Maintain	Improve	Innovate
Perceived mutual benefit	X		
Respect for national sovereignty	X		
ORIENTATION			
Horizontal (systems) versus vertical (disease) focus	X		X (conduct research on MBDS systems-oriented programming)
Ownership: Owner-driven versus donor-driven agenda	X		
Accountability: culture of responsible stewardship and quality data – Data → information → action		X (enhance data → action cycle and use monitoring regularly from local to national and network levels)	
Leveraging strengths and technical assets across countries		X (pursue more systematically)	
Multi-sector engagement		X (continue to strengthen links to animal health and other relevant sectors)	
ALIGNMENT			
Across countries	X		
With external partners	X		
Integration of network programming into national systems		X	
Alignment of network and national systems with IHR		X	
Alignment/coordination cross external partners	X	X (expand external partners, ensure alignment across all partners)	
PRIORITIES			

Factor	Maintain	Improve	Innovate
Cross-border cooperation	X		X (scale up cross-border model within national systems)
Animal-human interface		X (strengthen, expand)	
Community surveillance		X (strengthen, expand)	
Epidemiology capacity	X (continue to build)		
Laboratory capacity	X (continue to build)		
ICT capacity	X (continue to build)		
Risk communications capacity	X (complete plan, build)		
Cross-border/country communications capacity	X		X (CORDS -- MBDS is a founding member)
Research capacity		X (build capacity, expand research)	X (apply for research grants as a sub-regional entity)

Factor	Maintain	Improve	Innovate
TACTICAL LEVEL			
INFRASTRUCTURE			
Surveillance		X	
Response		X	
Preparedness		X	
Risk communication		X	
Human resources		X	
Laboratory		X	
Zoonotic diseases		X	
Points of entry		X	
ACTIVITIES			
Joint planning	X		
Joint exercising	X		
Joint outbreak investigation	X		
Joint response prevention/control	X		
XB information exchange	X		
Common protocols • Outbreak investigation • Response • Laboratory protocols • Laboratory equipment • Laboratory reagents	X X 	 X X X	

Factor	Maintain	Improve	Innovate
Meetings • XB pairs • XB clusters • Full network • Full network + external partners	X		X (virtual meetings)
		X	
		X	
		X	
VISIBILITY			
Recognition internally within and across member countries	X (continue surveillance information exchange, MBDS website)	X (online MBDS bulletin for network members; increased visibility across relevant sectors)	
Awareness from external partners	X (continue communications and relationships with external partners)	X (online MBDS bulletin also available to current partners; seek new partners)	
Awareness beyond external partners	X (continue limited participation in non-MBDS meetings to share MBDS experiences)	X (online MBDS bulletin fully publicly available; publish in professional journals; increased participation in non-MBDS meetings to share MBDS experiences)	X (establish MBDS center of excellence for surveillance and response networked systems research)

Melinda Moore *is a Senior Health Researcher and the Associate Director for Global Public Health at the RAND Corporation.*

David J. Dausey *is an adjunct researcher with the RAND Corporation and Professor of Public Health and Director of the Mercyhurst Institute of Public Health at Mercyhurst College.*

Bounlay Phommasack *is Deputy Director General, Department of Hygiene and Prevention at the Ministry of Health in the Lao People's Democratic Republic.*

Sok Touch *is Director of the Center for Disease Control at the Cambodian Ministry of Health.*

Lu Guoping *is Deputy Director, Division of African and Asian Affairs, Department of International Cooperation in the Ministry of Health of the People's Republic of China.*

Soe Lwin Nyein *is Director (Epidemiology) of the Department of Health in the Myanmar Ministry of Health.*

Kumnuan Ungchusak *is Senior expert in Preventive Medicine (Epidemiology), Bureau of Epidemiology, and International Health Regulation Focal Point in the Department of Disease Control at the Thailand Ministry of Public Health.*

Nguyen Dang Vung *is a Senior Officer in the Health Policy Unit, Planning and Finance Department in the Ministry of Health of Vietnam.*

Moe Ko Oo *is the Coordinator at the Mekong Basin Disease Surveillance Cooperation Coordinating Office.*

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