

Biosurveillance: a systematic review of global infectious disease surveillance systems from 1900 to 2016

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Summary

Biosurveillance is crucial to detect, identify and minimise the negative consequences of infectious disease. Its value to society and importance to global public health and global health security are growing. Despite the long history and global importance of biosurveillance, a systematic review of all existing biosurveillance systems across the 'One Health' spectrum has not yet been published. This study conducted a systematic review to identify all extant and defunct biosurveillance systems from 1900 to 2016. Of the 815 systems examined, the majority surveyed human, animal or plant data discretely. Some 105 collected human and animal data, whereas only 31 collected data on all three categories.

The authors found a large increase in the number of global biosurveillance systems between 1900 and 2008, but a reduction in the number of biosurveillance systems from 2008 to the present. The number of syndromic systems created, versus laboratory-based biosurveillance systems, increased rapidly after 1980 across the globe. However, in 2008, there was a large contraction in the number of biosurveillance systems. The authors also provide the number of biosurveillance systems per capita. Developed nations have greater biosurveillance coverage per capita than developing nations. The database created in this review includes over 800 documented traditional and syndromic surveillance systems used internationally between 1900 and 2016. Finally, the authors discuss the implications of global biosurveillance in relation to the detection of outbreaks of disease.

Keywords

Biological threat reduction – Biosurveillance – Biosurveillance history – Global health security – Surveillance – Surveillance systems.

Introduction

Global biosurveillance is crucial for the identification and prevention of emerging and re-emerging infectious diseases, and its usefulness in public health and animal health has been amply demonstrated throughout its long history (1, 2). The operational definition of biosurveillance as discussed and used throughout this review is as follows: 'Biosurveillance is the process of gathering, integrating, interpreting, and communicating essential information related to all hazards, threats, or disease activity affecting human, animal, or plant

health to achieve early detection and warning, contribute to overall situational awareness of the health aspects of an incident, and to enable better decision-making at all levels' (3).

Although newly created biosurveillance systems are often intended to complement or expand the capabilities of existing systems, current global biosurveillance capacity has rarely been comprehensively documented or reviewed in a single journal article, government report, or other scholarly literature. Since these biosurveillance systems have not been documented and compiled into a single report, determining

the potential impact, need for and usefulness of new biosurveillance systems is difficult (4). Without awareness of the current global biosurveillance landscape, there is a risk of misallocating resources through unnecessary duplication of biosurveillance systems in some areas, while potentially leaving gaps in coverage in other areas.

The increased risk of infectious disease emergence and the development of new technologies to detect infectious disease outbreaks have led to a new era of biosurveillance research and development (4, 5, 6, 7). The 2005 revision of the 1969 International Health Regulations (IHR) reflects the growing need for timely, accurate and integrated biosurveillance systems and tools. The revised IHR outline novel system requirements for sensitivity, timeliness, stability, flexibility, data quality and reporting from the local to the global scale (8). In 2012, the Office of the President of the United States released its first National Strategy for Biosurveillance, stating that a well-integrated, national biosurveillance system was imperative for decision-making at all levels (9). The 2005 IHR noted that biosurveillance systems often lack cohesion within countries and across global boundaries, a factor that limits their effectiveness in detecting emerging disease threats (8).

While there has been much focus on describing how biosurveillance systems should be designed and how they should function, a comprehensive review of all existing biosurveillance systems would be extremely useful to identify the gaps between existing surveillance systems and to determine what types of biosurveillance systems are currently needed. In this paper, the authors attempt to respond to this challenge.

In this study, past and present biosurveillance systems were collected and categorised into a comprehensive data set. The collected data include information on current biosurveillance systems, failed or discontinued systems, and biosurveillance pilot studies. These data also describe global biosurveillance capacity over time and can be used to identify gaps in the capabilities of current global public health biosurveillance systems. Additionally, biosurveillance system counts, ownership and composition are analysed over time. Lastly, the geographical density of biosurveillance systems is analysed and gaps in biosurveillance coverage are identified. The results of this study have the potential to guide improvements in future biosurveillance research and development.

Methods

Operational definitions

A major obstacle in the study of biosurveillance is the lack of consistent, accepted and widely adopted definitions for

the various types of biosurveillance methods and systems currently in use (10). As biosurveillance has moved beyond governmental institutions and into the realm of organisations such as hospitals, zoos, businesses, technology companies and non-profit organisations, information streams have diversified to include a variety of non-traditional data streams (e.g. Twitter, Facebook and Instagram) (7). The lack of consistent operational definitions and growing diversity of organisations engaged in biosurveillance activities demand a biosurveillance lexicon that incorporates strict operational definitions (10, 11).

To facilitate the authors' analysis, concise operational definitions were established through a literature review (see below) before data were collected. These definitions were selected using a modified Delphi method and employed biosurveillance experts to create comprehensive operational definitions.

Data

Systematic data collection was used to identify and catalogue local, regional and global biosurveillance systems that had previously collected or currently collect data on human, animal or plant health, in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for systematic reviews (12). Biosurveillance systems were identified on the websites of prominent public health organisations (e.g. the United States [US] Centers for Disease Control and Prevention [CDC] and the World Health Organization [WHO]); from systematic search queries on Google, Google Scholar and PubMed, based on relevant keywords (e.g. 'biosurveillance system' and 'disease surveillance system'); from specific historic outbreaks (e.g. '2003 severe acute respiratory syndrome [SARS] surveillance'); and from location names (e.g. 'India biosurveillance system'). An intensive literature review was conducted to uncover pilot programmes and historic systems that may be poorly documented on the Internet (Table I).

Biosurveillance system

Biosurveillance is the process of systematically gathering, integrating, analysing and disseminating information related to human, animal or plant health (3, 13). This definition includes both systems that continuously collect health data, and systems that were established for use in outbreaks but remain dormant until activated.

Laboratory-based surveillance

Laboratory-based surveillance systems are biosurveillance systems that rely on laboratory confirmation of disease presence. Examples of laboratory-based surveillance include confirmed case counts from hospitals, clinics and laboratory testing reports.

Syndromic surveillance

At present, there is no consensus on what constitutes syndromic surveillance. Most uses of the term refer to data collected on health events without confirmed laboratory identification. The common goal of syndromic surveillance is to identify disease clusters earlier than with traditional methods (1, 2). In this study, syndromic surveillance is defined as the systematic collection, analysis and dissemination of a broad array of non-laboratory-based data (11, 14, 15).

In this study, ‘pre-diagnostic’ refers to case counts without laboratory-confirmed diagnosis. Therefore, systems that count clinical diagnoses based on symptoms and syndromes are identified as syndromic surveillance. Justification for this distinction includes the clinical overlap of disease symptoms (i.e. fever, diarrhoea), the low specificity of interim case definitions in outbreak settings (16), and the necessity for laboratory-based analysis in identifying most infectious disease agents. Other examples of syndromic surveillance include trends in purchasing over-the-counter medications, self-reporting and Internet search queries.

Analyses

Initial searches were designed to cast a wide net and locate as many potential biosurveillance systems as possible. After preliminary data collection, candidate biosurveillance

systems were reviewed to ensure that they met this study’s operational definitions of biosurveillance (see above) and the inclusion/exclusion criteria (Table II). Laboratory networks, alert and communication systems, epidemiological reports, and past biosurveillance efforts were all reviewed and ultimately included in the final database. Capacity-building programmes, education or advocacy groups, informal communication forums on biosurveillance, and pilot systems that were proposed but never initiated were excluded.

Websites and peer-reviewed literature associated with each biosurveillance system were reviewed to determine:

- i) the sector of the organisation that created the system (government, non-profit or for-profit)
- ii) the date on which the system was created
- iii) the date on which the system was terminated
- iv) the geographical area surveyed (global, country, region or city)
- v) the types of data collected
- vi) whether the system performed active, passive, syndromic or Web-activity surveillance
- vii) the type of organism monitored by the system (humans, animals or plants)
- viii) the specific symptoms or diseases under surveillance.

Table I
Classification categories used for data sources, with operational definitions and examples

Surveillance systems: data sources	Operational definitions	Examples
Clinical	Data gathered from medical facilities or professionals	Physician diagnoses, Emergency Department data (chief complaints, hospital admittance), Veterinary Services
Non-clinical	Human-health-related or syndromic data gathered or inferred from non-clinical sources	Prescriptions, over-the-counter sales, absenteeism, call centres, health plans
Laboratory	Data gathered from laboratories	Laboratory test results; includes culture-dependent and culture-independent methods
Public health organisations	Reports from accredited public health institutions or organisations involved in human health	Incidence and prevalence reports, case counts from organisations such as the United States Centers for Disease Control and World Health Organization
Food, plant or animal health	Reports from accredited institutions or organisations on animal, plant, food or environmental health and safety	Food and Agriculture Organization of the United Nations, animal control and plant regulatory agencies
Field reporting	Data collected on plant or animal health in the field	Wet-market surveillance, sick or dead domestic animals and wildlife, presence of pests
Self-reporting	Voluntary reports	Surveys, polls, case reports
Literature	Peer-reviewed literature	Journals, books
News	Media sources	Online and print media
Social media	Social networking websites and applications	Facebook, Twitter
Internet activity	Patterns of Internet usage	Search queries, Web-access logs
Other surveillance systems	Data gathered from other surveillance systems	Anything not fitting the other definitions provided in this table

Government agencies and intergovernmental bodies (e.g. the European Commission) were identified as belonging to the government sector. Organisations self-described as non-profit or not-for-profit, registered charities, or in equivalent language were considered part of the non-profit sector, while corporations were classified as 'for-profit' bodies. Data sources were classified as per Table I. Data were aggregated and summarised in R (Version 3.2.2, 2015), an open-source software package.

Results

The first round of data collection identified 980 potential biosurveillance systems. Two hundred and sixty systems were flagged for potential exclusion (Table II).

Table II
Biosurveillance exclusion criteria based on the characteristics of each system

Systems excluded from analysis	Systems retained for analysis
Capacity-building networks	Software platforms
Biosurveillance education programmes	Communication platforms
Advocacy and policy groups	Alert systems
Informal communication forums	Epidemiological reports
Pilot systems that were never used	Pest biosurveillance
Information deemed insufficient	

Of these 260 systems, 165 were excluded and 95 were included. The final database contains information on 815 biosurveillance systems. Of these, 706 surveyed humans, 180 surveyed animals and 66 surveyed plants. Two hundred and sixty systems conducted syndromic surveillance but it was not possible to assess the syndromic nature of 376 systems, due to inadequate information. Government entities operated 689 systems, non-profit organisations operated 134 systems, and for-profit bodies operated 31 biosurveillance systems (Fig. 1). Various surveillance bodies from different sectors collaborated on 35 biosurveillance systems.

Data were also collected on the creation and termination date of each biosurveillance system (Fig. 2). Of the 815 biosurveillance systems in the database, 682 provided information on the year of creation and (unless the system is currently active) the year of termination. Biosurveillance systems are active for an average of 11.35 years (median: 9). Biosurveillance system creation peaked in 2006, tailing off in subsequent years. The termination of active systems increased significantly after 2000, peaking in 2013 (Fig. 2). Accounting for system creation and termination, the largest concurrent number of active surveillance systems was 513, which occurred in 2011.

The United States had the largest number of biosurveillance systems (290). However, the number of biosurveillance systems per country is not a meaningful measure of biosurveillance effort, as the US also covers a larger area and has a larger population than many other countries. To correct for this potential bias, the number of biosurveillance systems per capita was plotted for each country. Biosurveillance systems per capita may better illustrate biosurveillance coverage than raw counts of biosurveillance systems. Consequently, developed nations have more systems per capita than developing nations (Fig. 3). The US, for example, has 0.05 systems per 100,000 people. The country with the highest number of biosurveillance systems per capita is Tuvalu, with 40.4 per 100,000 people. However, Tuvalu's comparatively small population inflates this value. The countries with the fewest biosurveillance systems per capita are Iran (0.001), China (0.001) and India (0.001).

Laboratory-based biosurveillance was the predominant type of biosurveillance. Both laboratory-based and syndromic biosurveillance systems were created at about the same rate until the year 2000, when the creation rate of syndromic systems began to outpace that of laboratory-based systems. The total global number of syndromic systems overtook laboratory-based systems in 2008, and the number of syndromic biosurveillance systems has continued to grow. The number of laboratory-based systems peaked in 2011 at 131, and fell to 99 laboratory-based systems that were still active in 2016. The number of syndromic systems peaked at 135 in 2011, and fell to 127 syndromic systems that were still active in 2016. Fifty-six per cent of biosurveillance systems were labelled as either 'laboratory-based' or 'syndromic'.

Six hundred and forty-six surveillance systems were independently operated by government-sector organisations, 95 were operated solely by non-profit organisations, and 17 were operated by private, for-profit companies. In regard to partnerships, 33 surveillance systems were operated by government and non-profit bodies in partnership; eight were operated by partnerships between government and for-profit companies; and two were operated by government, private and non-profit organisations in collaboration.

Most biosurveillance systems conducted human biosurveillance (706 were mixed systems, while 598 were human-only systems). These were followed by animal surveillance systems (180 mixed, 57 animal-only systems), and plants (66 mixed, 14 plant-only systems). One hundred and five systems collected information on both humans and animals, while 31 collected information on all three classes of organisms.

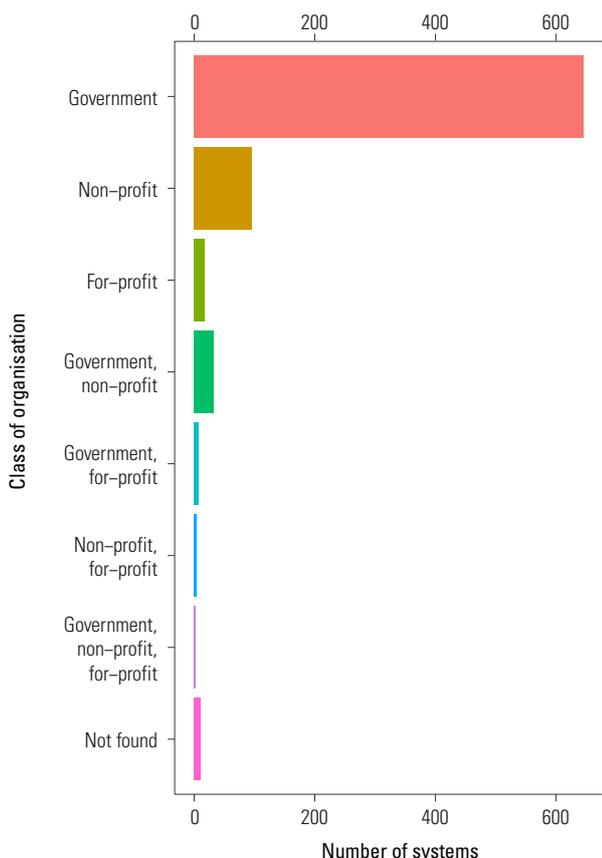


Fig. 1a
Organisations conducting biosurveillance
 The operation and ownership of biosurveillance systems globally from 1900 to 2016 by type of organisation. All possible combinations of ownership are depicted in the bar chart. Government organisations and non-profit organisations have operated the majority of biosurveillance systems during this time frame

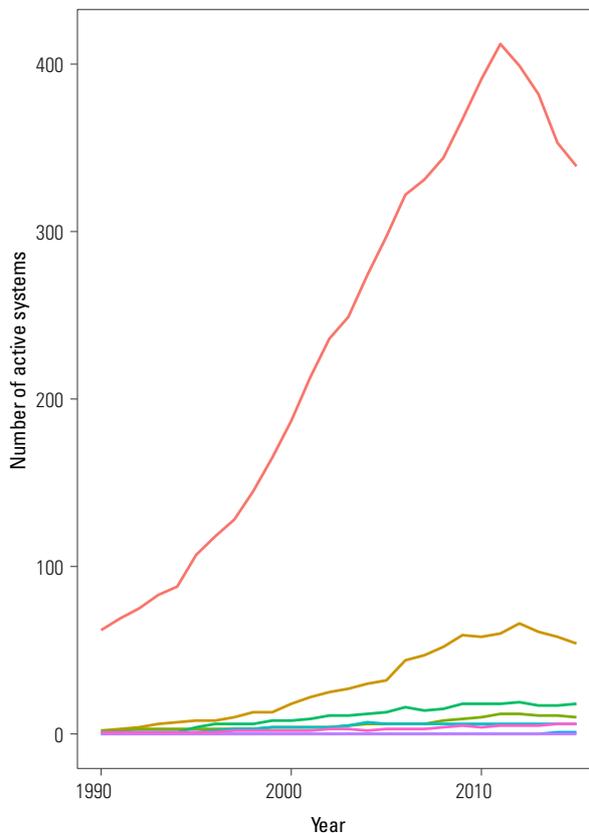


Fig. 1b
Changes in biosurveillance organisations over time
 The number of global active biosurveillance systems since 1990. The coloured lines represent the type of owner and operator of biosurveillance systems and all possible combinations of ownership (colours correspond to those used in Fig. 1a)

Discussion

Through a systematic search-and-review process, an extensive database of local, regional, national and global biosurveillance systems that currently collect infectious disease data on humans, animals and plants was created. Eight hundred and fifteen systems were included in the final analysis.

Creation and termination of biosurveillance systems

Beginning in 1975, new biosurveillance systems were created at increasing rates (Figs 1, 2 & 4) and the number of active surveillance systems grew substantially each year. This trend continued through the 1980s and 1990s, with the number of new systems created each year increasing from under five in 1980 to over 25 each year in 1995, 1999–2007 and 2008–2012. This reflects increased activity in the biosurveillance field, following the development

and widespread adoption of computers and the Internet (17, 18, 19), which radically improved the way in which health data were stored, analysed and communicated. System creation peaked in 2009, with 47 new systems introduced. This may have been due to the introduction of the updated IHR in 2005. These revised regulations called for improvements to global biosurveillance infrastructure and reporting time in order to help to mitigate the spread of infectious diseases. The significant structural improvements and funding reallocation needed to implement programmes that satisfied these new guidelines may have taken many countries several years to complete. The accuracy of the time-series analyses (Figs 1, 2 & 4) may also be skewed by information bias as older systems, especially those that have been terminated, probably have less documentation available.

In the period between 2010 and 2014, the number of biosurveillance systems created and terminated each year varied substantially (Fig. 2). This suggests that there may have been a high degree of experimentation in these years,

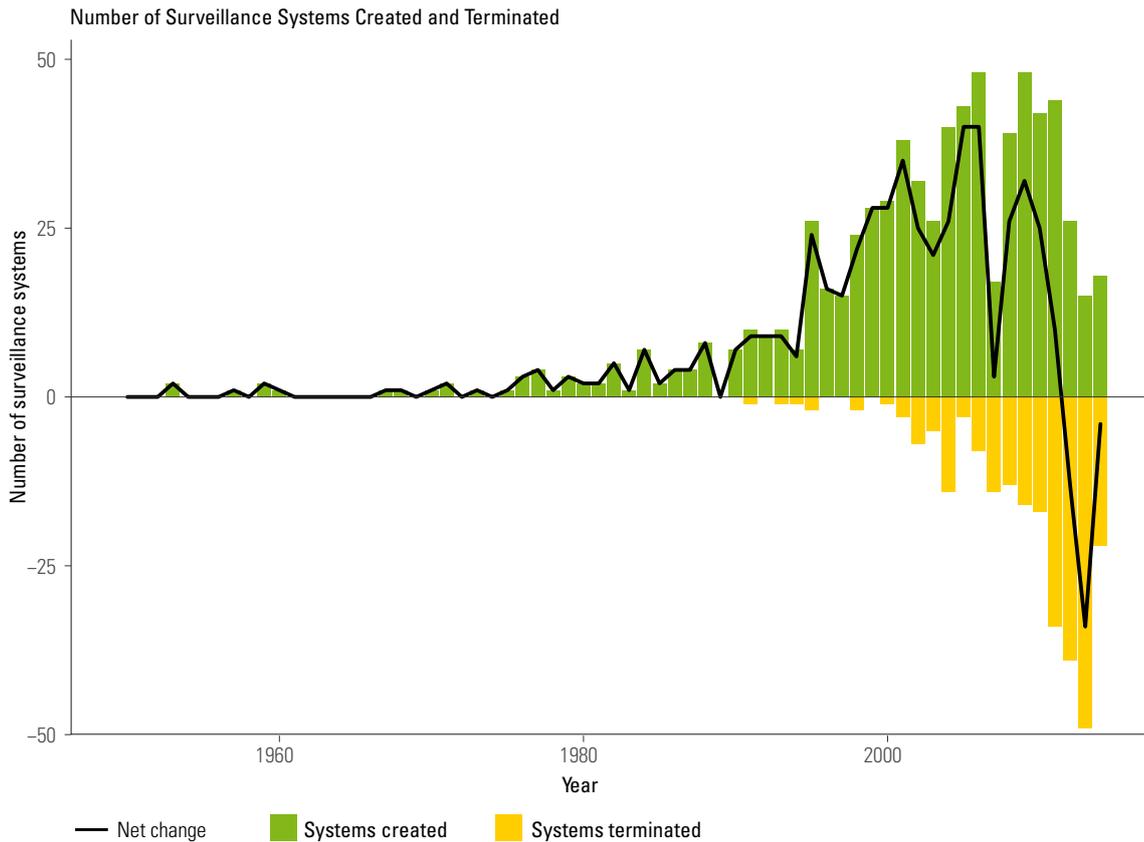


Fig. 2

The number of biosurveillance systems created and terminated over time worldwide

The green area of the histogram represents new biosurveillance systems created globally over time. The yellow area of the histogram represents the number of existing biosurveillance systems that were terminated globally over time. The black line indicates the net number of biosurveillance systems created or terminated globally each year. There is a significant increase in the number of biosurveillance systems terminated circa 2008, worldwide

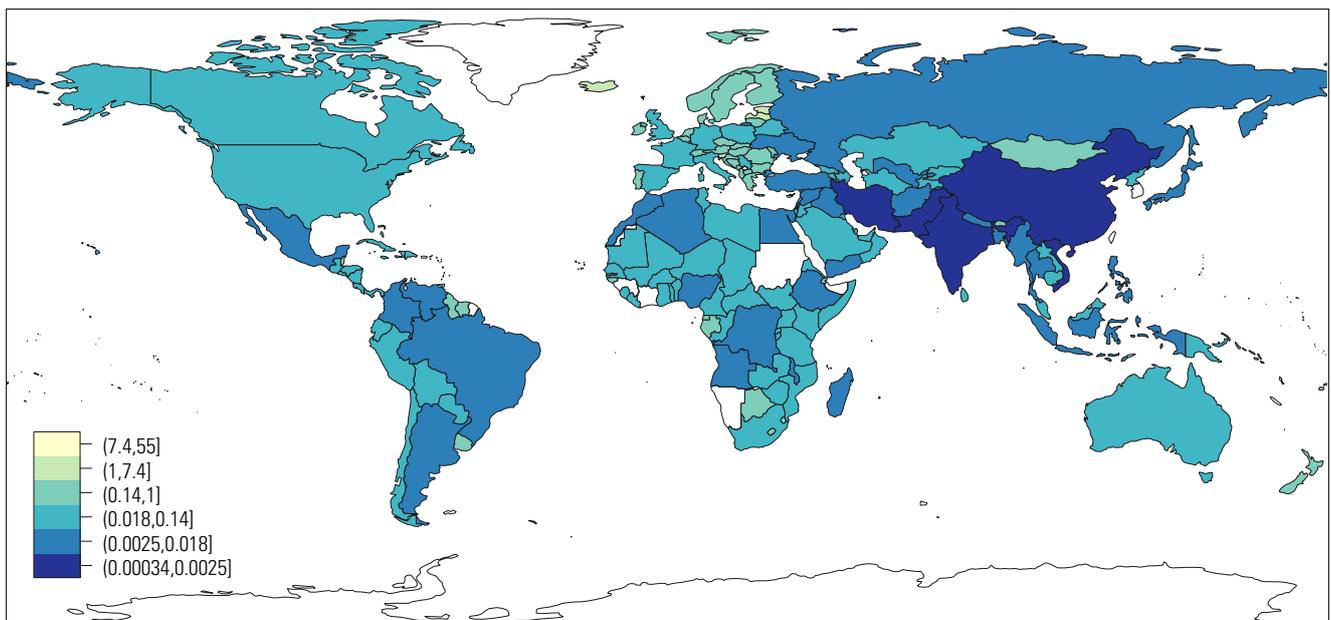


Fig. 3

The spatial distribution of biosurveillance systems by country per 10,000 people in 2016

White on the map represents no data and does not necessarily mean that there are no systems in those locations (e.g. Antarctica, Greenland and Sudan). In fact, Sudan is routinely named in ProMED–mail reports, which sometimes include health news reports

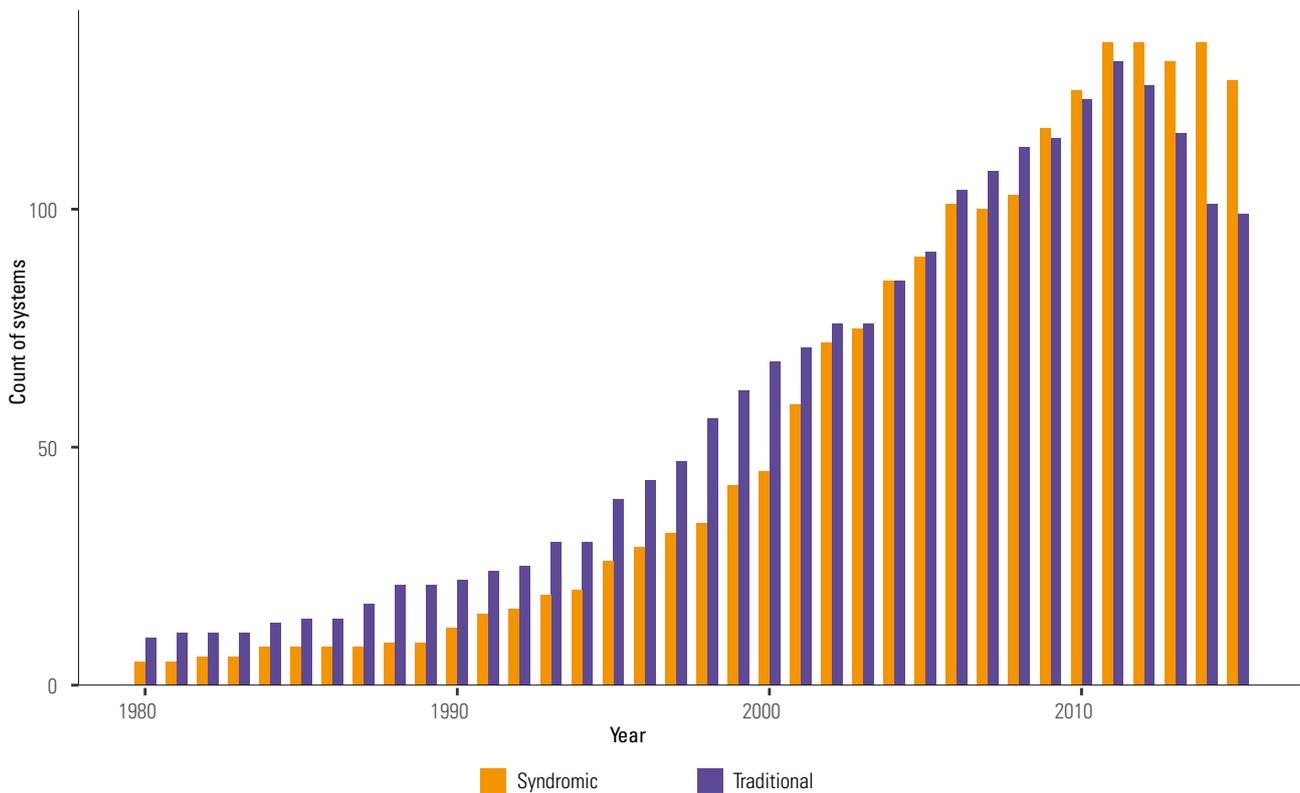


Fig. 4
Syndromic versus traditional biosurveillance systems

The purple bars represent the count of laboratory-based biosurveillance systems globally. The orange bars represent the global number of syndromic biosurveillance systems. The proportion of biosurveillance systems conducting syndromic biosurveillance, versus laboratory-based biosurveillance, is increasing

during which many systems were created and initiated but not maintained. This finding could be affected by information bias, as an Internet presence that contained creation and termination dates may have become more common for systems created after 2010.

In 2011–2014, the number of systems terminated exceeded the number of systems created, causing the overall number of active biosurveillance systems to fall for the first time (Figs 1, 2 & 4). While this could be due to information bias or inherent biases in the data collection procedure, economic factors are more likely to have caused this decrease in the number of biosurveillance systems. The global financial crisis in 2008 had a severe impact on the US economy and, consequently, government spending on healthcare plateaued in the following years, with the slowest growth in spending in recent history (20). As 290 of the 815 systems analysed (approximately 36%) were US-based, the downturn in government spending in the US was associated with a large drop in the number of biosurveillance systems globally.

One of this study's hypotheses is that the existence of multiple biosurveillance systems would tend to improve

both the overall sensitivity of biosurveillance (i.e. the likelihood of detecting an event) and the timeliness of reporting (the period between an event and its discovery and reporting). Some evidence supports this hypothesis.

Chan *et al.* (21) studied the duration between an outbreak and its discovery and public communication, using a series of outbreaks confirmed by WHO. It is interesting to note that, during the period of the study, between 1996 and 2009, a time associated with rapid growth in the number of biosurveillance systems, the time lag between outbreak and discovery declined substantially, from nearly 30 days to 13.5 days, and the time between outbreak and public reporting declined from 40 days to 19. This suggests an association between the global number of biosurveillance systems and the ability to rapidly detect infectious disease outbreaks. It is significant that the number of syndromic systems expanded at an especially rapid rate during this period. However, this possible association between the global number of biosurveillance systems and the increasing speed of outbreak detection is heavily confounded, most notably by advances in technology, data analysis and digital communication.

Multiple biosurveillance systems tend to complement each other. Consequently there is collinearity between the number of systems in use and the speed of detection. Barboza *et al.* (22) examined the sensitivity and speed of detection of outbreaks of highly pathogenic avian influenza (HPAI) H5N1 in humans and animals during March 2010, using six well-characterised biosurveillance systems. These systems varied in sensitivity and speed at reporting H5N1 outbreaks during this period, and overall sensitivity and timeliness were optimised by using a virtual combination of the six systems. Interestingly, the Barboza study used a method to improve data quality (retrospectively) by combining disparate data sources and then subsequently filtering out low-quality biosurveillance data. When considering the findings of the Barboza study with those of the present study, we must bear in mind that more biosurveillance systems do not necessarily lead to better outbreak detection. It is just as likely that higher fidelity data, because of improved technology, may have led to faster outbreak detection in recent years and the contraction of underperforming surveillance systems.

Syndromic surveillance

Initially developed as a tool to detect large-scale bioterrorism, the field of syndromic surveillance has greatly expanded over the past 20 years (11). Two hundred and sixty of the systems in the authors' database analyse syndromic data and Figure 4 depicts a significant increase in the proportion of biosurveillance systems analysing syndromic surveillance from 1980 to the present.

The advent, adoption and distribution of Internet access is a contributing factor, as is technology, to the expansion of syndromic surveillance because the Internet has made it much easier to collect, share and analyse the data that are used for this type of surveillance. Most disease surveillance systems are disease-specific (2). However, this trend could be changing as more syndromic surveillance systems focus on information communicated by people over the Internet, which is then stored and available for rapid analysis. Additionally, the Internet has made new types of syndromic data, such as social media, search queries, and website-access log data, publicly available (5, 23, 24). However, the value of these data and their impact on public health has yet to be quantified and determined.

Geographical analysis

A visualisation of the global distribution of biosurveillance systems by country, per capita, depicts the range of biosurveillance capacity by country (Fig. 3). It clearly illustrates that developed nations have more biosurveillance coverage per capita than developing nations. Since most biosurveillance systems are government-run or funded, wealthy nations are more likely to be able to afford broader

biosurveillance coverage across their population and more biosurveillance systems to cover the population.

This illustration also indicates that China has very low biosurveillance coverage per capita, which could be associated with the major infectious disease outbreaks in China (e.g. SARS, HPAI) over the last 15 years (25).

Wealth-associated factors, including reliable Internet access and mobile phone usage, may also contribute to higher biosurveillance coverage, particularly syndromic surveillance. Future analyses could compare biosurveillance coverage with historical outbreak and disease risk data, and other aspects of a country's infrastructure. This study's geographical analysis of biosurveillance system coverage (Fig. 3) may be limited, due to information bias. The current analysis may be less representative of actual biosurveillance capacity in resource-poor zones, where biosurveillance system documentation is limited.

Furthermore, the number of surveillance systems per capita is not a perfect measure of biosurveillance system reach. Countries with densely populated areas may cover large swathes of population within the catchment area of fewer surveillance systems than a country with the same population spread more evenly across a large area. The countries with populations that are more evenly distributed spatially would appear darker on this map, with fewer biosurveillance systems per capita. Countries with small, dense and more uniformly distributed populations that are covered by many overlapping biosurveillance systems (e.g. smaller European countries in the European Union) will have more systems per capita than neighbouring countries that do not benefit from the coverage of overlapping biosurveillance systems. Nonetheless, this is probably a better measure than a raw count of biosurveillance systems per country, which can be biased by countries that are covered by many regional biosurveillance systems.

Biosurveillance ownership

Figures 1 and 2 illustrate that biosurveillance has historically been conducted by national government bodies. From 2005 onwards, the type of organisation involved in biosurveillance has diversified. The rise of syndromic surveillance methods that can harness an expansive range of unstructured data sources has likely served as a catalyst to biosurveillance diversification, allowing non-profit organisations, private bodies and universities to become key stakeholders in the research and development of new biosurveillance methods. Despite this, government agencies remain the primary owners of biosurveillance capacity and data (Figs 1 & 2), often funding non-profit organisations through grants and sometimes working in tandem with private organisations to gather and collect health data. These findings indicate that global biosurveillance may be

limited, and public health jeopardised, if biosurveillance is overly controlled by governmental organisations. This is especially the case when governments are incentivised to avoid reporting infectious disease outbreaks, due to the severe negative economic implications of outbreaks (26).

'One Health'

Of the 815 systems surveyed, the majority were involved in the discrete biosurveillance of human, animal or plant data. Several systems (105) collected human and animal data, and fewer (31) collected data on all three categories. With growing recognition among scientists and policy-makers of the interdependency of human, animal and environmental health, and the consequent importance of the 'One Health' movement, the number of mixed-subject biosurveillance systems may increase in the future. Since 60% of human infectious diseases are caused by pathogens shared with wild or domestic animals, the simultaneous biosurveillance of animals and humans is crucial in detecting and mitigating the risk of infectious disease (27). Hopefully, the publication of this database (<https://drive.google.com/drive/folders/OB4hXKAFeFEWwRDhtMzFKYkpaSOU?usp=sharing>) will encourage the merging of human, animal and plant surveillance systems to coalesce and coordinate risk mitigation efforts and identify infectious disease spread at the critical point before an outbreak becomes an epidemic.

Conclusion

Biosurveillance is not a new area of study and was first established over 600 years ago (28). While the biosurveillance database created for this review is substantial, it is not a complete or exhaustive list of biosurveillance efforts globally or throughout history. Factors that limited the completeness of the authors' data collection included time and labour constraints, and the limited accessibility of information. In some cases, detailed information on systems was protected, or required organisational clearance for access. Even when resources were publicly available, sources were often incomplete and vague, lacking basic information about the system. Details about system characteristics such as data sources, dates of

creation and termination, activity status and geographical range were not always available via the literature or websites, leaving gaps in the data.

The goal of biosurveillance is extremely timely and accurate disease detection (29). Unfortunately, many biosurveillance systems are siloes that do not usefully share the information they collect, limiting their power and ability to inform policy and direct public health action. Public health benefits the most when biosurveillance information facilitates the accurate diagnosis of symptoms to create concise case definitions rapidly (30). The early identification of cases can result in significant economic savings and greatly reduce the number of cases (plant, animal, human or all combined) (31). As public health and biosurveillance advance, free and open data-sharing is necessary to detect rapidly spreading disease outbreaks and respond to them before they become epidemics. Enhanced international mechanisms for outbreak detection, alert and response will be needed, and data-sharing may be able to help to bolster outbreak detection (32). Infectious disease reports are increasingly being added to the Internet, and the technological advances and data available on the Internet will make sharing biosurveillance data easier and faster (33). As biosurveillance has been, and will continue to be, an integral tool in monitoring global public health, the current state of biosurveillance needs to be monitored to avoid the unnecessary duplication of systems and to ensure complete geographical monitoring of infectious disease outbreaks.

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La surveillance biologique : inventaire systématique des systèmes de surveillance des maladies infectieuses dans le monde de 1900 à 2016

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Résumé

La surveillance biologique est un procédé essentiel pour détecter, caractériser et minimiser les effets négatifs des maladies infectieuses. Son rôle à l'égard de la société et son importance pour la santé publique et la sécurité sanitaire mondiale ne cessent de croître. Malgré l'histoire déjà longue et l'importance mondiale de la surveillance biologique, aucun inventaire systématique des systèmes de surveillance biologique mis en œuvre dans une perspective « Une seule santé » n'avait été publié jusqu'à ce jour. La présente étude résume les résultats d'un examen systématique portant sur tous les systèmes de surveillance biologique appliqués entre 1900 et 2016, qu'ils aient été arrêtés ou qu'ils soient encore utilisés aujourd'hui. La majorité des 815 systèmes examinés exploite des données relatives soit aux êtres humains, soit aux animaux, soit aux plantes. Près de 105 systèmes recueillent à la fois des données sur l'être humain et sur les animaux et 31 systèmes seulement recueillent des données sur les trois catégories en même temps.

Les auteurs ont constaté une forte augmentation du nombre de systèmes de surveillance biologique dans le monde entre 1900 à 2008, puis un déclin de ce nombre entre 2008 et aujourd'hui. Le nombre de systèmes syndromiques, par opposition aux systèmes de surveillance biologique basés sur les examens de laboratoire a connu une augmentation rapide dans le monde entier à partir de 1980. Néanmoins, depuis 2008 on constate une nette contraction du nombre de systèmes de surveillance biologique. Les auteurs évaluent également le nombre de systèmes de surveillance biologique par habitant. La couverture par habitant de la surveillance biologique est plus élevée dans les pays développés que dans les pays en développement. La base de données créée dans le cadre de cette étude contient des informations sur plus de 800 systèmes de surveillance traditionnels et syndromiques, mis en œuvre à l'échelle internationale entre 1900 et 2016. Pour conclure, les auteurs examinent les effets de la surveillance biologique mondiale en termes de foyers de maladie détectés.

Mots-clés

Histoire de la surveillance biologique – Réduction des menaces biologiques – Sécurité sanitaire mondiale – Surveillance – Surveillance biologique – Système de surveillance.



Vigilancia biológica: estudio sistemático de los sistemas mundiales de vigilancia de las enfermedades infecciosas de 1900 a 2016

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Resumen

La vigilancia biológica (o biovigilancia), indispensable para discernir, detectar y reducir al mínimo las consecuencias negativas de una enfermedad infecciosa, reviste cada vez más interés para la sociedad y más importancia para la

salud pública y la seguridad sanitaria mundiales. Pese a la dilatada historia y a la relevancia mundial de la vigilancia biológica, hasta ahora nunca se había publicado un examen sistemático de todos los sistemas de biovigilancia existentes dentro del espectro de «Una sola salud». Los autores describen un estudio encaminado a examinar de forma sistemática todos los sistemas de vigilancia biológica, aún vigentes o ya extintos, instaurados entre 1900 y 2016. La mayoría de los 815 sistemas examinados estaban dedicados a la vigilancia específica de las personas, los animales o las plantas. En unos 105 se obtenían datos de humanos y animales, y solo en 31 de ellos se recogían datos de las tres categorías. Los autores observaron un marcado incremento del número de sistemas mundiales de biovigilancia entre 1900 y 2008, número que en cambio se fue reduciendo a partir de 2008. De 1980 en adelante se aceleró en todo el globo la creación de sistemas sindrómicos, por oposición a sistemas de biovigilancia basados en el trabajo en laboratorio. En 2008, sin embargo, se produjo una marcada contracción del número de sistemas de vigilancia biológica. Los autores también proporcionan el número de sistemas de biovigilancia per cápita. Las naciones desarrolladas presentan una cobertura per cápita de vigilancia biológica mayor que las naciones en desarrollo. La base de datos creada a raíz de este estudio contiene información contrastada sobre más de 800 sistemas de vigilancia, ya sea tradicional o sindrómica, utilizados a escala internacional entre 1900 y 2016. Los autores, por último, examinan la incidencia de la vigilancia biológica mundial desde el punto de vista de la detección de brotes de enfermedad.

Palabras clave

Historia de la vigilancia biológica – Reducción de las amenazas biológicas – Seguridad sanitaria mundial – Sistemas de vigilancia – Vigilancia – Vigilancia biológica.



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