# Review on Application of Animal Health Information System in Ethiopia

**Samson Terefe Kassa***

*Addis Ababa University College of Veterinary Medicine and Agriculture P. O. Box 34, Bishoftu, Ethiopia*

*\*Corresponding author*

## Abstract

At a time when the world is facing an unprecedented pandemic, the importance of animal disease surveillance has become evident. To support countries maintaining global transparency and reporting matters of animal and public health, the World Organisation for Animal Health (OIE) launches the leading most technologically advanced reference platform for animal disease and veterinary capacities reporting – the World Animal Health Information System (OIE-WAHIS).Since its creation in 1924, the OIE is the mandated international organisation collecting data on, observing and analysing animal diseases throughout the world. Through its current World Animal Health Information System (WAHIS), the Organisation ensures the prompt dissemination of information on potentially devastating outbreaks and facilitates decision making in terms of international trade of animals and animal products by collecting, verifying and publishing official animal health information, following a standardised process, thus providing high quality, reliable data. On a global scale, the spread of animal diseases poses a threat to public health, food security, economic and rural development. By enabling better understanding on animal disease trends, OIE-WAHIS will provide the opportunity to implement timely measures to curb the spread of diseases, as well as their devastating consequences.

## Introduction

Delivering timely and high-quality information to allow the management of risks to animals and humans using a "One Health" approach is one of the main mandates of the World Organisation for Animal Health (OIE). In that context, the 182 OIE-Members should comply with their reporting obligations for the animal health situation through different reports (OIE, 2018). Firstly, Members should report in a timely manner the occurrence of any exceptional epidemiological event related to the 117 OIE-listed diseases (OIE, 2019) and emerging diseases through the early warning system which comprises the submission of Immediate notifications (IN) and the Follow-up reports (FUR). Additional information is submitted through the monitoring system, which includes six-monthly reports (SMR) and annual reports (AR). The SMR are submitted bi-yearly to inform about the evolution of all OIE-listed diseases, the control measures and surveillance applied for each disease in each country.

The AR, in contrast, include contextual information on the veterinary, laboratory, diagnostic tests and vaccine production capacities, plus the animal population and zoonotic diseases in each country. In order to enable Member Countries to report disease events and the general animal health situation as well as to give the general public access to the reported information, the

OIE has its own disease reporting system. The first disease reporting system, called Handistatus, contains the information from 1996 until 2004 (OIE, 2018).

This system further evolved into WAHIS (World Animal Health Information System) which provides public access to all the information reported by Members from 2005 up to date. This officially reported information constitutes a unique public source of data on animal health as well as on animal diseases that affect public health (as many of OIE listed diseases are zoonotic, countries report on annual basis for more than 35 zoonotic diseases in humans).

The quantity and quality of data stored in WAHIS was evaluated over time, considering the submission rates and content of the different types of reports. This analysis allowed the identification of the strengths and weaknesses of the system to consequently address them in the development of the new platform OIE-WAHIS. The results showed that for the early warning system, the quantity and quality of the data collected and stored in WAHIS is remarkable and has increased year on year.

As an example: when WAHIS was launched in 2005 only 91 IN and 164 FUR were submitted on 31 diseases from 48 countries. During 2018, these reports went up to 332 IN and 1655 FUR, on 44 diseases from 93 countries. This poses a twofold increase of the number of IN and a tenfold increase in the number of FUR submitted, originated from twice as many countries. This reflects the increase on the coverage of the system.

However, the submission of these reports depends, not only on the surveillance capacities and reporting behaviors, but also, on the worldwide animal health situation as most of these reports, were concentrated in only four diseases, all of them with great impact on trade.

Specifically, infection with highly pathogenic avian influenza viruses (considering both OIE-listed diseases for domestic and wild birds) was the most frequently reported disease, with 23% of all reports, followed by African swine fever (17%), foot and mouth disease (10%) and bluetongue (7%).

In addition, the evolution of the reporting characteristics of the monitoring system (SMR and AR) was also evaluated. The SMR have a very high coverage of the world, as about 97% of the Member countries submit them on a regular basis, including information on average on 81% of the OIE listed terrestrial animal diseases (78 diseases). Currently, two types of SMR are submitted, concerning the terrestrial and aquatic animal diseases (Mur *et al.,* 2019).

In general, for the terrestrial reports, the quality and level of detail of information was quite high, as more than 50% of the terrestrial SMR submitted from 2014 until 2017 included the outbreak data in the most detailed level of information (by month and province). Some differences were also found between the report on domestic animals, for which 86% of diseases were reported, and wild animals with a lower level of reporting (76% of reported diseases). However, the submission rate and quality of information for the reports concerning the aquatic animal diseases is still lower. About 70% of the Members submitted aquatic reports, containing information on 77% of OIE listed aquatic diseases (22 diseases), however mostly reporting no disease present. Finally, the AR have also a very good coverage, having been submitted by most of the countries (average of 95% during the last years). Nevertheless, strong differences were observed between the completeness of the different sections of this type of report (Mur *et al.,* 2019).

All this data is currently stored in WAHIS and publicly available in the web interface (WAHIS interface). However, as it is built now, WAHIS presents some limitations regarding making use and correct interpretation of OIE data. Difficulties include the lack of clear explanations about the types of report present in WAHIS (early warning and monitoring), the non- user friendly interface (difficult to access to the different types of data), the lack of extraction and analysis tools for WAHIS data or the presence of old style design static maps, among others. The OIE, aware of these limitations, is developing a new platform, called OIE-WAHIS.

This new reporting system aims to facilitate reporting and improve the correct and wide use and interpretation of the collected official information. For that purpose, OIE-WAHIS is being designed to be a technically advanced, user-friendly, intuitive and efficient system. The new system will incorporate clear explanations about the different reports it contains and the interactions amongst them that will enable the user to select and decide which data source should be used for their interest. High resolution dynamic mappings will be incorporated that will enhance the report and interpretation of outbreaks reported. Analytical

dashboards will be also available for the visualization and analysis of the data; by integrating information from all the different reports, users will have an updated, comprehensive picture of the real situation that will support them on the decision making. Data mining tools and easy extraction capabilities will allow the general public to search and extract the data desired for their analysis. In addition, it also contemplates that field reporting will be integrated through new modules and app versions for tablets and mobile devices (always requiring the validation of the corresponding Delegate before the submission of information to the OIE).

Finally, OIE-WAHIS will be also ready to connect with other systems, facilitating reporting (avoiding data entry duplications) hence ensuring the correct transfer of information, enabling interoperability. All these new features will support OIE Members in their reporting obligations of submitting timely high-quality information and providing them better visualization and easy access to analytical tools for the information submitted. This will enable OIE Members to use their reported data for additional purposes besides complying with their reporting obligation. The public users will also benefit from the new tools of the interface, that will allow an easier search and use of the collected data. But in addition, the improved data accessibility and possibility of interaction with other data systems will allow researchers and organisations around the globe to use OIE data for their analysis and perusal, maximizing the value of the data collected. With these advances OIE-WAHIS will become a user-friendly powerful data source to support and improve the early warning and prevention of animal and human diseases (Mur *et al.,* 2019).

OIE-WAHIS (OIE World Animal Health Information System) is a unique comprehensive database through which information on the animal health situation worldwide is reported and disseminated throughout the world. OIE-WAHIS data reflects the information gathered by the Veterinary Services from OIE Members and non-Members Countries and Territories on OIE-listed diseases in domestic animals and wildlife, as well as on emerging diseases and zoonoses.

The digital revolution that has swept the globe during the last few decades has offered an unprecedented number of opportunities to improve animal health system sustainability. From farmers to Veterinary Services, all actors involved in these systems rely on solid animal health data to manage risks and make everyday choices,

sometimes in adverse economic environments. As part of the One Health approach, this data can also trigger responses from the public health sector, or others, to ensure early disease detection and the efficient prevention of global health risks.

To harness new technologies for the benefit of all countries, the World Organisation for Animal Health (OIE) is leading a digital transformation for data management and analysis. 2020 was marked by the achievement of several milestones underpinned by innovation and technology. In the upcoming years, the OIE will continue the journey toward a better governance of global animal health data, improving its accessibility and innovative use to tackle the challenges that lie ahead. Collecting, verifying and sharing data on animal diseases has been at the core of the OIE's mission since its creation in 1924. The World Animal Health Information System (OIE-WAHIS), used to report and track animal disease outbreaks, has worldwide recognition as the leading source of high-quality, reliable and official information on animal health. In 2020, WAHIS was upgraded to a more powerful, efficient, and user-friendly platform, and launched in 2021.

The data on OIE-WAHIS is accessible to everyone from the online platform or mobile app, allowing timely and efficient responses to transboundary and high-impact animal diseases, many of which have zoonotic potential. Government agencies, trade partners, industry, researchers and journalists can easily follow the evolution of outbreaks worldwide. The new user-friendly interface allows data to be viewed and extracted in different formats, making its analysis even more powerful and practical. All this information can be publicly accessed and visualized on this interface. OIE-WAHIS replaces and significantly extends the former web interface named WAHIS providing access to all reported data since 2005. This new public interface includes data extraction tools, interactive mapping tools and dashboards to support data consultation, visualization and extraction of officially validated animal health data.

Today more than ever, the international community recognises the importance of maintaining a global perspective and foresight on animal health and its inextricable connection with public health. Animal disease surveillance allows early detection of potentially impactful animal and human health threats and thus, the prompt implementation of appropriate control measures by the competent national authorities. This can only be

achieved by enabling timely access to reliable information about the global state of animal diseases. With official information provided by OIE Members, OIE-WAHIS becomes a key component of the global fight against animal and human diseases. Dr. Monique Eloit, OIE Director General, said "*The sustained spread of COVID-19, as well as current animal epidemics like African swine fever or Avian influenza remind the world the value of timely disease notification and information sharing. OIE-WAHIS will enable easier reporting and open-access to data*,"

As animal diseases continue to spread around the world, they also become a burden to the global economy and even threaten to disrupt food supply chains. Experts estimate that around 20% of production losses worldwide can be attributed to animal diseases. Maintaining animal health -- through tracking of disease outbreaks and followed by appropriate action -- is essential for protecting food security and livelihoods. In addition, by expanding the usage, OIE-WAHIS will increase even more transparency about diseases. It will therefore foster safe and fair cross-border trade of animals and animal products as well as evidence and risk-based decision making on animal and public health policies. With faster and more detailed notification about the geographic localisation of outbreaks and subsequently their control, trade restrictions will be better targeted.

As information systems become more powerful, we can analyse data and get new insights into disease dynamics. We are now able to monitor and control diseases more effectively than ever before.

The OIE marks the beginning of a new era in animal data systems, bringing this innovation also to the veterinary and scientific world. OIE-WAHIS will make information about animal health more easily available and usable to everyone who needs it -- government agencies, trade partners, international organisations, industry, researchers, academics, journalists and society in general -- free of charge, becoming the reference platform.

The new platform will make it easy for countries to collect and report information -- and upload data from their own databases. Its user-friendly interface will also allow for data to be viewed, analysed and extracted in different formats. OIE-WAHIS is a first cornerstone in the digital transformation of the OIE. It enables an easy and standardised way to connect with other information systems around the world, making data analysis even more powerful.

## Application of World Animal Health Information System

The World Animal Health Information System is an internet-based computer system that processes data on animal diseases in real-time and then informs the international community. Access to this secure site is only available to authorized users, namely the Delegates of OIE Member Countries and their authorized representatives, who use WAHIS to notify the OIE of relevant animal disease information.

OIE member Countries are encouraged to use the on-line notification application World Animal Health Information System/ WAHIS/ (https://www.oie.int/wahis/) and are asked to use the paper forms only if they have real difficulties in accessing WAHIS due to recurrent internet connection problems, so as to provide quickly the information (MOA, 2009).

To enable free access to world animal health data, WOAH provides Internet users with several computer tools designed to answer specific user needs. The World Animal Health Information System – WAHIS portal provides easy access to these tools, for more accurate results while searching for world animal health information.

Guaranteeing transparency of the world animal health situation is one of the primary missions of WOAH. WOAH Members have an obligation to submit information on their animal health situation, and a list of terrestrial and aquatic animal diseases notifiable to WOAH has been established for that purpose.

To fulfil this mandate, WOAH regularly adapts the information technology tools of the World Animal Health Information System (WAHIS), which comprises three essential elements:

An early warning system for the immediate management of alert notices for WOAH-listed diseases and emerging diseases. An early warning system to inform the international community, by means of "alert messages", of relevant epidemiological events that occurred in OIE Member Countries.

A monitoring system to manage six-monthly information updates on all WOAH-listed diseases. A monitoring system in order to monitor OIE Listed diseases (presence or absence) over time.

Further information provided by National Authorities through annual reports on animal diseases affecting human populations, animal populations and Veterinary Service capacities, such as personnel, laboratory capacity and vaccine production.

## Early Warning System

Whenever an important epidemiological event occurs in a Member Country, the Member Country must inform the OIE by sending an Immediate Notification which includes the reason for the notification, the name of the disease, the affected species, the geographical area affected, the control measures applied and any laboratory tests carried out or in progress. To improve the scope and efficiency of the OIE's early warning system, Member Countries should immediately notify to the OIE Headquarters the events of epidemiological significance according to the reasons laid down in the Terrestrial Animal Health Code for terrestrial animals and in the Aquatic Animal Health Code for aquatic animals (Chapters 1.1 – Articles 1.1.3).

Once they have been received, verified and validated by the OIE, the immediate notifications are published in the OIE's three official working languages (English, French and Spanish) under the heading Alerts and sent to everyone on the OIE-Info Distribution List.

This list is open not only to the Delegates of Member Countries, the OIE Reference Laboratories and Collaborating and international and regional organizations, but also, by subscription, to any institutions or individuals interested in receiving such information directly. After having informed the event OIE, the Member must send weekly Follow-up Reports so that the event can be monitored as it evolves. In all cases, the country must submit a final report to notify either that the event has been resolved or that the disease has become endemic. In both cases, the country will continue to submit information in its six-monthly reports if the disease is on the OIE List.

## Disease Reporting System

OIE has a website that the Delegates of Member Countries, their designated nominees Focal points authorized to report animal disease information to the OIE.

The World Animal Health Information System (WAHIS) secured web site access to this application allows users from Member Countries, namely Delegates or their nominees, to electronically submit standard notification reports (immediate notification and follow-up reports to the OIE. www.oie.int/wahisHome Page - OIE World Animal Health Information System.

## *The Delegates' Site*

This site has been updated to provide secure access to material and information intended only for OIE Delegates.

## Monitoring System

Six-monthly Reports provide information on the presence or absence of diseases on the OIE List and the prevention and control measures applied. For diseases reported as being present in a country/territory during a given six-month period, the country/territory in question must provide quantitative data on the number of outbreaks, susceptible animals, cases, deaths, animals destroyed and animals vaccinated. OIE provide the information to the international community with the most recent information on the diseases that are present and which Member Countries consider are the most important.

Annual Reports: the two six-monthly reports of a given year are combined as part of the annual report for OIE-listed diseases. Moreover and in cooperation with the WHO and the FAO, Member Countries are asked to complete it once a year with information on non OIE-listed diseases, the impact of zoonoses on Humans, animal populations, the Veterinary Services personnel, national reference laboratories and their performed diagnostic tests, and, when appropriate, vaccine manufacturers and vaccine production.

## Active Search for Non-Official Animal Health Information

OIE collects official notifications of animal diseases from its Member Countries, including notifications involving zoonoses and disseminates this information to the international community.

Non-official information and rumors relating to animal health and public health information is evaluated in the context of the animal health situation prevailing in the country or region concerned and, where appropriate, verified with the Member Country for the purposes of official confirmation and potential publication.

The active search procedure applied by the OIE is as follows

Search for non-official animal health information and rumors disseminated by the media, networks such as GPHIN (Health Canada's Global Public Health Intelligence Network) and ProMed, scientific journals and publications, OIE Reference Laboratories, etc.

Identify the discovered health event: suspected disease, clinical signs (e.g. high mortality), geographical location (region(s), country, village, etc.), animal species affected, etc.;

Analyze the credibility of the source

Analyze the relevance of the information, placing it both in the health context of the country and with respect to Member Countries' legal obligations to notify the OIE

Determine whether the information relates to an exceptional event requiring immediate action, which, in the case of official confirmation, will lead to an immediate notification.

Based on the outcome of the previous analysis, contact the national Delegate of the Member Country or Territory concerned to inform him or her of the identified event and its relevance. If the event is confirmed but has not yet been notified, request the Member Country or Territory to officially notify it to the OIE.

The information does not become official until it has been confirmed by the Delegate.

**World animal health information system interface**

The WAHIS Interface provides access to all data held within OIE's new World Animal Health Information System (WAHIS). A comprehensive range of information is available from:

Immediate notifications and follow-up reports submitted by Countries Members notifying exceptional epidemiological events current in their territory

Six-monthly reports stating the health status of OIE-listed diseases in each Countries

Annual reports providing health information and information on the veterinary staff, laboratories and vaccines, etc

**World Animal Health Publications and Documentation**

Publications produced by the World Organization for Animal Health (OIE) constitute a valuable source of documentation for the international scientific community and facilitate progress in Veterinary Medicine worldwide. OIE publications are available on the Online Bookshop and on the Website.

**Fig.1** www.oie.int/wahisHome Page - OIE World Animal Health Information System
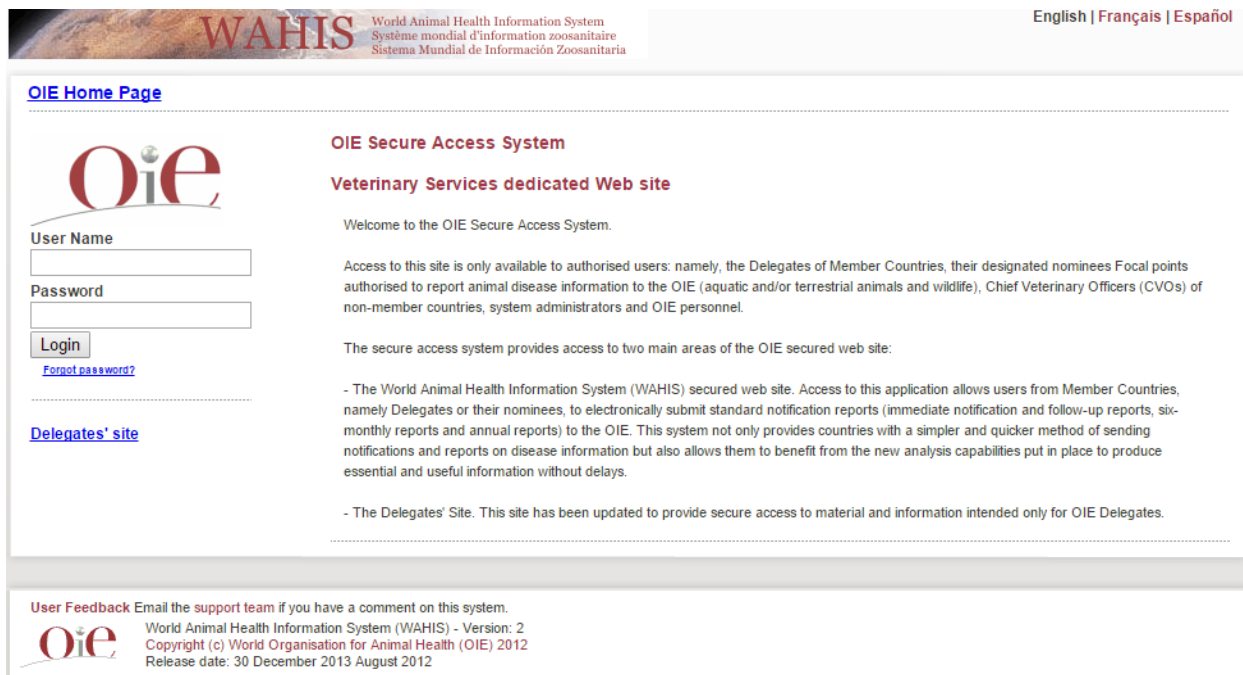
1. **Search:** for non-official animal health information and rumours
... disseminated by the media, networks such as GPHIN (Health Canada's Global Public Health Intelligence Network) and ProMed, scientific journals and publications, etc. Receive reports from OIE Reference Laboratories, which have a mandate that includes informing both the OIE Delegate of the country concerned and the OIE Headquarters of any positive finding relating to an OIE-listed disease

2. **Identification:** identify the discovered health event
Suspected disease, clinical signs (e.g. high mortality), geographical location (region(s), country, village, etc.), animal species affected, etc.

3. **Credibility:** analyse the credibility of the source
Determine if the source is reliable or not

4. **Evaluation:** of the relevance of the information
... placing it both in the health context of the country and with respect to Members' legal obligations to notify the OIE

**Non-relevant information**

5. **Verification:** determine whether the information relates to an exceptional event or not

5.1 If the information relates to a disease that is already present or to human cases of a zoonotic disease, keep the information and verify its notification in the six-monthly or annual reports as soon as they are received

5.2 If the information relates to an exceptional event requiring immediate action, in the case of official confirmation, it will lead to an immediate notification

6m  12m

24h

**Denial by Delegate**

**Official confirmation by Delegate**

6. **Immediate notification:** contact the Delegate of the Member...
... and based on the outcome of the previous analysis, inform him or her of the identified event and its relevance. If the event is confirmed but has not yet been notified, request the Member to officially notify it to the OIE
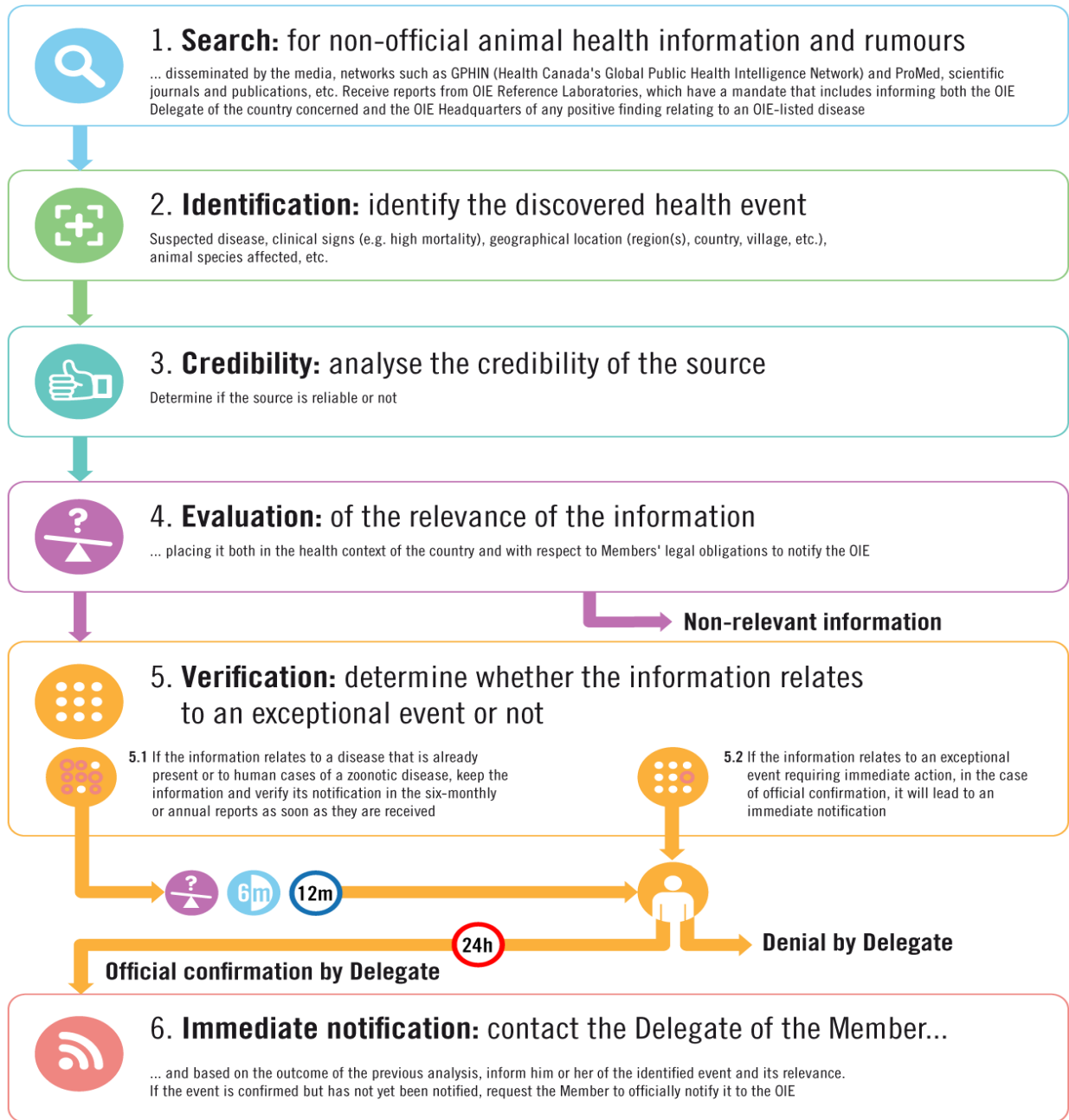
**Fig.3** Schematic representation of the operation of the World Animal Health Information System (WAHIS) and Database (WAHID) (Poissonnier and Teissier, 2013).
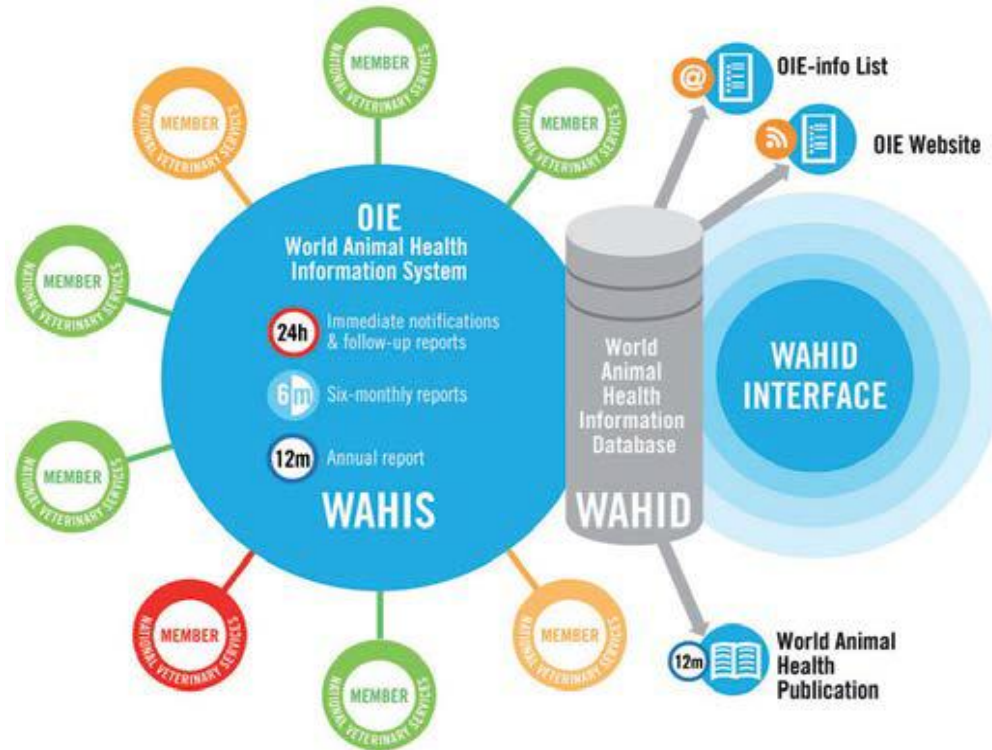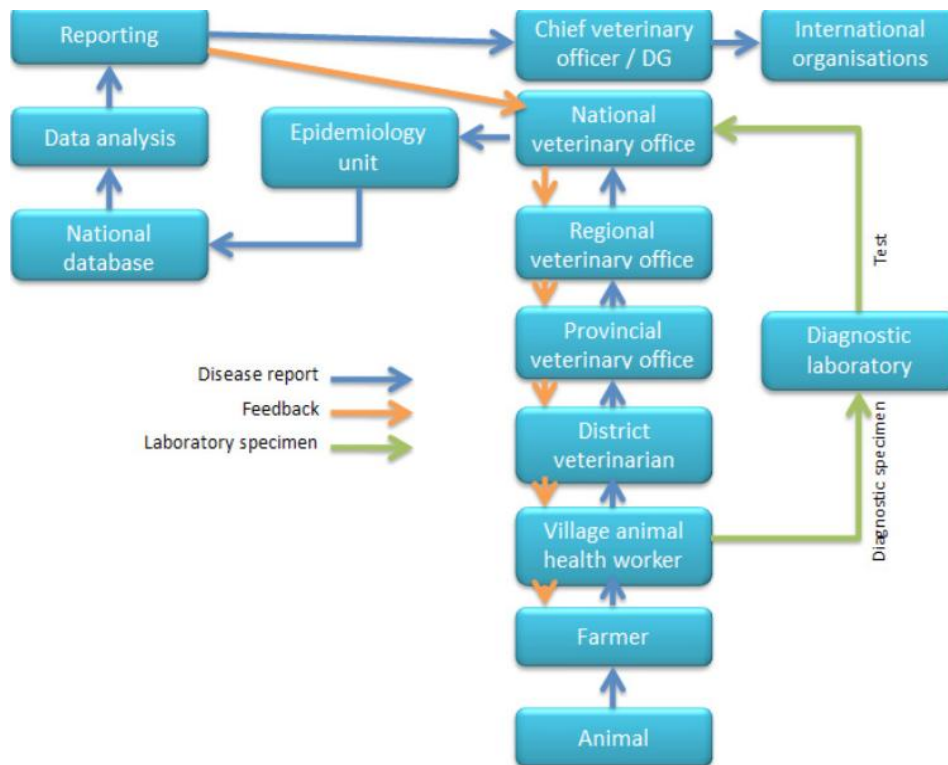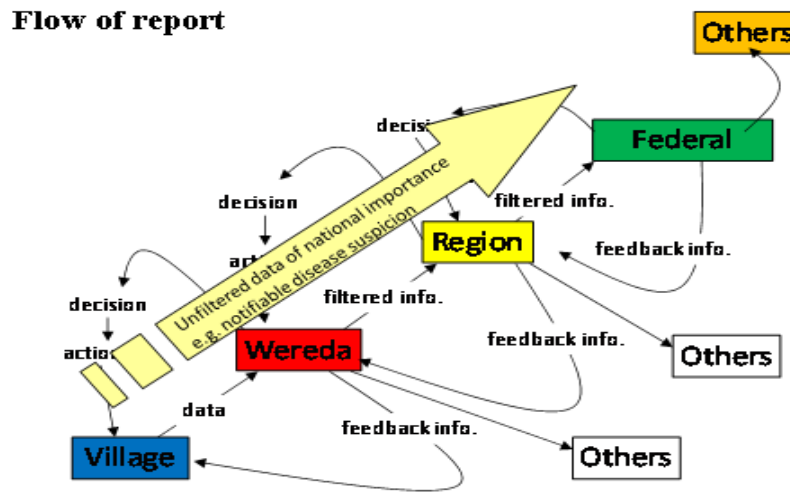


**Fig.4**

**Fig.5** Livestock Master Plan data analysis documents, Ministry of Agriculture, 2007 Addis Ababa (APHRD, 2012)



## OIE-Info Distribution List

To improve the efficiency and rapidity of animal disease information exchange among OIE Member Countries, especially for early warning purposes, the OIE has an electronic mailing list for OIE Delegates and international and regional organizations dealing with animal and public health.

Any institution or person can receive near real-time information on animal disease exceptional events, in the form of Alert messages notified by OIE Member Countries as well as the announcement of the release of weekly disease Information by Subscribing to the OIE-Info distribution list.

## Information Dissemination System

OIE disseminates official information about animal diseases including zoonoses in the three OIE official languages. The dissemination of emergency messages and follow-up reports (as per the OIE Early Warning System) is done using different tools: faxes, electronic distribution lists and the OIE website.

Also, Animal Health Information, from the OIE six-monthly and annual monitoring system is disseminated using the OIE website and in hardcopy (World Animal Health publication).

FAO disseminates bulletins, reports, descriptive and analytical early warning and emergency messages. The tools used to disseminate information are: FAO/AGAH/EMPRES web site and electronic distribution lists. The EMPRES bulletin is also distributed in hardcopy.

Concerning HPAI, a specific bulletin FAO AIDE News is issued every month or when appropriate. WHO disseminates information through a restricted e-mail list, the WHO web site and information bulletins, the Weekly Epidemiology Record is available in hard copy and electronically. The Global Early Warning and Response System for major animal diseases (GLEWS) initiative started with the voluntary participation of representatives of FAO, OIE and WHO, who share the common objective to enhance the Early Warning and Response capacity for the benefit of the international community.

The three organizations use complementary and partly overlapping sources of information to identify infectious disease events. Through sharing of information on disease alerts, the capacity for early warning of the three organizations could be enhanced while avoiding unjustified duplication of efforts (GLEWS, 2006).

## Application of Animal Health Information System in Ethiopia

In Ethiopia disease reporting activities date back as far as 1982, However improvements in animal disease information exchange were made since the establishment of the VEEU under Fourth Livestock Development Project (FLDP) in 1990 and Veterinary Epidemiology Units under Pan African Rinderpest Campaign (PARC) in 1995. The later project, particularly, introduced a

system of general disease reporting mechanisms which is based on monthly Woreda reports.

The key to control and eradicate animal disease epidemics is early detection and rapid response. Early detection and control of animal diseases are important to livelihood of producers, food safety, trade and the national economy. If a disease can be detected very early, then there is a possibility that it can be arrested and eliminated before it actually inflicts heavy damage in many parts of the country.

Therefore, early report of suspected disease outbreak to Federal Animal and Plant Health Regulatory Directorate (APHRD) is very important as it can be used. Early report and subsequent surveillance of animal diseases outbreaks will ensure transparency in animal disease status and will provide confidence in the safety of food of animal origin. International organizations such as OIE (World Organization for Animal Health), the technical wing of the World Trade Organization (WTO) in matters of Sanitary and Phytosanitary, require that an outbreak of a new trans-boundary animal disease should be reported to the OIE within 24 hours of its occurrence being detected

Disease reporting should be observed at different levels, i.e., from livestock owner to the nearest veterinary services, from animal health post, private veterinarian or animal health assistant or NGO veterinarian to woreda veterinary services, from woreda veterinary services to zonal and regional veterinary services, from regional state veterinary services to federal veterinary services and from the federal veterinary service to international organizations like OIE.

## Active Surveillance

Active surveillance is one of the methods to assess the current health status of animal population. In 2009/10, National Animal Health Diagnostic and Investigation Center (NAHDIC) in collaboration with Regional veterinary laboratories has collected a total of 14,328 serum samples for RVF, Foot and Mouth Disease, Peste des Petits Ruminants and Brucellosis. The overall prevalence of the diseases was 0%, 11%, 57% and 0.4%, respectively (MOA, 2009).Data is moved progressively through the administrative hierarchy. The next figure shows an alternative disease reporting system. Central office, the provincial offices should have immediate access to the data as soon as it is entered (Cameron, 2012).

## Passive Surveillance

Passive surveillance of livestock diseases in the field is the responsibility of Regional animal health services, Regional veterinary laboratories and Woreda animal health personnel. Disease investigations are generally conducted in response to reports of health problems from livestock owners.

Livestock owners report when outbreak appeared in their herds to the nearest extension agents, veterinary post or District (Woreda) Administration. Disease outbreak reports are then compiled filled in standard reporting formats and communicated to Regional animal health services and Federal Veterinary Epidemilogy Unit by Woreda animal health personnel. APHRD has prepared a national strategy to improve disease surveillance and reporting at national level. The main objectives of the strategy are:

To design a system for collecting monthly animal health information from Woreda animal health services, regional laboratories, and major city municipal and export abattoirs and

To create linkages between field and laboratory services so that reported outbreaks are properly investigated and confirmed.

APHRD discuss to the concerned body and proposed disease reporting strategy in 2010. Woredas to prepare the report in five copies for APHRD, Regional Bureaus of Agriculture (BoA), Zonal administrations, Regional laboratories and one copy to remain at each Woreda (MOA, 2009).

The current disease reporting system is unsatisfactory. Regional State Veterinary Services and Regional Laboratories could collect, enter and process data of their areas of operation and forward digital copies to APHRD. Establishing such a system requires more staff to be assigned to a well-funded epidemiology unit at both federal and regional state levels.

Dr. Gebregzyabher Gbreyohans, State Minister of Livestock Resource Development for the Ministry of Agriculture on February, 2015 reports; Ministry of agriculture announces the beginning of new animal health Information system helps to eradicate and control the spread of animal disease but the detail is not available on the website.

## Constraints Encountered in Disease Reporting System Application

Poor farmer-veterinary services interface.

Reporting format not clear to all field staff, due to insufficient training.

Even if there is no disease outbreak, the absence should be reported regularly on monthly basis

The frequent changes in woreda political boundaries make it difficult to set up a GIS based data processing system,

Lack of data processing capacity in regions and also at federal level,

Lack of incentives and evaluation for good and poor reporting, respectively

## Way forward to improve disease reporting and application

Commitment and decision by professionals and woreda and regional agricultural offices with provision of support to field trips to villages and sites to investigate outbreaks

Training of field staff in disease surveillance and reporting

Better coordination between federal and regional veterinary services

Establish federal and regional animal health information system through capacity building and establishment of well-trained human resources and well equipped Epidemiology Units,

establish a comprehensive database which includes data from woreda animal health clinics, laboratories, abattoirs/slaughterhouses, quarantine stations etc

Include animal health information system in the woreda, regional and federal agricultural networks with access to internet networks

Provide feedback to field staff.

## References

Animal and Plant Health Regulatory Directorate, Ministry of Agriculture (APHRD) (2012).Epidemiology Newsletter *Biannual* Addis Ababa, Ethiopia Volume 2, Issue 2.

Cameron, A. (2012) Manual of Basic Animal Disease Surveillance African Union– Interafrican Bureau for Animal Resources / AU-IBAR Publication ISBN 978-9966-1659-1-6.

Global Early Warning and Response System for Major Animal Diseases, including Zoonoses (GLEWS) (2006) Final version adopted by the three organisations ñ tripartite 2006 ñ 01/02/2006 ñ 6:00 PM ñ VF 2.

https://cgspace.cgiar.org/bitstream/.../LMP_animalhealth _2013.pdf?Animal health strategy and vision for Ethiopia- CGSpace.

https://cgspace.cgiar.org/bitstream/.../LMP_animalhealth _2013.pdfAnimal health strategy and vision for Ethiopia - CGSpace.

Ministry of Agriculture animal & plant health regulatory directorate (2009).Ethiopia Animal health year book 2009/10.

Mur L, Tizzani P, Awada L, Lambergeon N, Braham I, Masse C, Caceres P, Melens P and Arroyo M (2019). WAHIS, the unique source of official worldwide animal health information, is becoming OIE-WAHIS, a new digital platform. *Front. Vet. Sci. Conference Abstract: GeoVet 2019. Novel spatio-temporal approaches in the era of Big Data.*doi: 10.3389/conf.fvets.2019.05.00058

OIE, 2018. Terrestrial Animal Health Code.Chapter 1.1.Notification of diseases, infections and infestations, and provision of epidemiological information. OIE, 2019: OIE listed diseases. WAHIS interface.

Poissonnier, C. & Teissier, M. (2013). The role of the OIE in information exchange and the control of animal diseases, including zoonoses, *Rev. sci. tech. Off. int. Epiz., 32 (2), 447-457.*

Shapiro, B. I., Gebru, G., Desta, S., Negassa, A., Nigussie, K., Aboset, G. and Mechal, H. (2015). Ethiopia livestock master plan. ILRI Project Report.Nairobi, Kenya: International Livestock Research Institute (ILRI).

www.oie.int/animal-health...animal-health-information-system/the-oie-da.The World Animal Health Information System: OIE - World.

www.oie.int/wahisHome Page - OIE World Animal Health Information System.