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Informatics progress of the Global Burden of Animal Diseases programme towards data for One Health

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Summary

The Global Burden of Animal Diseases (GBADs) programme will provide data-driven evidence that policy-makers can use to evaluate options, inform decisions, and measure the success of animal health and welfare interventions. The GBADs' Informatics team is developing a transparent process for identifying, analysing, visualising and sharing data to calculate livestock disease burdens and drive models and dashboards.

These data can be combined with data on other global burdens (human health, crop loss, foodborne diseases) to provide a comprehensive range of information on One Health, required to address such issues as antimicrobial resistance and climate change.

The programme began by gathering open data from international organisations (which are undergoing their own digital transformations). Efforts to achieve an accurate estimate of livestock numbers revealed problems in finding, accessing and reconciling data from different sources over time. Ontologies and graph databases are being developed to bridge data silos and improve the findability and interoperability of data. Dashboards, data stories, a documentation website and a Data Governance Handbook explain GBADs data, now available through an application programming interface. Sharing data quality assessments builds trust in such data, encouraging their application to livestock and One Health issues. Animal welfare data present a particular challenge, as much of this information is held privately and discussions continue regarding which data are the most relevant. Accurate livestock numbers are an essential input for calculating biomass, which subsequently feeds into calculations of antimicrobial use and climate change. The GBADs data are also essential to at least eight of the United Nations Sustainable Development Goals.

Keywords

Dashboards – Data access – Data quality – Data strategy – Data visualisations – Global Burden of Animal Diseases – Interoperability – Livestock – One Health data.

Introduction

Policy-makers need a sound foundation to match their resources to the needs of the populations they serve, taking past and future trends into account. Just as the Global Burden of Disease (GBD) programme has provided metrics to guide investments in human health, the Global Burden of Animal Diseases (GBADs) programme aims to provide data-driven evidence about animal health and welfare trends, as well as costs, so that policy-makers have that sound basis on which

to evaluate their options, base decisions and measure the success of interventions [1]. These data can be combined with those on other global burdens (such as crop loss [2] and foodborne diseases [3]) to provide a more comprehensive range of One Health data, required to address cross-cutting issues such as antimicrobial resistance (AMR) and climate change.

The COVID-19 pandemic highlighted and accelerated the importance of the digital transformation of the health sector and exemplified the enhanced collaboration that can take place with digital resources [4]. International organisations, including the World Organisation for Animal Health (WOAH, founded as OIE), Food and Agriculture Organization of the United Nations (FAO) and World Health Organization are bolstering their data management programmes, automating access to their data by developing application programming interfaces (APIs), and providing dashboards for visualisation.

Since 1990, the GBD has grown to include over 7,000 collaborating researchers in more than 156 countries [5]. The GBADs Informatics team was established at the University of Guelph with multidisciplinary expertise (epidemiology, computer and data science, animal welfare [AW]). It interacts with other GBADs teams and external collaborators to ensure responsible data management and a proactively designed, responsive information architecture to manage and visualise data, which will accommodate innovation and growth.

The objective of this paper is to describe the progress of the Informatics team, which develops data resources in synchrony with, and dependent on, advances by other GBADs teams [1], including those designed for modellers and economists. At this point in time, the Informatics team is only using existing data from official sources, curating available data sets and identifying variables of interest to the modellers, who will validate and publish their results separately. The greater challenge is finding the needed data, rather than choosing from an abundance of sources. By making data visible and accessible to users, the team can help to identify errors and provide input on further needs for data resources. These data resources collectively form the GBADs Knowledge Engine at https://gbadske.org [6].

The initial objective of the Informatics team is to make existing data easy to find, visualise and access, so they can be used to calculate animal health burdens and related metrics (Table I). By sharing their assessment of the measures taken to improve data quality, the authors hope to build trust in the data, in order to encourage the development and dissemination of burden calculations and models within the animal health community. The authors further hope to motivate the uptake of these data for all wider issues in which animal health plays a part.

Calculation of GBADs depends on having accurate estimates for various counts and costs of livestock production and disease. One might expect that a basic parameter, such as livestock population numbers obtained from official sources, would be reasonably easy to interpret and re-use. It has proven, however, to be more difficult, as the numbers and categorisation of animals are not consistent across different organisations, or over time. For example, sheep and goats are sometimes combined as small ruminants, and cattle may or may not include buffaloes or be divided into beef and dairy (Table II). Accurate livestock numbers are an essential input for calculating measures of productivity, as well as biomass, both of which subsequently feed into calculations of antimicrobial use (AMU) and climate change.

Data fall on a spectrum from closed to shared to open [14]. Starting with open data available from international organisations such as WOAH, FAO and the World Bank, as well as data from national governments, GBADs is embarking on 'the road to reproducibility', whereby these data are transparent, interoperable, annotated, audited for quality and meet standards for privacy. The usefulness of these data is demonstrated by developing data products such as dashboards – minimum viable products developed in an agile manner and made publicly available to garner feedback that then drives further development [6]. Pilot and case studies developed to date are described below.

Global Burden of Animal Diseases data strategy

Recognising the significant efforts by FAO, WOAH and other institutions to gather global data on livestock over the decades and the call for an integrated international data system [15], GBADs is working to produce curated data useful for livestock modelling. Instead of each user having to find, clean and interpret his or her own data, GBADs strives to provide a curated source of data available for all to visualise, analyse and use in the development of models and other data products. In order to build trust and confidence, it is necessary to document where the data come from and how they have been manipulated. The GBADs Informatics team aims to create a community around shared, curated and re-usable data on a single platform. The development of all data products (Table I), including metadata and provenance, is guided by four founding principles: findability, accessibility, interoperability and reusability, commonly known as FAIR principles [16, 17].

Livestock population data collection and analysis

The GBADs data strategy began with the collection and analysis of livestock population numbers by country, species and production system. Achieving accuracy for these data was both difficult and essential, as they serve as an input for subsequent calculations, such as biomass.

Starting with data from WOAH, the FAO Statistical Database (FAOSTAT), and the Statistical Office of the European Union

Table I

Outputs of the Informatics team of the Global Burden of Animal Diseases programme, as of 25 June 2022

Links and access information for dashboards, documentation and other data products are available via the GBADs Informatics Knowledge Engine website [6]

Disclaimer: the Informatics team is responsible for the curation, visualisation and dissemination of the data whereas the other teams are responsible for validating the models they provide

Product type	Product	Description
Data sets produced by models	Output data sets	Output data sets are produced by models that are created and validated by collaborating modellers. The outputs are ingested and stored in database tables and made accessible via APIs
Dashboards	Livestock populations	Livestock population numbers displayed by country from three different data sources (Eurostat, FAOSTAT, WOAH)
	Biomass	Biomass calculations from GBADs displayed by year, species and country. Multiple data inputs/estimation methods available
	Total economic value	Total global economic value of livestock and livestock products; multiple denominators available
	Ethiopian data sandbox	Accesses and visualises data scraped from the Ethiopian Central Statistical Agency. A case study for national and regional analysis for GBADs
	Dashboard modules	Framework for rapid development and deployment of new dashboards. Tutorials are available to quickly bring new developers on board
Reports and data products	Data reports	Rapidly generatable pdf reports for quick comparison of key data points over time. Topics in progress include national livestock mortality trends, livestock genetics and data-source comparisons
	Data stories	A medium to demonstrate the utility of data provided through GBADs, highlight avenues for future work and collaboration, and inspire creative thinking
Results dissemination	Informatics site	A location hosting results and documentation content, including tutorials, news updates and highlights, blog posts and explainers, publications and presentations, and videos
	External presentations and publications	List of and links to presentations and publications produced by GBADs Informatics
	Style guide	Using best practices for dashboard design and colour theory, the GBADs style guides provide a consistent colour scheme and framework for data visualisations, presentations and dashboards. The guide ensures that outputs can be identified as GBADs outputs
	Amazon S3 buckets	Secure storage of metadata, and provenance, data-cleaning and model methodology documents. Available upon request
Documentation	GitHub repositories	Collection of publicly available code to reproduce GBADs methodology
	Tutorials	Written and video tutorials to replicate major processes and products in the Knowledge Engine [6]
	Data Governance Handbook	A living document that acts as a manifesto for the intended use of data in GBADs while also providing guidance and documentation on best practices for data management for GBADs stakeholders [7]
Data acquisition and access	Web-scraping scripts	Programmes that transform data in pdf tables and reports to a more usable and accessible format (csv, json). These scripts are available through the GBADs GitHub
	Database tables	Database tables store data collected and disseminated by GBADs. The GBADs API allows users to access the data stored in these tables
	APIs	Publicly accessible tool to access all data used and created by GBADs, including data not previously available in accessible formats
	Metadata	GBADs metadata and data provenance information are available via GBADs dashboards. Links to source metadata (as provided by the data source) are also provided when applicable
	User authentication system	In anticipation of private data, this system authenticates users via a log-in system to keep private data secure and accessible only to those who have permission to view it
Interoperability tools	Graph databases	Under development for storage and management of data resources that change over time, between and within different sources, and across geographic regions. These also serve to document data provenance and lineage information
	Ontology	Livestock production and disease ontology under development to facilitate interoperability of livestock data and models from disparate sources
	Data quality assessment tools	Programmes that compare how species were reported by different countries and data sources to measure their level of agreement and identify potential data entry errors or anomalies
Miscellaneous	Horizon-scanning report	Report examining determinants of success and failure in large data aggregation initiatives. Critical for developing a data strategy and future planning
	Anduryl accessibility improvements	The open-source expert elicitation tool Anduryl [8] was adapted to be accessible through RStudio. Adapted version available via GBADs GitHub

API(s): application programming interface(s)
csv: comma-separated values
Eurostat: Statistical Office of the European Union
FAOSTAT: Food and Agriculture Organization of the United Nations Statistical Database
GBADs: Global Burden of Animal Diseases
json: JavaScript object notation
pdf(s): portable document format(s)
WOAH: World Organisation for Animal Health

Table II

Differences in categorisation of cattle, buffalo and bovine species in general, in major data sources

Data source	WOAH [a]	FAOSTAT	FAOSTAT	Eurostat
Data set	WAHIS	Live animals: QCL [b]	FAO tier 1: GE [c]	Number of bovine animals [d]
Categories	Cattle Adult beef cattle (2+ years) Adult dairy cattle (2+ years) Male and female cattle (1–2 years) Calves (<1 year) Buffaloes	Cattle Cattle and buffalo	Cattle Cattle, dairy Cattle, non-dairy	Live bovine animals Bovine animals (less than 1 year old) Bovine animals (less than 1 year old) for slaughter Bovine animals (less than 1 year old) not for slaughter Bovine animals (1 to less than 2 years old)

(a) WOAH categories according to 2018 annual reporting guidelines [9]
(b) Metadata from FAOSTAT – crops and livestock products (Live animals: QCL) [10]
(c) Metadata from FAOSTAT – climate change – enteric fermentation – Tier 1 [11]. The FAOSTAT emissions database is computed following Tier 1 2006 Intergovernmental Panel on Climate Change Guidelines for national greenhouse gas inventories, Vol. 4, chapters 10 and 11 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html) [12]
(d) Eurostat (bovine population – annual data) [13]
All data accessed on 14 June 2022
Eurostat: Statistical Office of the European Union
FAO: Food and Agriculture Organization of the United Nations
FAOSTAT: Food and Agriculture Organization of the United Nations Statistical Database
GE: Table code for FAOSTAT data set: FAOSTAT – climate change – enteric fermentation (GE) – Tier 1 dataset
QCL: Table code for FAOSTAT data set: FAOSTAT – crops and livestock products (Live animals: QCL) data set
WAHIS: World Animal Health Information System
WOAH: World Organisation for Animal Health

(Eurostat) for proof of concept, data were downloaded via the web portal or provided by the data source (in the case of WOAH). While FAOSTAT and Eurostat data were available via APIs, their use was difficult due to insufficient technical documentation on how to use them. Internal software updates also resulted in deprecated or unreliable APIs. As Ethiopia is the national pilot study for GBADs, data from the Ethiopian Central Statistical Agency (EthCSA) were obtained from publicly available portable document formats, commonly known as 'pdf reports'. Web-scraping programmes (Table I) were coded to convert pdf tables to a digitally accessible format (comma-separated values files, or 'csv files'). Collected data were then stored in cloud-hosted database tables. An API was designed to pull data from the database, allowing data to be accessed by both humans and machines.

Process flow for ingestion of model outputs

Collaborating modellers create and validate models (e.g. biomass) using data from the GBADs API as inputs. Once the output data sets are provided to Informatics, they are ingested into database tables, and made available through the API and dashboards. These data sets can then be used as inputs for subsequent models. All models are coded and made available in GitHub repositories (Table I). Information about data inputs, data provenance, methodology and source code is documented in metadata.

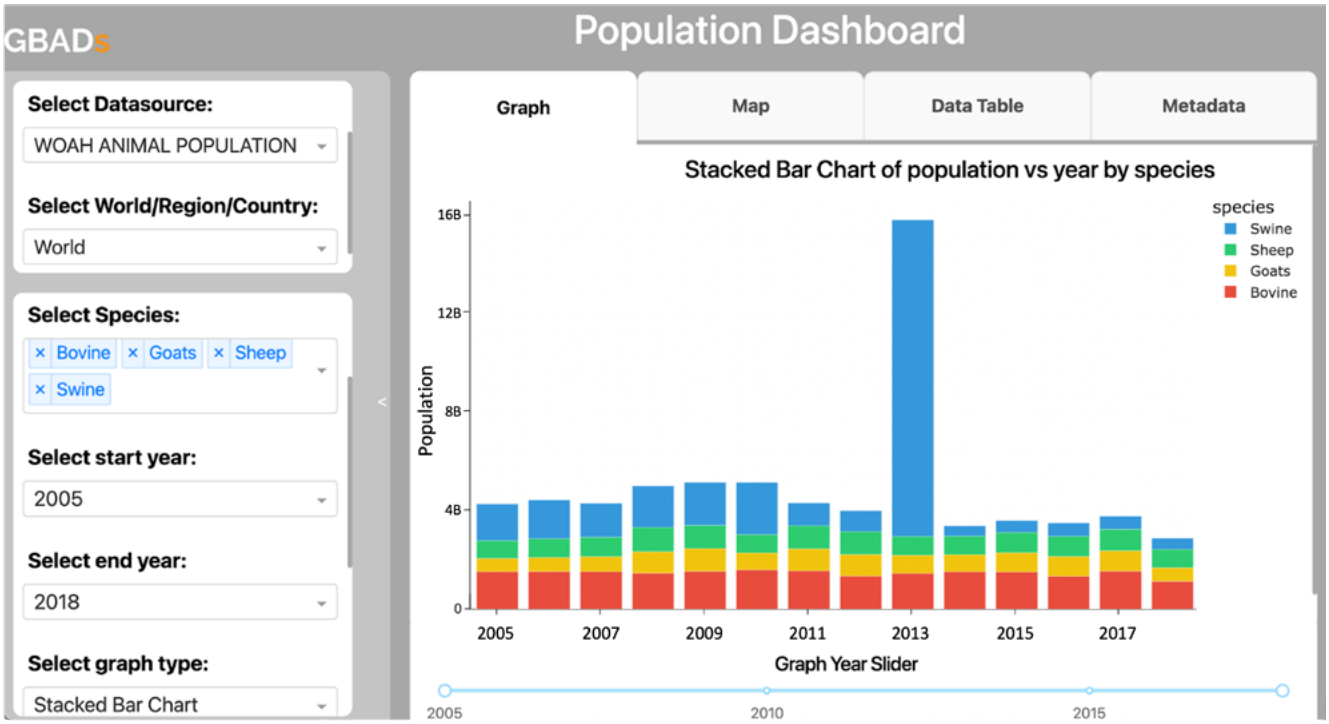
Exploratory analysis of data values and species categorisations

The GBADs Informatics team explored data quality by identifying outliers in population numbers. Outliers were defined as numerical values that were much larger or smaller than possible, given the temporal trends of species populations, and were identified by examining data visualisations (Figure 1). Agreeability among data sources that reported populations for the same species and country was assessed by determining whether the reported numbers were the same. Data reports (Table I) with visualisations of data over time, and across different countries and species, were used to identify outliers and compare the data. When erroneous data values were identified, they were reported to the host organisation and, in some cases, these organisations directed GBADs to change the values and these changes were documented. Furthermore, data values using differing units (1,000 head of livestock/number of livestock; kilogram/gram [kg/g]) were harmonised to ensure consistency across curated data sets.

Exploring interoperability involved a comparative analysis of how species are categorised between and within data sources, and over time. The results of the analysis (Table II and Table III) revealed different categorisations of species between data sources, and within data sources over time. When available, controlled vocabularies and metadata were referenced to better understand the semantics (i.e. contextual meaning) of a term. However, metadata were often nonexistent or did not adhere to vocabularies, leading to ambiguity over what the data categories represented.

Interoperability, ontologies and graph databases

Achieving semantic interoperability (i.e. 'the unambiguous access and interpretation of data by different stakeholders' [19]) is a challenge, as described in the previous subsection. For data to be re-used and combined, these data must be



GBADs: Global Burden of Animal Diseases
WOAH: World Organisation for Animal Health

Figure 1

GBADs Dashboard visualising the global animal population from 2005 to 2018 using data provided by the World Organisation for Animal Health [18]

This visualisation highlights a likely error in the swine data for 2013 (which has since been rectified)

Table III

Changes in cattle and buffalo species categorisations over time, as described in the World Organisation for Animal Health annual reporting guidelines [9]

2009–2014	2015–2016	2017–2019	
Cattle	Cattle	Cattle	Male and female cattle (1–2 years)
Buffaloes (not *Syncerus caffer*)	Buffaloes	Adult beef cattle (2+ years)	Calves (<1 year)
		Adult dairy cattle (2+ years)	Buffaloes

reported using consistent categorisations and interpreted in the way that was intended. Ontologies are being developed to map similar concepts in data categories, based on observed behaviour of how data are reported.

Graph databases (GraphDBs) are being developed for storage and management of data resources that change over time, between and within different sources, and across geographic regions. By using the GraphDB to connect interrelated data, similar terms can be identified and connected, thereby bridging data silos and improving the findability and interoperability of the data.

Data provenance

Data provenance provides information about the origin of the data, where the data have flowed from, changes that have been made, and how the data have been used. Detailed data provenance and lineage is important in two scenarios:

1) There may be different versions, updates or changes to data sets that are used in GBADs estimates.
2) Processed data sets are obtained from GBADs data portals and APIs, where they are used in calculations that produce more data sets.

To ensure that estimates and data flows are reproducible, reusable and transparent, data provenance and lineage is documented in a GraphDB.

Data governance and private data

The GBADs programme's data flows, best practices for data use and sharing, data-sharing principles, metadata standards,

and data governance documentation are communicated through an online Data Governance Handbook (Table I) [7].

The Informatics team's current work has focused on open data (such as data that do not contain personal identifiable or sensitive information), and any available licensing information about the data is recorded in the metadata. In anticipation of controlled governance of private data (such as AW data), Informatics has developed secure log-in systems for the GBADs data portal, to support secure use and dissemination of sensitive data. Data agreements and licences with private data holders will govern how sensitive data can be used, by whom, and for which purposes.

Accomplishments and future plans

Once the basic data accessibility issues have been dealt with, tools can be built to display, visualise and make data available to users. This is being done through the development and deployment of dashboards, data quality reports, data stories, an extensive documentation website and a GBADs API.

Dashboards

It is essential to provide users with an easy-to-use site that will help them to understand and access the available data and metadata. A dashboard is 'a visual display of data used to monitor conditions and/or facilitate understanding' [20]. The Informatics team is continually developing and deploying dashboards for animal populations (Figure 1), biomass calculations, the total economic value of livestock agriculture, and comparing data sources. Dashboards include tabs for visualisations, maps, data table downloads, and metadata. The findability and interoperability of data are improved by using a machine-actionable format for metadata, such as JavaScript object notation for linked data, commonly known as 'json-ld'. This method uses metadata terms from the Dublin Core Metadata Initiative and schema.org [21, 22]. When external metadata were nonexistent or did not adhere to standards, information was gathered from grey literature, such as data collection protocols, data manuals, websites or reports. In some cases, information on data and data licensing was obtained from an established contact point or expert. Thus, each dashboard gives full access to the metadata for all data displayed or used in calculations or models. All dashboards can be accessed through the GBADs Knowledge Engine at https://gbadske.org [6].

Reports

Data reports are being developed to explore whether different data sources reporting similar metrics (i.e. national population by livestock species) agree in terms of numeric value, and whether data can be understood, documented and modelled longitudinally, using numbers on their own and through the information available in metadata. One example of this phenomenon is animal population numbers collected by different agencies. The question people should be asking of all models and calculations is: what were the criteria for selecting a particular data source and what impact does this choice have on the model? To aid modellers in assessing multiple data sources, reports have been generated that analyse each data source and compare them to similar sources. These analyses are under development for global data sources such as FAOSTAT and WOAH, as well as for data from national sources. Current reports include a health and mortality analysis of data from livestock reports from EthCSA, a comparison of population numbers from different data sources, and an analysis of species categorisation in population data.

Data stories

A series of data stories are being developed to illustrate the potential insights that can be gleaned from GBADs data and to stimulate outside researchers' ideas on using GBADs' data portal to add value to their work. These stories will highlight the value of livestock data being made more accessible through GBADs and bring together data from different initiatives to address key topics synergistically, providing fresh insights and new ways of viewing them. The exercise of developing these stories also helps GBADs' Informatics team to identify interoperability challenges and differences in key methodologies between sectors, in addition to cross-checking the narrative of data from different sources. For example, new estimates of human disease burdens from the global burden of animal disease in Ethiopia [23] can be compared with similar livestock disease data (recently made more accessible by GBADs) to identify trends and relationships between human and animal health at the regional level. The first data story on animal mortality in Ethiopia is available at https://gbadske.org [6].

The Global Burden of Animal Diseases application programming interface

The GBADs API allows access to all data sets stored by GBADs in its database tables, as well as to other external APIs. The first type of access is standard for APIs, but the GBADs version has features that make it easy to use for many purposes.

- Fields to return can be selected so that users can return as much or as little of the data record as they need.
- Sophisticated queries are allowed, including joins between tables (to combine columns from one or more tables) and ordering of the records returned.
- Since the conventions for naming species differ between data sets, generic 'superclasses' of species can be used. These are transferred into the appropriate name used by the data set.

This last feature allows users to request 'All Sheep' and get back the records corresponding to 'Sheep', 'Adult sheep' and 'Lambs' in the WOAH population data set, while getting 'Sheep' records from the FAOSTAT – crops and livestock products (Live animals: QCL) data set (see Table II).

If the data set to be searched is not stored by GBADs, then the appropriate external API request is constructed and executed, and the results filtered to correspond to GBADs API standards, which include field selection. All units are a specific singular unit (e.g. head of population instead of 1,000 head of population for animal counts, US$ for certain economic indicators, etc.). This design gives the user a seamless view of all data sets available through the GBADs data portal. The GBADs Informatics website [6] provides directions to the API web interface and documentation.

Documentation site

All documentation for the data portal and Knowledge Engine is found in a single repository [6]. This website (powered by Docusaurus [24]) provides a portal to user and developer documentation, tutorials and other learning materials, relevant papers and presentations, and access to the GBADs Informatics YouTube channel (presentations and tutorials, https://www.youtube.com/@gbadsinformaticsmedia6966).

There is also a blog feature where GBADs Informatics team members provide insights into the work of the team and the products being produced. The website has been designed to be a dynamic resource for all GBADs stakeholders, and is linked to the main GBADs site (https://animalhealthmetrics.org), which provides more information about GBADs' overall programme and vision.

Global Burden of Animal Diseases in the context of One Health data

The data collated, insights produced, and resources developed by GBADs can be integrated across the One Health community. Direct and indirect human health impacts include dietary impacts, emerging disease risks, foodborne disease risks and zoonotic disease transmission. The GBADs outputs could also be integrated with crop loss data [2], climate data, better AMU and AMR monitoring and evaluation, and societal outcomes such as gender equity and livelihood impact. In addition to the economic value of GBADs data, these outputs are proving invaluable in other areas. New driving forces are impacting livestock production, including the global United Nations Sustainable Development Goals (SDGs) [25]. Sustainability involves not only environmental impact and food safety and security, but also the challenge of ensuring AW [26].

Animal welfare data

The World Organisation for Animal Health defines AW as: 'the physical and mental state of an animal in relation to the conditions in which it lives and dies'. In addition to defining the concept, a set of AW guidelines was developed for farm animals [27]. The aim is to prevent unnecessary suffering, safeguard animal health, and improve food safety and quality. Given the various cultural, religious and political backgrounds of WOAH's Members, along with the ethical, social and economic components shaping AW [28], closing the gap between AW policy and its practical application remains a challenge. The economic impact of AW depends on how the cost of implementing welfare measures compares to its impact on production costs [29], which often affects compliance with AW guidelines. For instance, WOAH does not yet have guidelines for laying hens, given the complex welfare issues involved in each housing system and the economic costs of switching housing systems for this species [30].

Furthermore, most AW guidelines are based on the 'Five Freedoms' [31]. Depending on the production system, some of these freedoms can be easily fulfilled, like the provision of *ad libitum* (freely available) feed and water and enough space in intensive dairy production.

Intensive production, however, does not prevent animals from experiencing some forms of pain, injury and disease. On the other hand, although extensive systems do offer AW opportunities (such as expressing natural behaviours), chronic welfare issues still persist (including chronic thirst and exposure to harsh climates) [32].

What this means is that introducing a few changes to a production system, or even completely substituting it, can easily result in exchanging some welfare issues for others. This causes difficulties not only in prioritising AW issues, but also in identifying the right data to best reflect welfare impairment.

The GBADs programme takes a holistic overview of animal disease when estimating economic losses. Indeed, along with communicable and non-communicable diseases, GBADs considers the lack of feed and water and the presence of injuries, accidents and predation as part of disease. Given the intersection of the Five Freedoms with the GBADs disease list, this holistic approach can provide a clearer understanding of the key aspects impeding good AW, based on the production system involved.

The GBADs programme's work in developing, identifying and harmonising AW data from open and private sources is ongoing. There are different ways to measure AW, including animal-based and resource-based outcomes, along with data on slaughterhouse performance. Data can be collected by trained individuals using assessment protocols, by collecting body fluids and secretions, or through precision livestock farming techniques [33, 34, 35]. However, such data are considered confidential and their collation must meet data privacy policies, which differ among regions. The question

of interoperability, and how to combine data from different sources to provide clear insights into the burden of AW, remains a challenge [36]. A scaling system of the welfare opportunities available in each production system would assist policy-makers to better address welfare concerns.

One Health data for the Sustainable Development Goals

The GBADs programme's outputs could also improve research and policy in adjacent sectors to contribute to the SDGs [37] (Figure 2).

Human dietary health

Most estimates of national food or nutrient supplies begin with production, utilisation and trade data on agricultural commodities from FAOSTAT [38, 39, 40]. The GBADs programme will improve the accuracy and interoperability of animal-sourced food production numbers and trade patterns, which will strengthen approaches to estimating global nutrient supplies. The programme is also developing a globally applicable livestock production classification system. Greater detail on livestock breeds and other characteristics may increase the accuracy of nutrient availability metrics from animal-sourced foods.

Zoonoses and disease prioritisation

Prioritisation exercises help stakeholders to methodically rank zoonotic diseases by the magnitude of threat to their designated area or country [41]. Ranking diseases confers priority on those diseases with a high score, although often there are insufficient data to support these rankings. The GBADs programme will increase access to data on production and disease, filling some data gaps and highlighting others. This will support effective disease prioritisation and policy design.

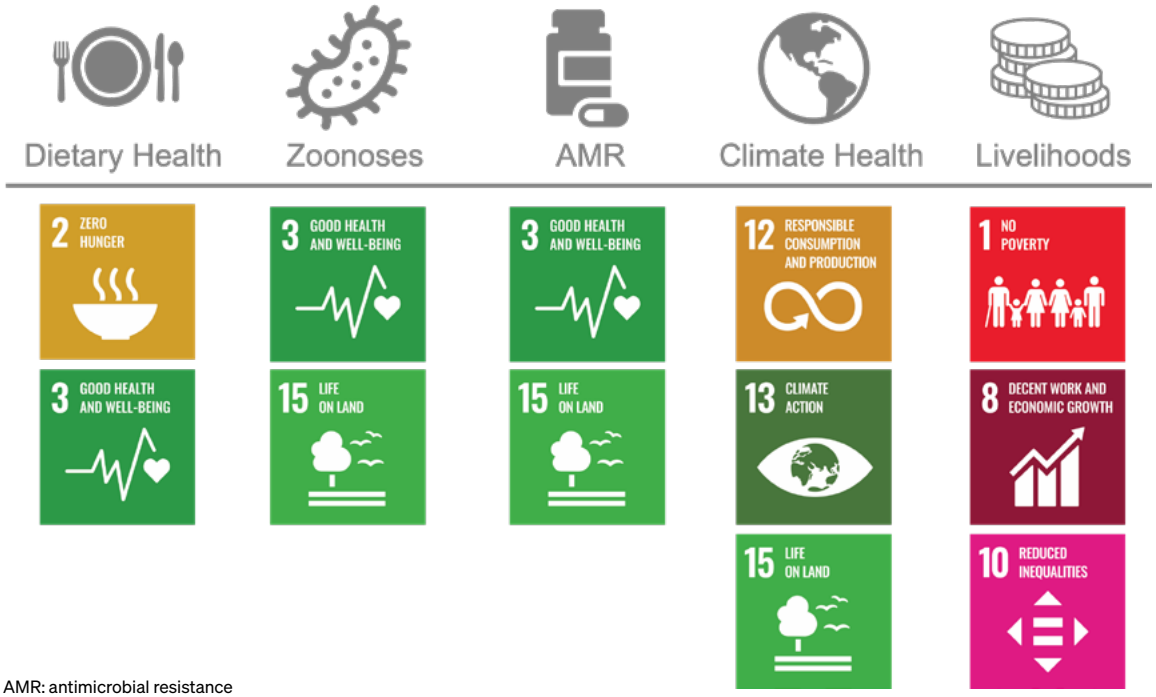
The Human Health team within GBADs is also studying zoonoses (such as brucellosis) that are not yet directly estimated in the GBD. Through this area of research, GBADs will highlight the need to develop consistent metrics for these diseases to uniformly assess their impacts on both livestock and human health.

Antimicrobial resistance

Antimicrobial resistance is a complex One Health problem, as it involves humans, livestock and companion animals. This leads to challenges in data collection and interoperability. Antimicrobial use drives resistance; therefore, it is important to measure AMU to understand AMR. The World Organisation for Animal Health is leading efforts to systematically collect AMU data from Members [42]. In parallel, GBADs will estimate the cost of antimicrobials as a component of livestock expenditures, as well as the cost of resistance in livestock and livestock production. This work will complement recent work by GBD on AMR in humans [43], to better define the total burden of AMR across humans and animals.

Climate health

Differences in livestock population or biomass estimates, or in descriptions and estimates of production systems, can



AMR: antimicrobial resistance

Figure 2

The Global Burden of Animal Diseases (GBADs) programme and the United Nations Sustainable Development Goals

The Sustainable Development Goals [37] to which the GBADs outputs contribute

contribute to large variations in the attribution of greenhouse gas emissions to livestock [44]. Accurate numbers are paramount in developing effective climate change mitigation strategies and for encouraging confidence in and support for these measures [45]. As the climate emergency escalates, it will be increasingly important to decide how to allocate crops and cropland to human consumption versus animal feed. Accordingly, GBADs estimates of livestock production and classification of production system typologies can be used in tandem with data from the Global Burden of Crop Loss [2] and climate data from the United States National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, and other organisations to support decisions on land use and other environmentally relevant concerns.

Livelihoods and gender equity

Data from GBADs on livestock health loss and attribution, production loss and expenditure, and the total economic value of livestock will increase understanding of who, in a community, benefits from the production and sale of livestock commodities. The GBADs programme aims to assess which community members are least able to weather livestock health shocks and to understand how such shocks affect different people economically. Mobilising this information could improve the livelihoods of producers on the margins and support gender equity in livestock production globally.

Conclusions

The GBADs Informatics team has used advanced analytics to move towards an end-to-end solution that seamlessly integrates and unlocks the potential of available animal health data. The authors hope to stimulate discussion and inspire collaboration by liberating livestock data and disseminating GBADs knowledge products through a variety of media. Data from GBADs and other global burdens (human health, crop loss, foodborne diseases) can be combined with other major data initiatives to constitute One Health data, thus helping to measure and meet the SDGs surrounding poverty, hunger, fair wages and inequality, as well as developing a sustainable future.

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Led by the World Organisation of Animal Health and the University of Liverpool, GBADs received US$ 7 million in funding from the Bill and Melinda Gates Foundation and the United Kingdom's Foreign Commonwealth and Development Office between September 2020 and December 2022, and initiated activities on 1 January 2021.

Les avancées informatiques du programme « Impact mondial des maladies animales » pour compiler les données Une seule santé

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Résumé

Le programme « Impact mondial des maladies animales » (GBADs) a pour but de réunir des éléments probants axés sur des données, qui soient exploitables par les décideurs politiques pour évaluer les solutions envisagées, fonder leurs décisions et mesurer le succès des interventions dans les domaines de la santé et du bien-être des animaux. L'équipe informatique du GBADs a conçu un processus transparent pour l'identification, l'analyse, la visualisation et le partage des données, grâce auquel il sera possible d'estimer l'impact des maladies du bétail et de réaliser des modèles et des tableaux de bord sur le sujet.

Les données ainsi réunies peuvent être combinées avec celles couvrant d'autres problématiques ayant un impact mondial (santé humaine, pertes de récoltes, maladies d'origine alimentaire) afin de fournir l'éventail complet d'informations Une seule santé requis pour faire face à des enjeux tels que la résistance aux agents antimicrobiens ou le changement climatique.

La première phase du programme a consisté à recueillir des données ouvertes auprès de diverses organisations internationales (qui procèdent également à leur propre transformation numérique). Les efforts déployés pour parvenir à une estimation précise des effectifs des cheptels ont mis en lumière les difficultés à trouver les données détenues par différentes sources, à y accéder et à les recouper au fil du temps. Des ontologies et des bases de données graphiques sont en cours d'élaboration pour résoudre le problème des silos de données et pour améliorer la facilité de recherche

et l'interopérabilité des données. Les données du GBADs sont désormais expliquées sous forme de tableaux de bord, de récits construits à partir des données, ainsi que dans un site web documentaire et un Manuel de gouvernance des données, tous disponibles via une interface de programmation d'applications. Le partage des évaluations de la qualité des données renforce la confiance dans ces dernières et encourage à les appliquer pour traiter les problématiques affectant l'élevage ou relevant de l'approche Une seule santé. Les données relatives au bien-être animal présentent une difficulté particulière : elles sont, pour l'essentiel, détenues à titre privé et la question de savoir quelles sont les données les plus pertinentes est toujours en discussion. Les effectifs des cheptels doivent avoir été déterminés de manière précise afin de calculer la biomasse animale, élément qui entre par la suite dans le calcul des quantités d'agents antimicrobiens utilisés et des indicateurs du changement climatique. Les données du programme GBADs sont également essentielles au regard d'au moins huit des objectifs de développement durable des Nations Unies.

Mots-clés

Accès aux données – Bétail – Données Une seule santé – Impact mondial des maladies animales – Interopérabilité – Qualité des données – Stratégie sur les données – Tableaux de bord – Visualisation des données.

Avances informáticos del programa sobre el Impacto Global de las Enfermedades Animales: camino de un acervo de datos al servicio de Una sola salud

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Resumen

El programa sobre el Impacto Global de las Enfermedades Animales (GBADs) proporcionará información contrastada y basada en el uso de datos de la que luego puedan servirse los planificadores de políticas para valorar distintas opciones, decidir con conocimiento de causa y medir la eficacia de una u otra intervención en materia de sanidad y bienestar animales. El equipo informático encargado del GBADs está preparando un proceso transparente destinado a seleccionar, analizar, visualizar y poner en común datos que ayuden a calcular la carga de enfermedades del ganado y a guiar la elaboración de modelos y paneles de control.

Estos datos pueden ser combinados con datos referidos a otros grandes problemas planetarios (salud humana, pérdida de cultivos, enfermedades de transmisión alimentaria) para obtener el repertorio completo de información en clave de Una sola salud que se necesita para abordar problemáticas como la resistencia a los antimicrobianos o el cambio climático.

El programa empezó por reunir datos abiertos procedentes de organizaciones internacionales (inmersas, por otra parte, en su propio proceso de transformación digital). La labor emprendida para estimar con exactitud las cifras de ejemplares del mundo pecuario reveló ciertos problemas a la hora de encontrar, obtener y conciliar datos de distintas fuentes a lo largo del tiempo. Ahora se están elaborando ontologías y bases de datos gráficos para crear conexiones entre los «silos de datos» y lograr que los datos sean a la vez más compatibles entre sí y más fáciles de localizar. Paneles de control, interpretaciones narrativas de los datos («*data stories*»), un sitio web de documentación y un manual de gestión de datos ayudan a explicar y aprehender los datos del GBADs, accesibles ahora por medio de una interfaz de programación de aplicaciones. El hecho de poner en común las evaluaciones de la calidad de los datos genera mayor confianza en esta información, promoviendo con ello su aplicación en temas de ganadería y de Una sola salud. Los datos de bienestar animal plantean una particular dificultad, pues gran parte de esta información está en manos privadas y todavía no está claro cuáles son los datos de mayor interés. Disponer de cifras exactas sobre el número de cabezas de ganado es fundamental para efectuar los cálculos de biomasa que después se utilizan para hacer otros cómputos referidos al uso de antimicrobianos y al cambio climático. Los datos del GBADs son asimismo esenciales para al menos ocho de los Objetivos de Desarrollo Sostenible de las Naciones Unidas.

Palabras clave

Acceso a los datos – Calidad de los datos – Compatibilidad – Datos para Una sola salud – Estrategia de datos – Ganado – Impacto Global de las Enfermedades Animales – Panel de control – Visualización de datos.

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