Deliverable D-WP1.1

OHEJP JIP MATRIX - WP1

Responsible Partner: 10-FLI

GENERAL INFORMATION

European Joint Programme full title	Promoting One Health in Europe through joint actions on foodborne zoonoses, antimicrobial resistance and emerging microbiological hazards
European Joint Programme acronym	One Health EJP
Funding	This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 773830.
Grant Agreement	Grant agreement n° 773830
Start Date	01/01/2018
Duration	60 Months

DOCUMENT MANAGEMENT

Title OHEJP deliverable	REPORT: COMMONALITIES AND DIFFERENCES OF THE DIFFERENT OPERATIONAL FRAMEWORKS IN ANIMAL HEALTH, PUBLIC HEALTH AND FOOD SAFETY
WP and task	WP1-T1
Leader	Carola Sauter-Louis, 10-FLI
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Due month of the deliverable	Month 36, December 2020
Actual submission month	Month 36, December 2020
Type *R: Document, report* *DEC: Websites, patent filings, videos, etc.; OTHER*	R Save date: 2-Jul-21
Dissemination level *PU: Public (default)* *CO: confidential, only for members of the consortium (including the Commission Services).*	PU *See updated Grant Agreement*
Dissemination *Author's suggestion to inform the following possible interested parties.*	OHEJP WP 1 ☐ OHEJP WP 2 ☐ OHEJP WP 3 ☒ OHEJP WP 4 ☒ OHEJP WP 5 ☒ OHEJP WP 6 ☒ OHEJP WP 7 ☐ Project Management Team ☒ Communication Team ☒ Scientific Steering Board ☐ National Stakeholders/Program Owners Committee ☐ EFSA ☒ ECDC ☒ EEA ☐ EMA ☐ FAO ☒ WHO ☒ OIE ☒ Other international stakeholder(s): as per OHEJP dissemination plan Social Media: as per OHEJP dissemination plan Other recipient(s): n.a.

REPORT: COMMONALITIES AND DIFFERENCES OF THE DIFFERENT OPERATIONAL FRAMEWORKS IN ANIMAL HEALTH, PUBLIC HEALTH AND FOOD SAFETY

1. Introduction

One health (OH) is an approach to infectious disease management which acknowledges that multiple factors often influence pathogen dynamics in a population of interest[1]. Three factors commonly considered, are those of humans, animals and environment. The importance of a One health approach to infectious disease management is gaining recognition given that many infectious diseases of current human health concern are spread by food borne means, and around 75% of all new and emerging diseases are zoonotic in origin (i.e. transmit from animal to humans or vice versa) [2]. Zoonotic and food borne diseases, by their very nature, benefit from a multi-faceted or One health approach to disease management.

Effective disease management decision making is often underpinned by surveillance data[3]. That is because surveillance data provide important information including the current status of a disease in the population, the distribution of that disease within the population, and patterns in prevalence and distribution over time. This information helps decision makers not only with developing or modifying control/prevention/eradication programs, but also with evaluating their effect. For zoonotic and food-borne diseases that benefit from a One health approach, data from multiple surveillance systems are required. For instance, for management of a zoonotic disease, surveillance data from the human population, the host-animal population and from the environment would all need integrated consideration.

Although simple in theory, accessing and integrating surveillance data from multiple different sectors can be difficult. The difficulty arises from a lack of harmonization between the surveillance systems across the sectors resulting in different data that can be hard to integrate, for example surveillance systems from different sectors may collect data on different variables, collect data in different formats and use different sampling strategies to collect the data. This lack of harmonization decreases the ability to use surveillance data in a One health context.

To help address the lack of harmonization in surveillance systems across the health sectors, the MATRIX project was developed. The MATRIX projects aims to connect or harmonise dimensions in One health surveillance by developing common frameworks for designing and implementing surveillance and control activities. The project is co-funded by the One Health European Joint Programme and is part of a bigger group addressing issues in One health implementation including the ORION project and the COHESIVE project.

To begin harmonising surveillance systems through developing common frameworks for designing and implementing surveillance and control activities, it was first necessary to identify, describe and analyse the commonalities and differences of the different operational surveillance frameworks in the animal health sector (AH), the public health sector (PH) and the Food Safety sector (FS). This work had two streams; the first was to identify, describe and analyse commonalities and differences of individual surveillance systems for zoonotic or food borne pathogens in each sector, and the second was to identify, describe and analyse commonalities and differences between existing One health surveillance systems that spanned across sectors. These data could then be used to determine where harmonization could occur across the surveillance spectrum and to identify which aspects in existing systems currently work and which do not, allowing for the development of a (theoretical) best practice One health common surveillance framework.

In this report, we describe the results of our investigation into the first stream, to identify, describe and analyse commonalities and differences of individual surveillance systems for zoonotic or food borne pathogens between AH, PH and FS.

2. Methods

To identify, describe and analyse commonalities and differences of individual surveillance systems for zoonotic or food borne pathogens between AH, PH and FS, we collaborated with the ORION project in developing an inventory of surveillance systems across AH, PH and FS for each project member's country. We then used our experiences from the development process and analysis of the final data to complete the task.

Although, for the purpose of this report, we describe the method used for designing the inventories and collating the data, that work was driven by the ORION project. MATRIX members performed a supporting role in that aspect, and then drove/performed all the subsequent analyses described.

2.1. Selecting variables

A core group of three researchers created an exhaustive list of potential surveillance variables and response options (where suitable) drawing from personal experience, SURVTOOLS and communication with external experts. The variables were organized into logical categories. The list was then presented to ORION project members (n~40) for discussion and consensus selection of the variables that were deemed necessary. Members were cognizant of the delicate balance between keeping data providers engaged with an acceptable number of variables, yet capturing enough information to meet the aims of the inventory. Variables requesting confidential data were not considered. Consensus selection occurred over several rounds of consultation.

The initial list of variables and response options was then presented to both the European Centre for Disease Prevention and Control (ECDC) and the European Food Safety Authority (EFSA) for comment. All comments were addressed, including mapping of the variables and input options against existing variables collected by both EFSA and ECDC to identify and remove overlap where possible, and to align terminology where possible.

2.2. Questionnaire

Questionnaires were designed in Excel (2019). Variables were arranged into the header row of an Excel table and grouped by category. Variables associated with an open question were formatted for plain text. Variables associated with a closed question were formatted to provide a drop-down box with all answer options to select from. Entry options for closed question variables were not restricted and free-text was enabled, however, a message encouraged participants to use the drop-down options where possible.

A guide was provided with the Excel questionnaire, explaining each variable, the associated question, the data type required and whether it was a mandatory or optional variable.

2.3. Responses/Data management

The Excel questionnaires and associated guides were distributed to members of ORION and MATRIX by e-mail. This group of recipients were a diverse representation of AH, PH, and FS across the project member countries. The e-mail also included a cover letter explaining the aim of the questionnaire, confirming that no confidential data was requested and describing the data storage plan.

The questionnaires and explanatory guide were also made publically available on a web-server (OHEJP Knowledge Base: Inventory on Surveillance systems) at: https://shiny.fli.de/ife-apps/EJPORION_WP2Epi/

Responses were saved in raw format on a server of the Friedrich-Loeffler-Institut in a restricted access folder and collated in a single separate Master-version for each questionnaire type. Final data were uploaded to a public platform after confirmed permission from the data providers (https://shiny.fli.de/ife-apps/EJPORION_WP2Epi/).

2.4. Assessing commonalities and differences between surveillance components

Commonalites and differences between surveillance components for each sector were identified and assessed throughout the process of developing the questionnaires and eliciting responses.

Data received in response to the questionnaires were also systematically analysed within Excel (2019) on a copy of the Master-version data to assess commonalities and differences.

2.5. Data Sharing platform

The data sharing platform was specifically developed within the ORION project to fulfill the objective of providing easy access to information on existing surveillance systems for food borne or zoonotic diseases across sectors and member states (https://shiny.fli.de/ife-apps/EJPOrion_WP2Epi/). However, this is beyond the scope of this deliverable and will therefore not be discussed further.

3. Results

3.1. Variables

3.1.1. Final list of variables

Extensive discussion and consultation amongst project members, EFSA and ECDC highlighted that three separate questionnaires – one for each sector – were needed to capture the data of interest. This went against the initial plan to capture data from all three sectors in a single questionnaire, but was necessary to keep the questionnaires simple yet accommodate variables that could not be resolved across the three sectors.

Broadly, the variables chosen fell into one of two categories: those that provided information about the structure of the surveillance system (structural) and those that provided descriptive information about the data captured (descriptive).

The final list of variables for each sector are presented in Table 1.

Table 1 Final list of variables for Public health, Animal health and Food Safety for which data were collected, including whether a drop-down list was provided, and the type of variable (structural or descriptive).

Category	Public Health/Animal Health	Food Safety	Drop-down	Type
Health Targets	Hazard	Hazard	✓	D
	Subtype	Subtype	✓	D
	Disease or syndrome	-	✓	D
Time Frame	Start Date	Start Date	×	S
	End Date	End Date	×	S
Geographical Information	Country	Country	✓	D
	Region	Region	✓	S
Disease Status	Disease Status	Disease Status	✓	D
Surveillance Objective	Surveillance objective	Surveillance objective	✓	S
Legal Basis	EU legal Classification	EU legal Classification	✓	D
	National legal Classification	National legal Classification	✓	D
Sampling Context	Sampling context	Sampling context	✓	S
Case Definition	Case definition	Case definition	×	S
Sampling Strategy	Sampling strategy	Sampling strategy	✓	S
Target	Target species	Target Matrix	✓	D
	Target unit	Target unit	✓	S
Sampling Stage	Sampling stage	Sampling stage	✓	S
Sampling Unit	Sampling Unit	Sampling Unit	✓	S
Sample Type	Sample type	Sample type	✓	D
Sampler	Sampler	Sampler	✓	D
Website	Website	Website	×	D

D = Descriptive; S = Structural

To ease both data entry and processing, drop-down options were provided for all variables except Start Date, End Date, Case Definition, and Website. If variables were shared with EFSA surveillance data description or The European Surveillance System (TESSy) from ECDC, drop-down options were developed to align with EFSA regulations and pre-existing options provided in TESSy, however additional options were included based on discussion with experts in each sector and feedback from

data-providers. Drop-down options for each variable within each sector can be found within the questionnaires, online at: https://shiny.fli.de/ife-apps/EJPOrion_WP2Epi/

Developing drop-down options proved a useful avenue for identifying commonalities and differences between the surveillance systems and the data they collected within each sector. On the whole, the type of data collected for the variables Hazard, Subtype, Disease or Syndrome, Country and Region were similar across sectors and used comparable terminology. However, the remaining variables with drop-down options all revealed differences across the sectors. These differences broadly fell into one of three categories: conceptually different, frequency different and sector-specific logically different variables.

Conceptually different variables were those that had fundamentally different meanings between the sectors or simply existed in one sector(s), but not the other. Three variables fell into this category: *European Union (EU) Legal Classification, National Legal Classification* and *Sampling context*. *EU Legal Classification* describes the legal status of a disease at the EU level. In AH and FS the diseases are commonly described as being notifiable or not, whereas in PH they are classified as 'communicable' or not. At the national level, PH appears to share the classification of 'notifiable' with AH, however AH has the additional classification of 'reportable'.

Interestingly, the variable *Sampling context* revealed that two drop-down options, Active Monitoring/Surveillance and Passive Monitoring/Surveillance had fundamentally different meanings between PH and AH/FS. Table 2 presents representative definitions for each within each sector. It appears that within PH the meaning of Active or Passive Monitoring/Surveillance is associated with data collection, whereas in AH and FS the term relates to sample collection.

Table 2 The definition of Active and Passive monitoring/surveillance in Public health, and Animal health or Food safety.

Definition*	Public health	Animal health/Food safety
Active Monitoring/Surveillance	A system based on the public health officials' initiative to contact the physicians laboratory or hospital staff or other relevant sources to report data. Active surveillance typically generates high-quality data (high levels of completeness, validity and timeliness) through a direct link with data providers. Active surveillance relies on a prompt response from public health professionals, who will usually monitor replies and can respond to low response rates in order to improve external completeness.	Investigator-initiated collection of animal health related data using a defined protocol to perform actions that are scheduled in advance. Decisions about whether information is collected, and what information should be collected from which animals is made by the investigator.
Passive Monitoring/Surveillance	Regular reporting of disease data by all institutions that see patients (or test specimens) and are part of a reporting network. There is no active search for cases. It involves passive notification by surveillance sites and relies on the physicians laboratory or hospital staff or other relevant sources to take the initiative to report data to the health department	Observer-initiated provision of animal health related data (e.g. voluntary notification of suspect disease) or the use of existing data for surveillance. Decisions about whether information is provided, and what information is provided from which animals is made by the data provider.

* Definition sourced at the ORION One Health Glossary, available at: https://aginfra.d4science.org/web/orionknowledgehub/catalogue

Frequency different variables were those, where a starkly different selection of drop-down options between the sectors was predicted during discussions. Two variables fell into this category: *Sampling Strategy* and *Sampling Unit*. In both cases, it was predicted that PH would differ most. In the case of *Sampling Strategy,* PH was thought to primarily use a suspect sampling strategy for most hazards, whereas AH and FS would use a spread of the remaining options: census, objective, selective, convenient and import sampling. Similarly, for *Sampling Unit*, discussions suggested that for most hazards under PH surveillance, an individual sampling unit would be used, whereas for AH and FS, there would be more diverse use including 1 sample/group and multiple group sampling.

Sector specific logically different variables were those, where the associated drop-down options were almost completely different between the sectors, however, the differences were logical, when considering the sector and its operation. For instance, it was logical that the variable *Target Species* had fewer overlapping drop-down options between the sectors given that PH mainly focuses on 'humans', AH on 'animals' and FS on 'food (matrix) products'. Four additional variables fell into this category: *Target unit*, *Sampling stage*, *Sample type* and *Sampler*. In all these cases, the differences were logical based on the surveillance context.

3.1.2. Mapping against ECDC and EFSA

The final list of inventory variables for PH, AH and FS were mapped against variables already collected by ECDC in TESSy and EFSA. Table 3 shows variables from the inventory with an equivalent counterpart in the TESSy or EFSA databases. Of the 21 possible variables, eight were equivalent between TESSy and the surveillance inventories, and 12 between EFSA databases and the surveillance inventories.

Table 3 Inventory variables and presence of an equivalent in ECDC TESSy or EFSA Atlas.

Category	Inventory Variable	ECDC (TESSy)	EFSA (Atlas)
Health Targets	Hazard	✓	✓
	Subtype	✓	✓
	Disease or syndrome*	✓	-
Time Frame	Start Date	-	-
	End Date	-	-
Geographical Information	Country	✓	✓
	Region	-	✓
Disease Status	Disease Status	-	-
Surveillance Objective	Surveillance objective	-	-
Legal Basis	EU legal Classification	-	-
	National legal Classification	✓	-
Sampling Context	Sampling context	✓	✓
Case Definition	Case definition	✓	✓
Sampling Strategy	Sampling strategy	-	✓
Target	Target species**	-	✓
	Target unit	-	✓
Sampling Stage	Sampling stage	-	✓
Sampling Unit	Sampling Unit	-	-
Sample Type	Sample type	✓	✓
Sampler	Sampler	-	✓
Website	Website	-	-

* not present in Food/Feed Safety inventory

** variable called *Target matrix* in Food/Feed Safety inventory

3.2. Data collection and analysis

3.2.1. Responses

The questionnaires and associated guides were distributed to members of ORION and MATRIX by e-mail on 2 October 2020. Follow-up and reminder e-mails were sent at least bi-monthly until 14 April 2021. Table 4 presents the responses received from ORION and MATRIX members by 7 May 2021. Potential responses indicate the number of member states from each sector represented within ORION and MATRIX and therefore the theoretical number of possible responses. The column 'Complete responses' reports the actual number of completed questionnaires received. Partial responses were derived from data provided by ORION members in the early phase of questionnaire development. Where possible, these data were transferred to the final questionnaires, however, significant amounts of data were missing from these inventories.

Table 4 Responses to questionnaires on existing surveillance systems sent out by e-mail to ORION and MATRIX members

Sector	Potential Responses	Complete Responses	Partial Responses
Public Health	8	3	2
Animal Health	8	3	2
Food Safety	4	2	1
Total	20	8	5

Complete responses were received from PH (n=3), AH (n=3) and FS (n=2). Member state A contributed complete responses for all three sectors, and Member states B and C provided complete responses for both AH and PH. These data were most useful for investigating the similarities and differences between the components of the surveillance systems between the different sectors given that any member state influence would be normalised. The remaining complete data received for FS was from a fourth Member state (Member state D).

Partial responses represented two EU member states. The most complete variables were *Hazard* and *Disease or Syndrome*.

3.2.2. Analysis by variables

In the following analyses, only data from the 'Complete responses' were analysed, except for the variables Hazard and Disease or Syndrome, where data from 'partial responses' were also appropriate for inclusion.

We have included a short description for each variable in *ITALICS* to help clarify the meaning of the variable to the reader.

3.2.2.1. Hazard and Disease or Syndrome

Hazard – refers to a biological, chemical or physical agent in, or a condition of a human animal or animal product, with the potential to cause an adverse health effect. In the questionnaire, it is synonymous with the zoonotic or foodborne 'infectious agent'.
Disease or Syndrome – refers to the adverse health effect caused by the zoonotic or foodborne infectious agent.

Altogether, surveillance systems were reported for over 155 unique hazards of a zoonotic or foodborne nature. These hazards included subtypes, for example, in the case of Salmonella, *Salmonella Infantis* and *Salmonella Arizonae* were counted as two separate hazards. Grouping the hazards by disease or syndrome (for example *Salmonella Infantis* and *Salmonella Arizonae* are grouped in non-typhoidal Salmonellosis) resulted in a more meaningful 99 unique diseases or syndromes reported. Table 5 shows that two of these diseases and syndromes were reported in both PH and FS, thirteen in both AH and PH, and a further six in all three sectors, AH, PH and FS.

Table 5 Common hazards present across the Animal health, Public health and Food safety sectors

Hazard or Syndrome/Disease	Animal health	Public health	Food safety
Enterococcus		✓	✓
***Escherichia coli**		✓	✓
***Anthrax**	✓	✓	
***Brucellosis**	✓	✓	
***Psitticosis**	✓	✓	
***Ebola**	✓	✓	
***Echinococcosis**	✓	✓	
Influenza	✓	✓	
***Leptospirosis**	✓	✓	
***Prion diseases**	✓	✓	
***Q Fever**	✓	✓	
***Rabies**	✓	✓	
***Toxoplasmosis**	✓	✓	
***Tularemia**	✓	✓	
***West Nile**	✓	✓	
***Campylobacterosis**	✓	✓	✓
***Listeriosis**	✓	✓	✓
***Methicillin-resistant Staphylococcus aureus**	✓	✓	✓
***non-typhoidal Salmonellosis**	✓	✓	✓
***Trichinosis**	✓	✓	✓
***Enterohaemorrhagic Escherichia coli**	✓	✓	✓

**Indicates where the pathogen was present in two or more sectors within the one member state*

No difference in preference to use the 'Hazard' variable or 'Disease or Syndrome' variable was discernable between the sectors.

3.2.2.2. Start Date and *End Date*

Start date – asks for the date or year when data collection into the system began
End date – asks for the date or year when data collection into the system ceased (if it ceased)

There were few missing data points for '*Start Date'* across the inventories (<5%). Figure 1 demonstrates discreet and considerable spikes in the number of PH surveillance systems initiated in certain years. In most cases, these spikes coincided with an explanatory event. For example, the spike in 1977 for Member state C coincided with the year that state established its national surveillance system for communicable diseases.[1]

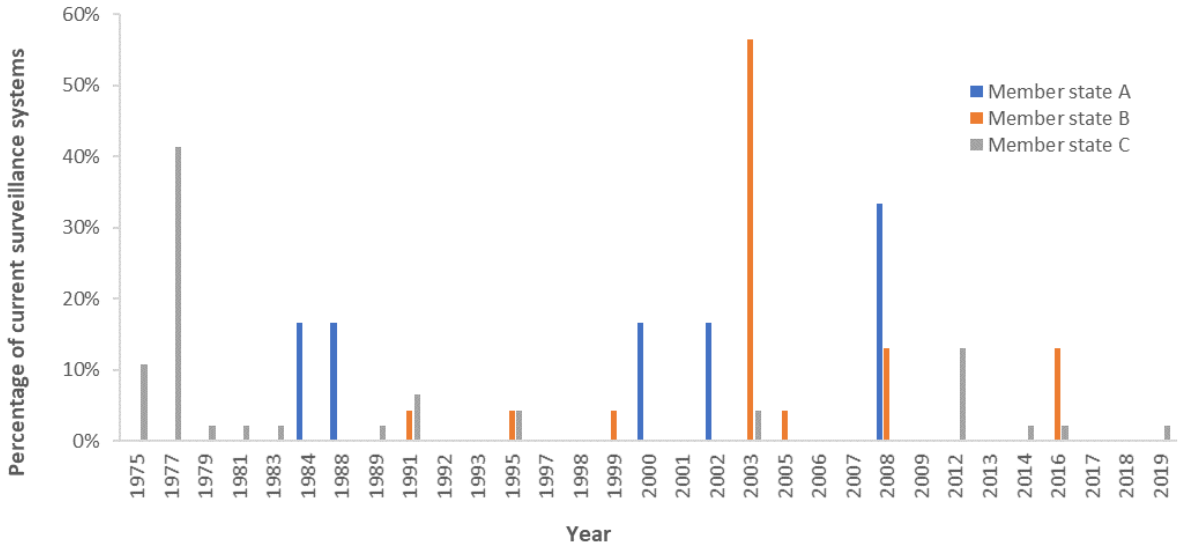

Figure 1 Percentage of current surveillance systems initiated by year in the Public health sector for Member states A, B and C.

In contrast, Figure 2 suggests a more homogenous spread of years in which surveillance systems were initiated in the AH sector, and only the occasional small peak. Almost all the surveillance systems reported for the FS sector were initiated in 2006 and 2008 (member states D (94%) and A (93%) respectively). Although many surveillance systems are reported for each member state, they represent only a handful of pathogens but in differing contexts. Furthermore, the timing in some cases co-incides with related changes in food safety legislation. Taken together, this result is likely an outcome of the small number of pathogens reported under surveillance and/or changes in food safety legislation.

[1] https://www.euro.who.int/__data/assets/pdf_file/0018/237204/HiT-Norway.pdf

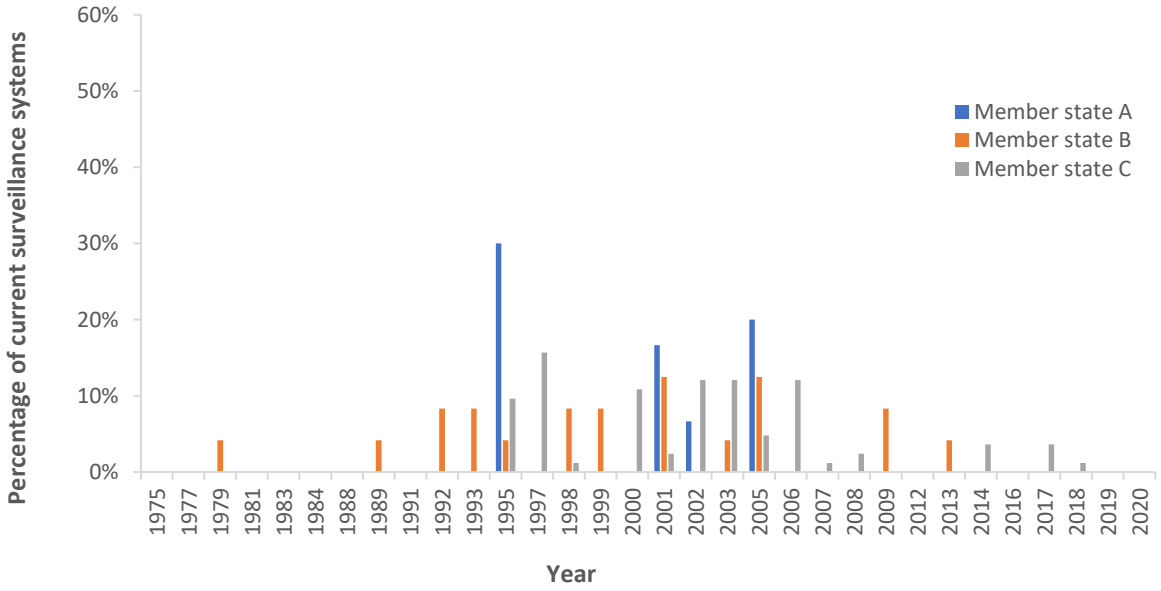

Figure 2 Percentage of current surveillance systems initiated by year in the Animal health sector for Member states A, B and C.

End Date entries indicated that all systems reported were ongoing.

3.2.2.3. Regions

Asks for the region(s) in which the surveillance system (component) is in place.

For each member state and sector, the variable 'Region' was entirely completed using either the 'all regions' drop down option or left blank. The single exception was the PH sector for Member state C, that recorded 'not applicable' for five surveillance systems. Each of these surveillance systems were associated with hazards that had a historically absent, sporadic, or sporadic-travel related disease status.

None of the responses indicated that surveillance systems operated in specific regions.

3.2.2.4. Disease status

Asks for the current status of the disease in the geographical area covered (e.g. historically absent, absent,eradicated, endemic etc.)

Data were descriptively analysed for all member states that contributed data from the PH and FS sectors. Data from two member states from the AH sector were also included, however member state C recorded less than 50% data for this variable and was therefore excluded from the analysis given the potential for bias.

Figure 3 demonstrates considerable variation between sectors with regard to the disease status of the food-borne and/or zoonotic diseases under surveillance. Two clear features that appeared unique to the AH sector was the presence of surveillance for 'absent (eliminated)' diseases under and the lack of surveillance for 'sporadic travel-related diseases'. These findings are consistent with the hosts under

surveillance and the priorities of the associated industries. The FS sector reported surveillance for diseases of a sporadic disease status only.

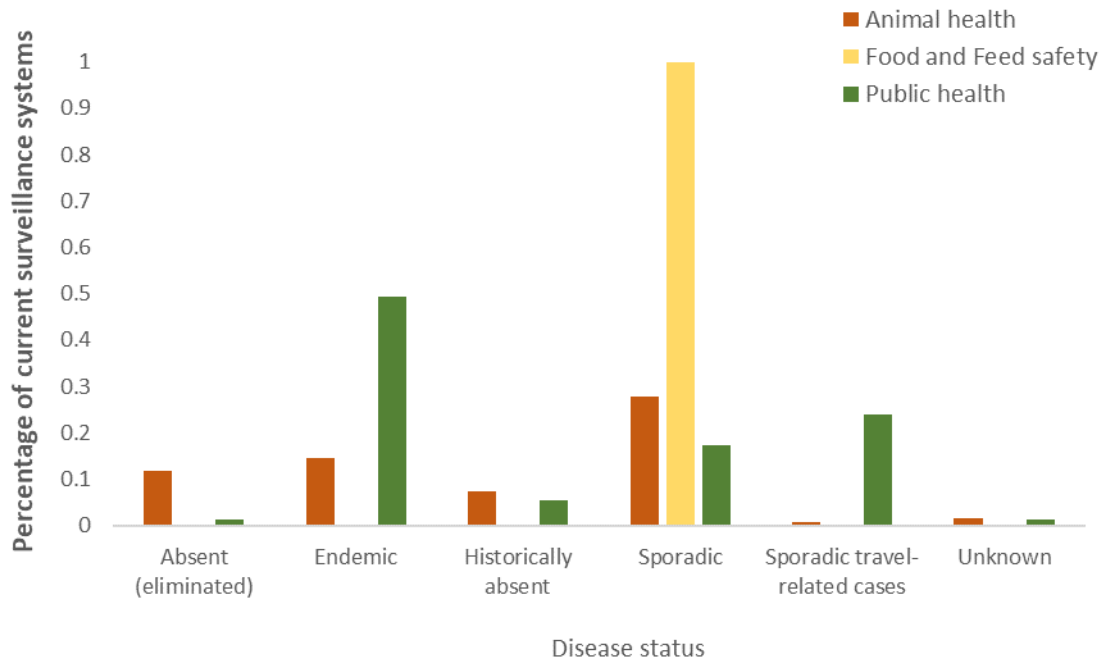

Figure 3. Percentage of current surveillance systems by the status of the disease under surveillance, broken down by sector

With the exception of FS, Figure 4 demonstrates considerable variation in the disease status of the diseases under surveillance within sectors across the member states. This variation likely reflects the expected difference in disease dynamics across geographic areas based on numerous factors such as control efforts, variations in host movements and behaviours, suitable environmental conditions and so on. There is potential that some of the variation was the result of different understandings of the meaning for each disease status, although this is less likely given that definitions were provided to data contributors.

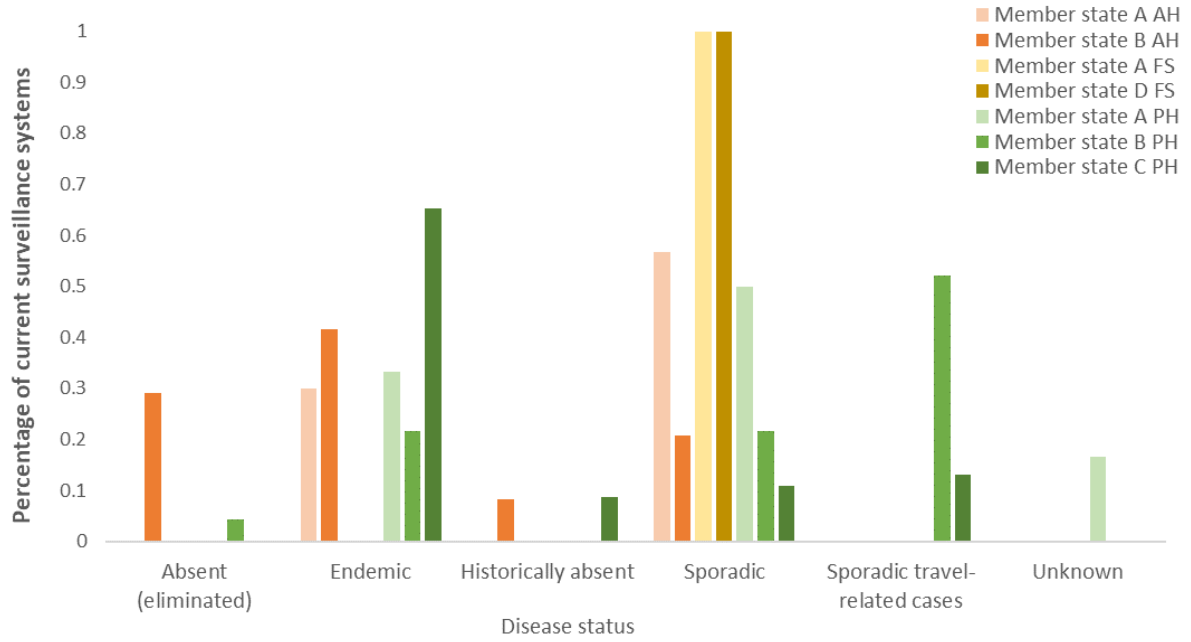

Figure 4 Percentage of current surveillance systems by the status of the disease under surveillance, broken down by member state and sector

3.2.2.5. Surveillance objective

Asks for the goal(s), that when met, will result in the collection and analysis of data in order to achieve the purpose of the system.

Data analysis revealed that an error in the drop-down options provided for the variable *Surveillance Objective* had led to nonsensical results in PH responses for Member state B, and as a result these data were removed from the analysis.

We found that PH had a single surveillance objective, case detection, for all the surveillance systems they reported. In the FS sector, Member state D reported only a surveillance objective of prevalence estimation, however, Member state A reported prevalence estimation, '*concentration at different stages of storage'* (not a drop-down option) and case detection. Although this might initially appear as an intra-sectoral difference, when the description '*concentration at different stages of storage'* was considered as a type of prevalence estimation, this option represented over 90% of all the surveillance systems reported by Member state A, and demonstrated similarly few surveillance objectives to Members state D. In contrast, the AH sector appeared to perform surveillance for a greater range of objectives than both PH or FS including case detection, prevalence estimation, early detection and freedom from disease documentation. It was interesting to note, that whilst case detection was an important surveillance objective for AH (46% of surveillance systems) similar to PH, the next most common objective for zoonotic and foodborne disease surveillance in AH was freedom from disease documentation (24% of surveillance systems) reflecting the specific needs of the sector.

3.2.2.6. EU and National Legal Classification

Asks for the EU and/or National legal status of the disease/hazard in the country

Across all sectors and member states these variables together had over 97% (294/303) completion rate. Missing data at both the EU and national level was observed for 4 of 30 surveillance systems reported by the AH sector of Member state A. For the AH sector of Member state B, although 75% (62/83) of hazards under surveillance were classified as 'notifiable' at the EU level, the remainder had missing data. However, 76% (16/21) of these were classified as notifiable at the national level, leaving only 5 (5/83) with truly no reported legal classification. Similarly, for the PH sector of Member state B there were 13 % (6/46) missing data for the variable EU legal classification, however 100% of these had a national legal classification of communicable or notifiable, meaning no surveillance system reported was not underpinned by an EU or national legal classification.

For each surveillance system reported within the AH and FS sectors across all the analysed member states, the EU and National legal classification was 'notifiable' or 'reportable'. In contrast, most of the surveillance systems reported for PH, had a 'communicable' EU legal classification – except for Member state C where 33% were listed as 'notifiable'.

3.2.2.7. Sampling Context and Sampling Strategy

Sampling context – asks for the purpose, or context in which sampling is carried out
Sampling strategy – asks for the sampling strategy in place for each particular surveillance system

Sampling context and *Sampling strategy* both had a completion rate over 90% for all member states and sectors. Table 5 illustrates that the AH sector showed more variability in the purpose of their surveillance systems and their sampling strategies than PH or FS.

Table 6 Drop-down options reported by Public health, Animal health and Food safety for sampling context and sampling strategy

	Sampling Context		
	Public Health	Food Safety	Animal Health
Reported data	Surveillance Monitoring passive	Monitoring – active Monitoring – passive Surveillance	Surveillance Clinical investigations Control and eradication programmes Monitoring – active Monitoring – passive
	Sampling Strategy		
	Suspect	Selective Objective	Suspect Selective Objective Import Convenient Census

3.2.2.8. Target species/Target matrix and Target Unit

Target species – asks for the susceptible population about which conclusions are drawn
Target unit – asks for the unit that is targeted in the surveillance system component

Not surprisingly, PH only reported a target species of 'Human' and target unit of 'Individual'. Animal health responses were naturally much more variable with several species (and categories within species) and target unit types reported (Individual, Compartment, Herd/Flock, Pool).

The equivalent of target species for FS is target matrix. Similar to AH, there was a broad range of target matrices under surveillance in FS. Table 7 demonstrates that FS reported surveillance systems targeting both single and batch units.

Table 7 – Number of surveillance systems by sector and the type target unit sampled

Sector	Target Unit Drop-down Options	Number	Percent
Public health (n= 75)	Individual	71	95
	Target age group	-	-
	Target gender	-	-
	Target occupational group	-	-
	Missing data	4	5
Animal health (n=135)	Individual (Animal)	67	50
	Herd/flock	55	41
	Slaughter animal batch	-	-
	Slaughter animals (heads)	5	4
	Compartment	1	1
	Holding	6	4
	Pool	1	1
	Missing data	-	-
Food Safety (n=91)	Single (food/feed)	71	78
	Batch (food/feed)	20	22
	Missing data	-	-

3.2.2.9. Sampling stage, Sampling Unit, Sample type and Sampler

Sampling stage – asks for the point/location where samples are collected
Sampling unit – asks whether individuals, groups or multiple groups are sampled
Sample type – asks for the primary types of sample collected
Sampler – asks for an indication of who collects/takes the sample

Table 8 demonstrates that for the variables Sampling stage and Sampling unit there was least variation in the PH sector and most in the AH sector. For the sample type variable, AH and PH reported many different types of samples collected whereas food safety was restricted to only four types. One 'type' was 'food sample' and likely represented multiple different sample types. Overall, these were predictable outcomes based on the industries represented.
At first glance the number of samplers used to collect samples for both AH and PH appeared similar. However, within PH, all of the five different 'samplers', with the exception of 'patient', relate to persons with a background in medical training. On the other hand, for AH the four 'samplers' reported came from very different training or experience backgrounds, for example, the farmer vs the veterinary official vs

the semen collection personnel. For FS, only 'Official samplers' and persons associated with a HACCP check collected samples for data input into the surveillance systems. These observations have likely implications for sample quality.

Table 8 Options selected by Public health Animal health and Food sectors for Sampling stage, Sampling unit, Sample type and Sampler

Variable	Public Heatlh	Food safety	Animal Health
Sampling stage	• Primary care • Hospital sector	• Farm • Processing plant • Retail • Slaughterhouse	• Articial insemination station • Farm • Hatchery • Natural habitat • Slaughterhouse • Hunting
Sampling unit	•Individuals	• Individuals • 1 sample/group	• Individuals • 1 sample/group • Multiple group sample
Sample type	• Blood/serum/plasma • Faeces • Clinical sample • Urine • Lumbar puncture • Nasal swab • Post Mortem Organs/Tissues • Pus • Spinal fluid	• food sample • food sample –carcase swabs • food sample – meat • food sample – milk	• Blood/serum/plasma • Brain • Caecum • Cloacal swab • Milk • Faeces • Environmental sample • Lumph nodes • Nasal swab • Post Mortem Organs/Tissues
Sampler	• Primary care-physician/specialist/ nurse/technician • Patient • Nurse/Technician at the request of a primary care physician • Nurse/Technician at the request of a specialist physician • Specialist physician	• Official sampler • HACCP producer check	• Farmer • Veterinary Official • Semen collection centre • Industry sampler

4. Discussion

4.1. General

To begin to identify commonalites and differences between the different operational surveillance frameworks in AH, PH and FS, we first chose to focus on the individual components of existing surveillance systems for food borne and zoonotic diseases. For that reason, we collaborated with the ORION project to develop an inventory of surveillance systems from the AH, PH and FS sectors in the EU for food borne and zoonotic diseases. We reasoned that we could later explore this inventory for differences and commonalities between the sectors.

The process of choosing variables for inclusion in the inventory provided the first avenue for identifying commonalities and differences between the sectors, though these findings were theoretical in nature. Commonalities and differences hypothesised at this developmental stage fell broadly into three categories: *conceptually different*, *frequency different* and *sector specific logically different*. For the categories *conceptually different* and *sector specific logically different* our predicted outcomes were later supported by the data. Although our predictions for the category *frequency different* for PH and AH held true following data analysis, FS was less variable than predicted and provided a novel insight into the surveillance conducted in this sector. However, these findings are based on the FS data from two member states only and should, therefore, be interpreted cautiously.

One of the most notable differences between the PH and AH/FS sectors was that of the definitions for 'Active' monitoring/surveillance and 'Passive' monitoring/surveillance. These terms were both firmly entrenched in each sector, but with very different meanings that could not be reconciled. This was a particularly important finding for harmonising data, not because it would obstruct the process, but rather because it needed to be known and thereafter considered for accurate interpretation of any data resulting from a harmonised system.

A potential point of criticism with respect to the development of the inventories to explore intersectoral surveillance differences and commonalities was that ECDC and EFSA collect similar data in their surveillance databases. We mapped the variables collected in the inventories against both those of TESSy (ECDC) and EFSA, and found that 8 out of 21 and 12 out of 21 were equivalent variables, respectively. Most of the overlap occurred in descriptive rather than structural variables. Given that structural variables are more likely to impact efforts towards harmonising surveillance systems, it was clear that our inventory was a more informative tool for this analysis.

A major limitation of this study was the low response ratio to the call for completing the questionnaires, upon which the inventories were developed. Of a potential 20 responses from ORION and MATRIX members, only eight complete responses were received by 7 May 2021. Three of the eight responses were from the AH sector, three from the PH sector, and two from the FS sector. Our analysis was facilitated in the sense that two complete responses for each the PH and AH sectors were received from the same member states, and one member state contributed data from all three sectors. This provided a reasonable platform, from which to describe commonalities and differences between surveillance systems from each sector, but given the low numbers, the findings may have limited external validity to other member states. However, communication with MATRIX members indicates that several more responses may be received over the year. We will therefore, review the data in the inventories in December 2021, and assess whether an updated analysis and report is warranted.

In analysing the responses, we found that the variables 'hazard' and 'disease or syndrome' were used fairly similarly between the AH, PH and FS sectors and that there was no preference for one or the

other. Furthermore, we easily found evidence of situations, where all three sectors had surveillance in place for the same hazard indicating that there was a common 'language' for labelling 'hazards' and 'diseases or syndromes' across the sectors. This apparent harmony in the variables 'hazard' and 'disease or syndrome' across the sectors was an important finding given that these variables provide the linking key, when attempting to harmonise surveillance systems for a particular hazard or disease across multiple sectors.

When analysing each individual variable, many commonalities and differences were observed. They are summarised throughout the results. The real question, however, is what is the implication of these commonalities or differences - are they important or not? This will depend on the intended use of the data. From the perspective of harmonising data across sectors, differences in structural variables are more likely to present hurdles to harmonisation and have greater impact than differences in descriptive variables. Overall, the implication of any differences or commonalities will need to be explored for each variable with the intended use of that data in mind. That is beyond the scope of this work, however, the data contained within this report will remain publicly available for others to make those contextually specific analyses.

In summary, we report our findings on the commonalites and differences between the different operational surveillance frameworks in AH, PH and FS, based on the data collected in the ORION surveillance inventories. The results of this report may have low external validity based on the limited data received, and therefore, the reader should interpret these results with caution. Nonetheless, they provide an initial description of the commonalities and differences in surveillance systems across different sectors, and an initial base of information from which to begin to understand how to harmonise these systems for an improved One health approach to disease management.

4.2. Future directions

In the coming months we will continue to promote the inventories and encourage additional member states and sectors to contribute data throughout the MATRIX project period. With this in mind, we consider it prudent to review the data contained within the data base at the end of 2021 and 2022, and review whether a subsequent analysis is appropriate given the new data (if any) present.

In parallel, we will continue work that addresses the second stream of this task, i.e. identifying, describing and analysing commonalities and differences between existing One health surveillance systems that span two or more sectors. To that end, we will research and collate an inventory of existing One health surveillance systems and analyse their components to explore differences and commonalites, as well as investigate, which aspects have been successful and useful. Ultimately, this information will be used to inform the development of new One health surveillance systems or improvement of existing One health surveillance systems through harmonisation across the sectors.

5. References

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