

Health Surveillance Ontology



ORION WP3



One Health data

Readability

Interoperability

Humans

Machines

CONTEXT

The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2016

European Food Safety Authority
European Centre for Disease Prevention and Control



AL: Albania; BA: Bosnia and Herzegovina; FYRM: the Former Yugoslav Republic of Macedonia; ME: Montenegro; and SR: Serbia.

Figure 7: Prevalence of the *S. Typhimurium*-positive breeding flocks of *Gallus gallus* during the production period, 2016

Table 1: Categorisation of zoonoses and food-borne outbreaks monitoring data used in EUSR 2016 (adapted from Boelaert et al., 2016)

Category	Type of analyses	Type/comparability between MS	Examples
I	Descriptive summaries at national level and EU-level	Programmed and harmonised monitoring or surveillance	<i>Salmonella</i> national control programmes in poultry
	EU trend watching (trend monitoring) Spatial and temporal trends analyses at the EU-level	Comparable between MS; results at EU-level are interpretable	Bovine tuberculosis Bovine and small ruminant brucellosis <i>Trichinella</i> in pigs at the slaughterhouse
			<i>Echinococcus granulosus</i> at the slaughterhouse
II	Descriptive summaries at national level and EU-level	Not fully harmonised monitoring or surveillance	Food-borne outbreaks data
	EU trend watching (trend monitoring) No trend analysis at the EU-level	Not fully comparable between MS; caution needed when interpreting results at EU-level	Monitoring of compliance with process hygiene and food safety criteria for <i>L. monocytogenes</i> , <i>Salmonella</i> and <i>E. coli</i> according Reg No 2073/2005 ⁵ Monitoring of rabies
III	Descriptive summaries at national level and EU-level	Non-harmonised monitoring or surveillance data with no (harmonised) reporting requirements	<i>Campylobacter</i> <i>Yersinia</i> Q fever <i>Francisella tularensis</i> West Nile virus
	No EU trend watching (trend monitoring) No trend analysis at the EU-level	Not comparable between MS; extreme caution needed when interpreting results at EU-level	<i>Taenia</i> spp. other zoonoses <i>Toxoplasma</i>

SCIENTIFIC REPORT



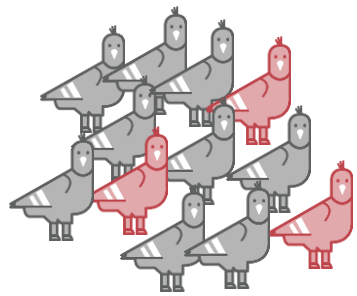
APPROVED: 13 November 2017
doi: 10.2903/j.efsa.2017.5077

The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2016

European Food Safety Authority
European Centre for Disease Prevention and Control

Table 4: Reported human cases of campylobacteriosis and notification

Country	2016				
	National coverage ^(a)	Data format ^(a)	Total cases	Confirmed cases & rates	
				Cases	Rate
Austria	Y	C	7,086	7,083	81.5
Belgium	Y	A	10,055	10,055	88.9
Bulgaria	Y	A	202	202	2.8
Croatia	Y	A	1,547	1,524	36.4
Cyprus	Y	C	21	21	2.5
Czech Republic	Y	C	24,291	24,084	228.2
Denmark	Y	C	4,712	4,712	82.6
Estonia	Y	C	382	298	22.6
Finland	Y	C	4,637	4,637	84.5
France ^(b)	N	C	6,698	6,698	50.2
Germany	Y	C	73,999	73,663	89.6
Greece ^(c)	–	–	–	–	–
Hungary	Y	C	8,579	8,556	87.0
Ireland	Y	C	2,511	2,511	53.1
Italy ^(d)	N	C	1,057	1,057	–
Latvia	Y	C	93	90	4.6
Lithuania	Y	C	1,225	1,225	42.4
Luxembourg	Y	C	518	518	89.9
Malta	Y	C	212	212	48.8
Netherlands ^(e)	N	C	3,383	3,383	38.3
Poland	Y	C	787	773	2.0
Portugal	Y	C	366	359	3.5
Romania	Y	C	517	517	2.6
Slovakia	Y	C	7,738	7,623	140.5
Slovenia	Y	C	1,642	1,642	79.5
Spain ^(d)	N	C	15,556	14,856	–
Sweden	Y	C	11,021	11,021	111.9

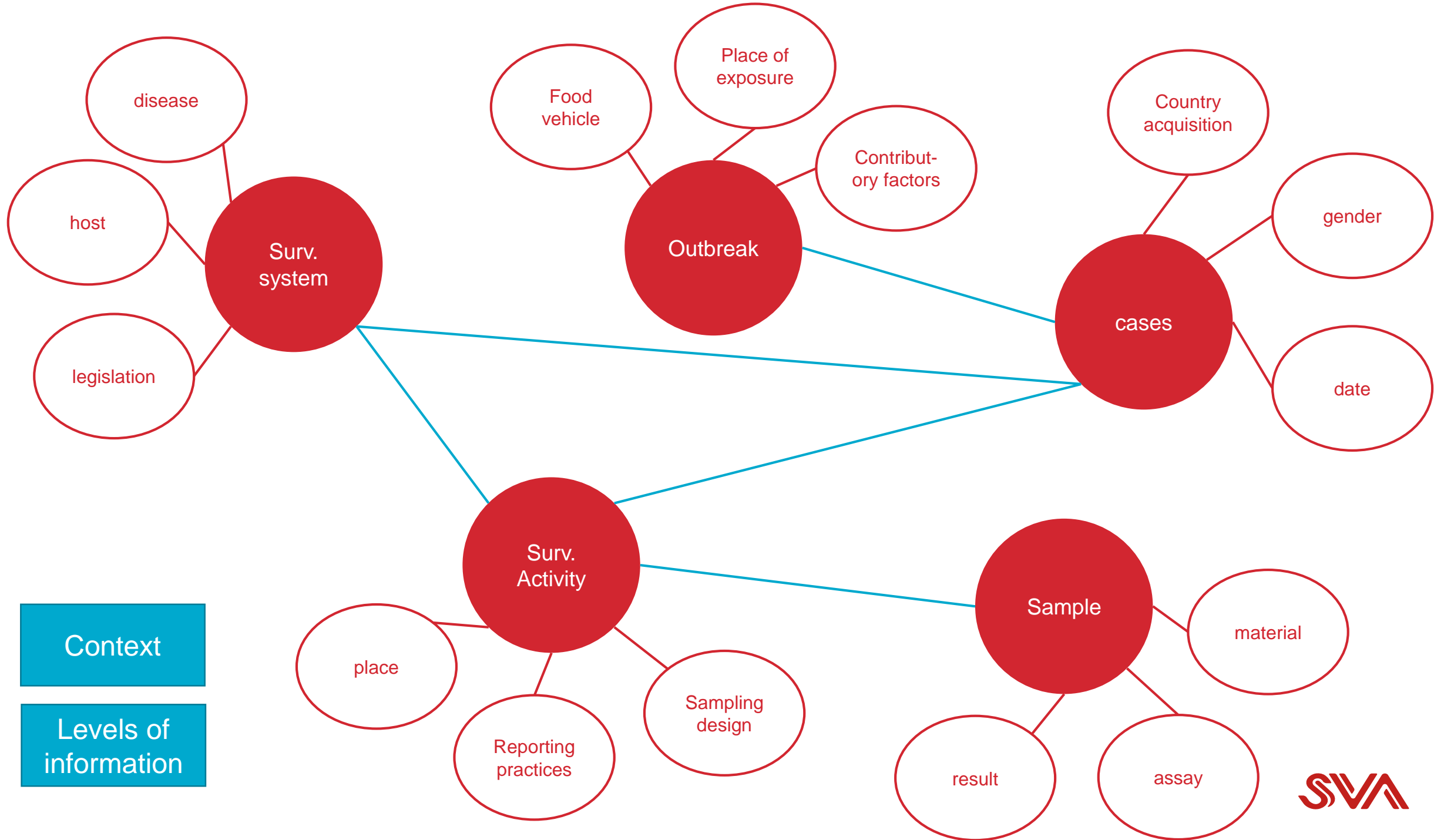


prevalence



cases

outbreaks





Surveillance objective

System description: AH

System description: FS

System description: PH

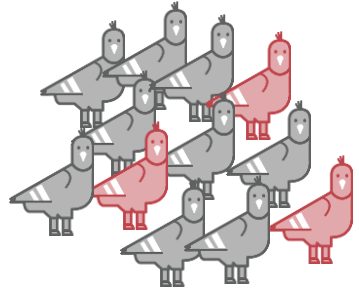


Surveillance Protocol

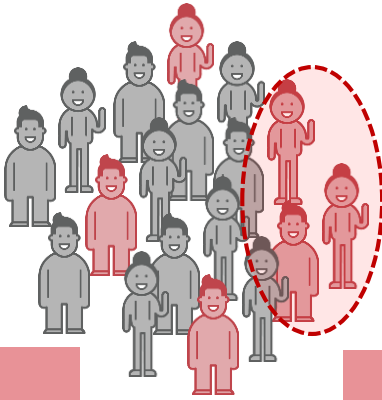
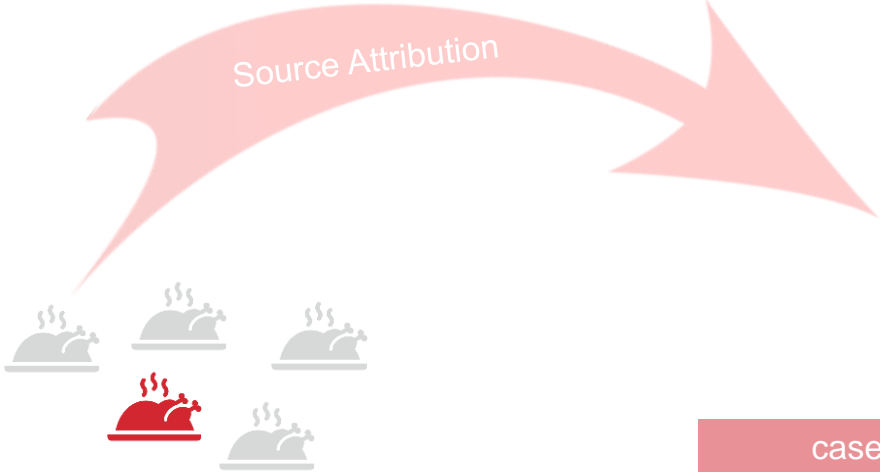
Sampling design

Reporting protocol

Sample collection protocol



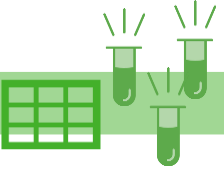
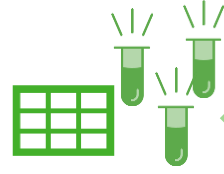
prevalence



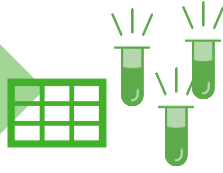
cases

outbreaks

Diagnostic protocol

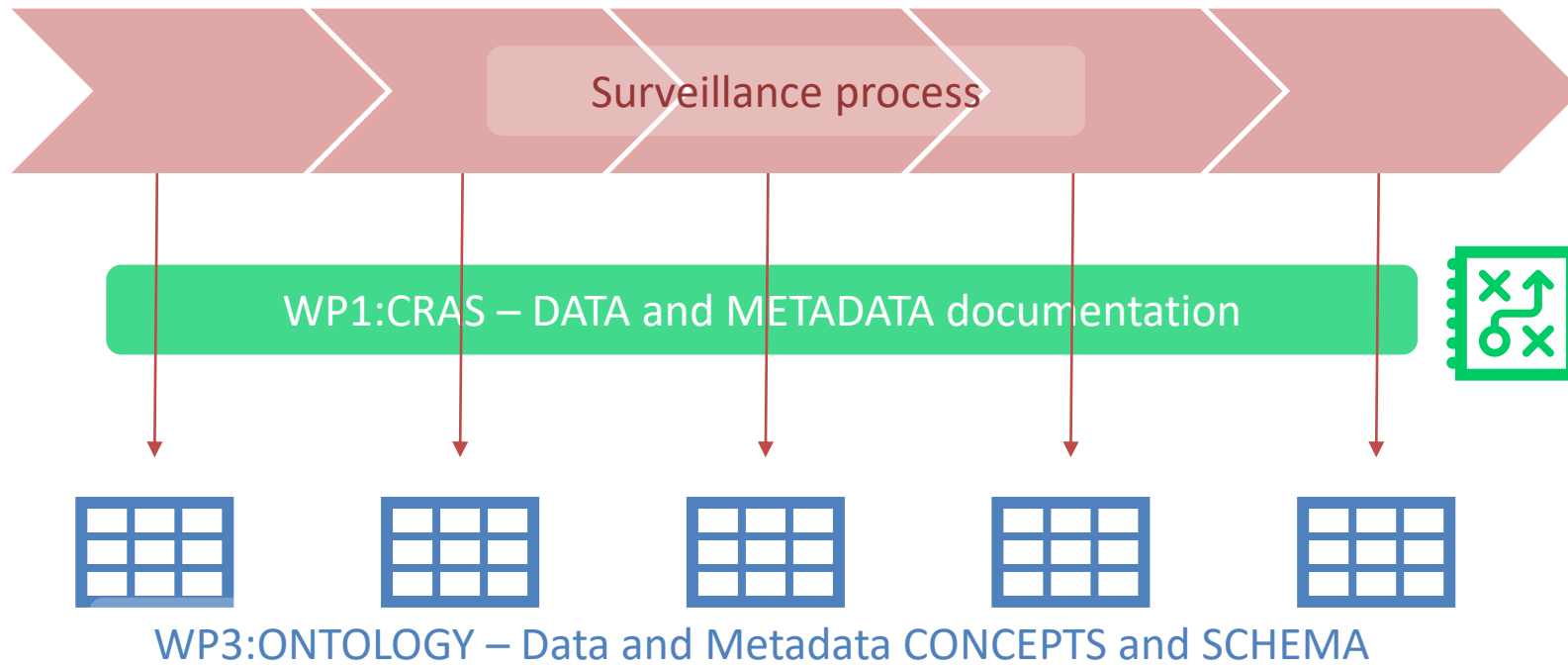


Data about the samples / individual results



Results of aggregated analyses







Data (meta-data??)



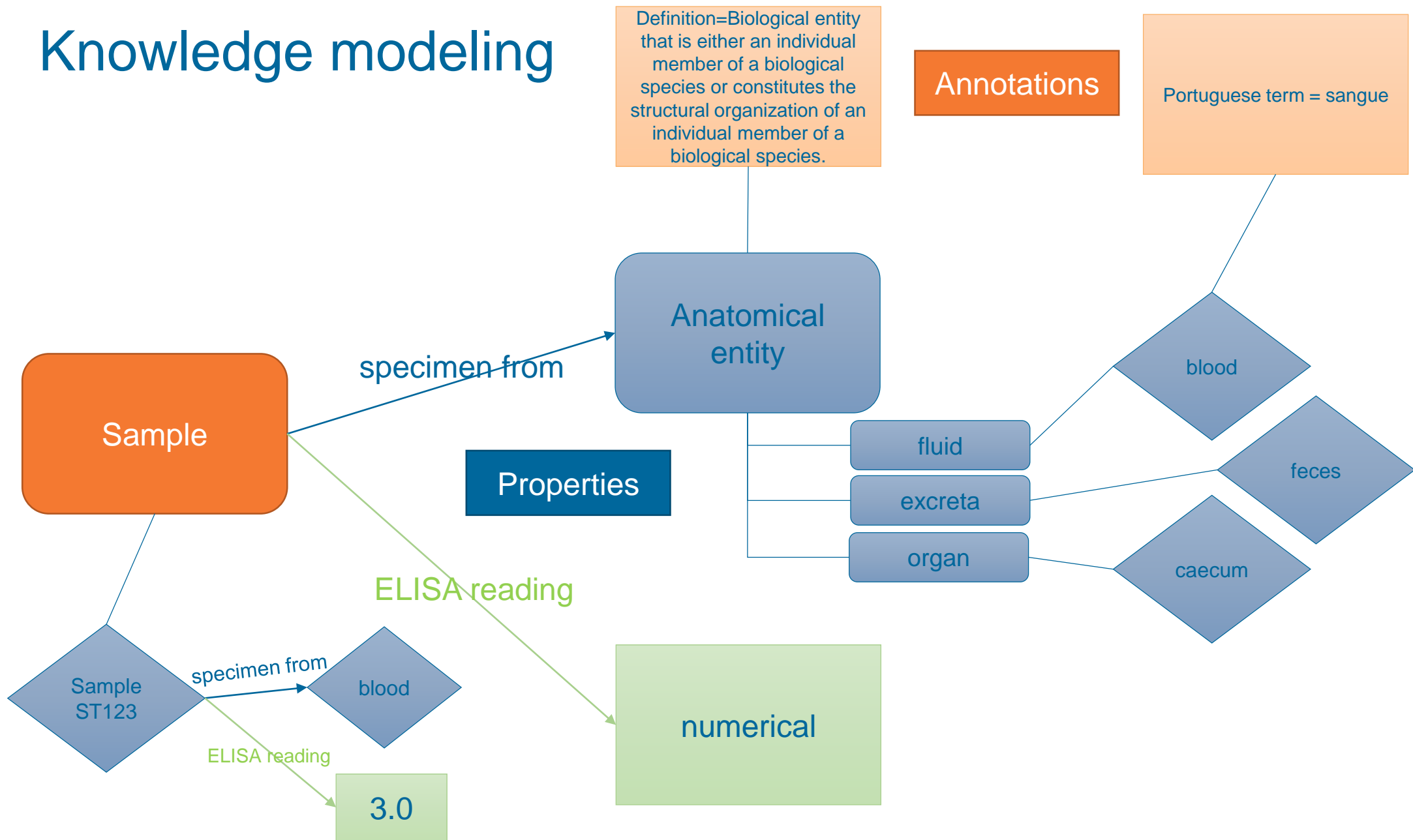
Blood sample
BTV-ELISA
positive

From a cow
From project X
Assay protocol
Person who ran test
Equipment settings

Data available
Knowledge needed to make meaningful use



Knowledge modeling

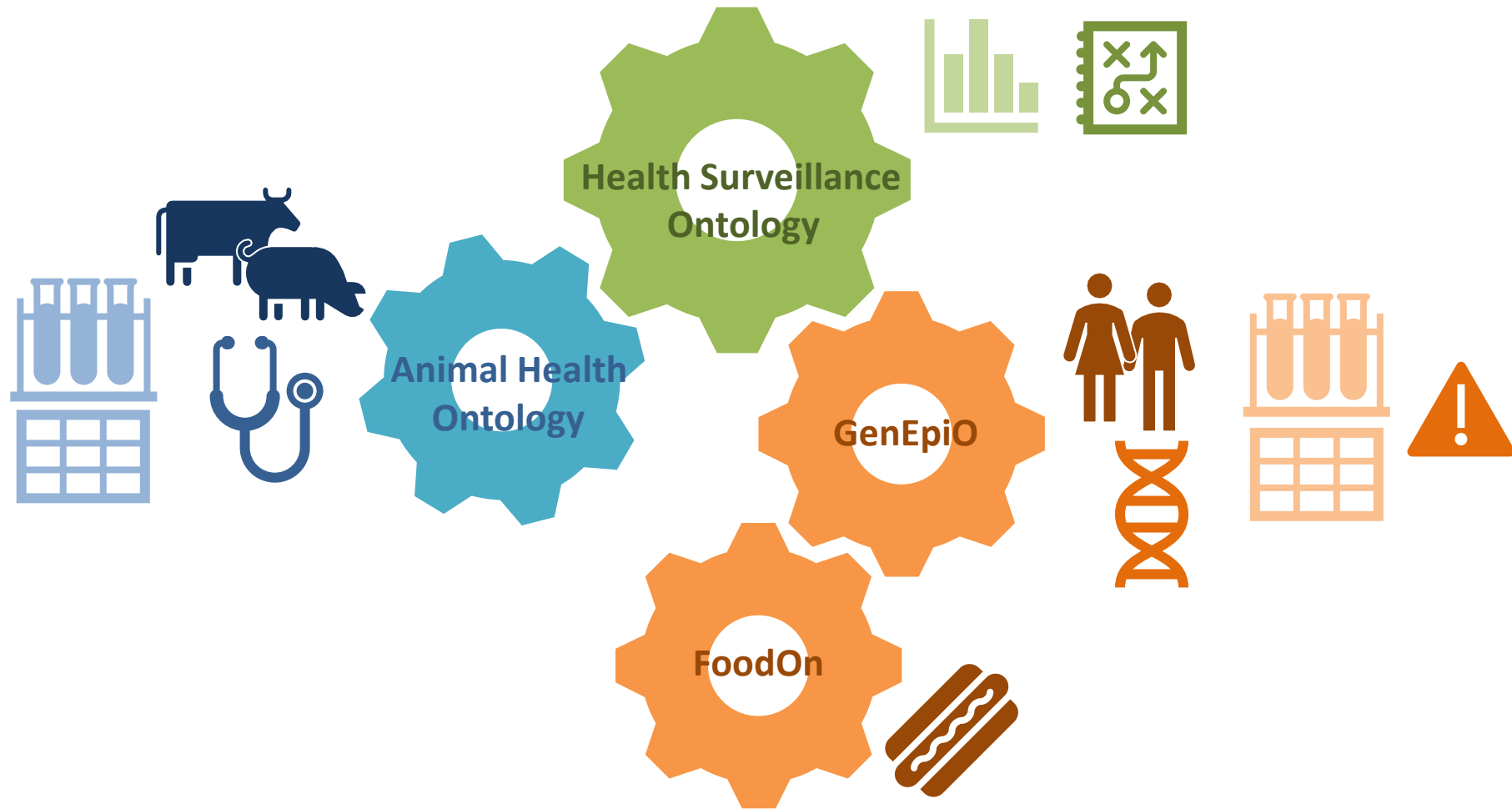




Why an ontology?

Separate data from knowledge

Reuse knowledge





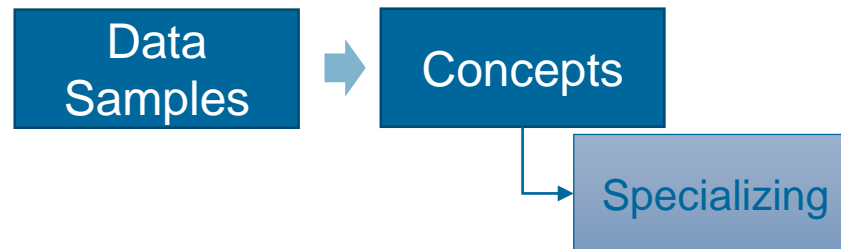
Building the ontology



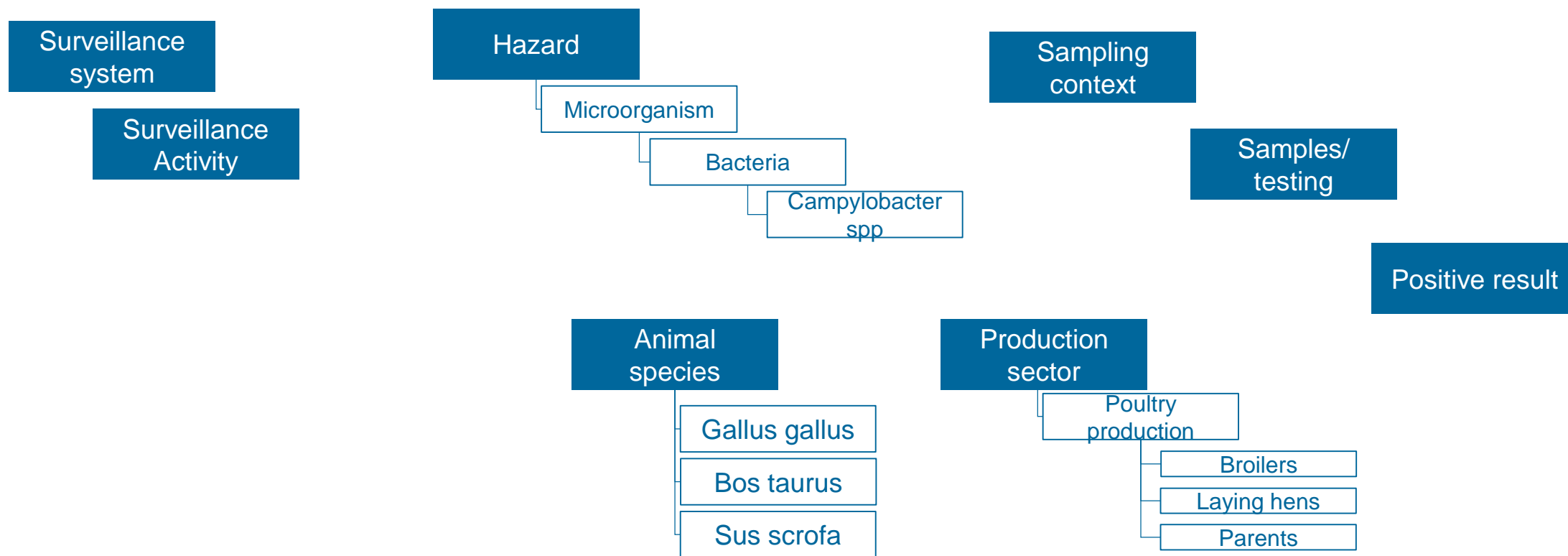
Surveillance	Surveillance	Hazard	Animal	Production	Sampling	Samples/	Positive result
Surveillance_Activity		targetHazard	targetSpecies	targetSector	SamplingContext	SamplesTested	SamplesPositive
campy surv. slaughterhouses 2017		Campylobacter_spp	Chickens	Broilers	Active monitoring	4419	474



Building the ontology

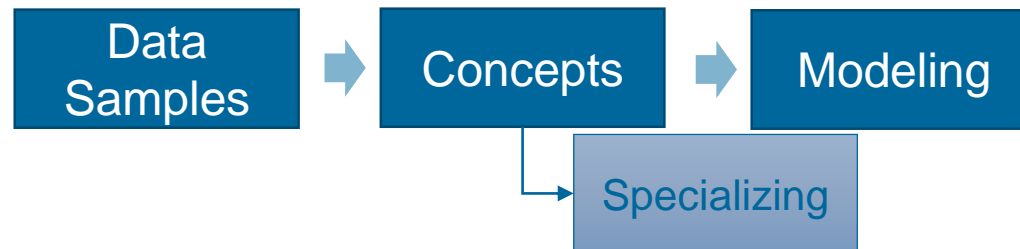


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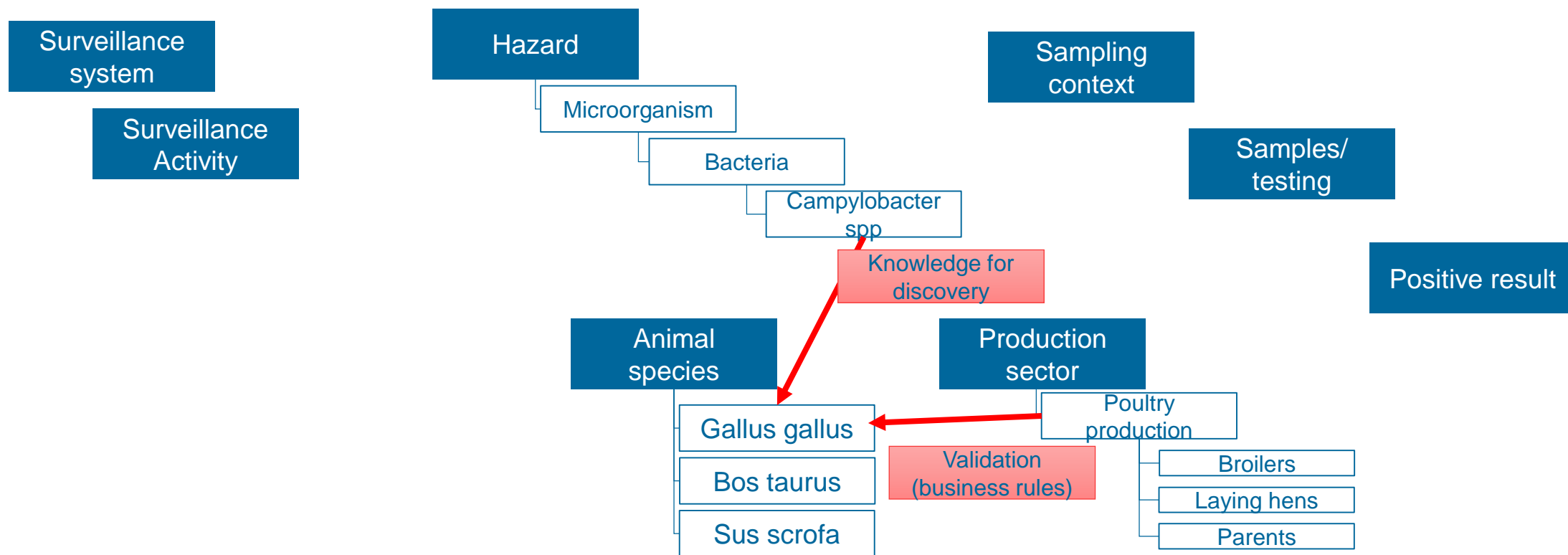




Building the ontology

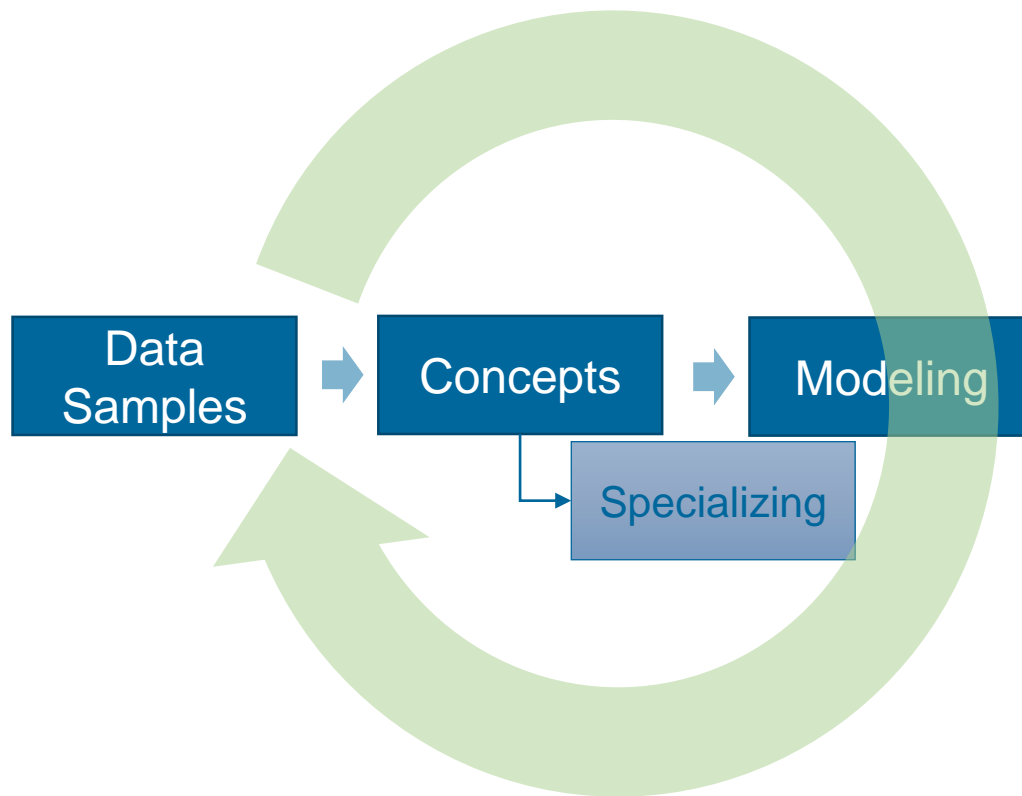


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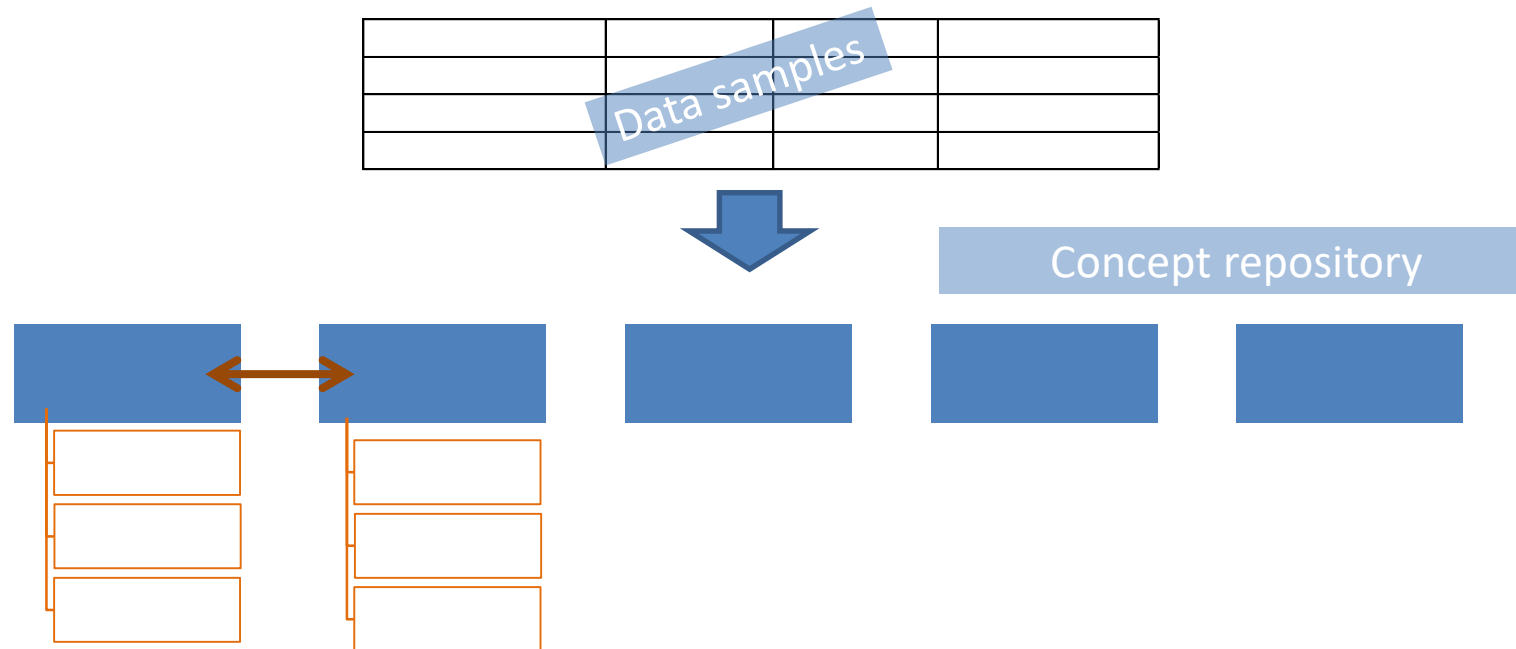




Buildign the ontology



Building the ontology TOGETHER





Review resources

WP2epi

RISKSUR – AHSURED

SIGMA

Anyone can add more examples/requests:

https://drive.google.com/drive/folders/1GmkSzVjqAXsftplZORdHbg_6ZYe2b5GV?usp=sharing

List of mappings:

https://docs.google.com/spreadsheets/d/1cb8VArby2JnR2sEx7nYZUi1eWWeNEf8TxY_ZBRRDjak/edit?usp=sharing

Modeling structure

Material Entity

Animal =
Chicken

Role / function /
quality

Production type =
broiler

Process

Surveillance
Activity

Information Content
Entity

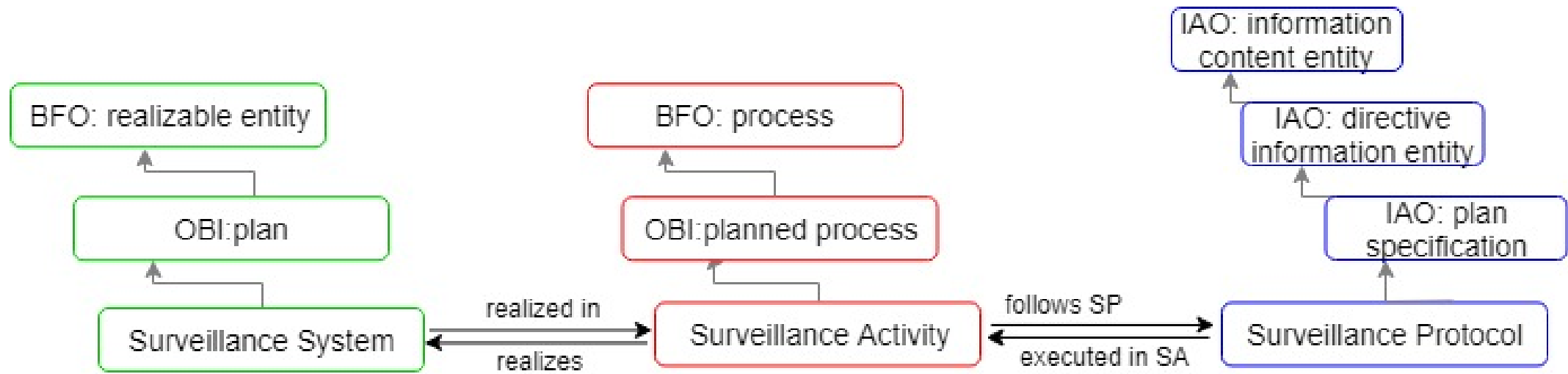
Reporting
Protocol

Data sample 1 = EFSA FBZ prevalence data model

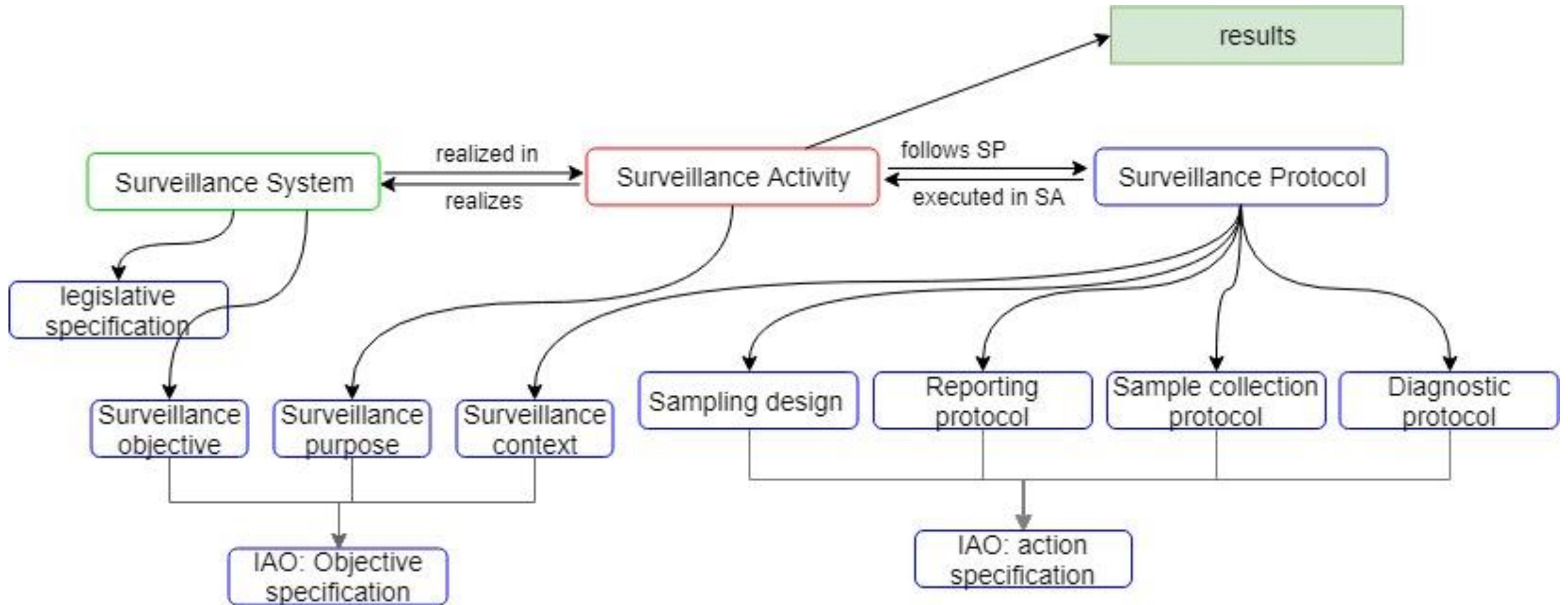
Surveillance_Activity	targetHazard	carriedOutInYear	targetCountry	targetPopulation	hasSamplingContext	nrSamplesTested	nrSamplesPositive	hasSamplingUnit	hasSamplingStrategy
campy surveillance slaughterhouses 2017	Campylobacter_spp	2017	SE	A0C78	K023A	4419	474	G200A	ST50A
campy surveillance slaughterhouses 2016	Campylobacter_spp	2016	SE	A0C78	K023A	4389	678	G200A	ST50A
campy surveillance slaughterhouses 2015	Campylobacter_spp	2015	SE	A0C78	K023A	3759	437	G200A	ST50A
campy surveillance slaughterhouses 2014	Campylobacter_spp	2014	SE	A0C78	K023A	3162	363	G200A	ST50A
campy surveillance slaughterhouses 2013	Campylobacter_spp	2013	SE	A0C78	K023A	3046	267	G200A	ST50A
				Gallus gallus broiler	Monitoring - active			slaughter batch	census
				Human (as organism)	Clinical investigations			individual	Suspect sampling

hasObjective	samplingMaterial	samplingStage	confirmationMethod
prevalence_estimation	S002A	E311A	F163A
prevalence_estimation	S002A	E311A	F163A
prevalence_estimation	S002A	E311A	F163A
prevalence_estimation	S002A	E311A	F163A
prevalence_estimation	S002A	E311A	F163A
	animal sample - caecum	slaughterhouse	ISO 10272-1:2006 Campylobacter
	animal sample - faeces		

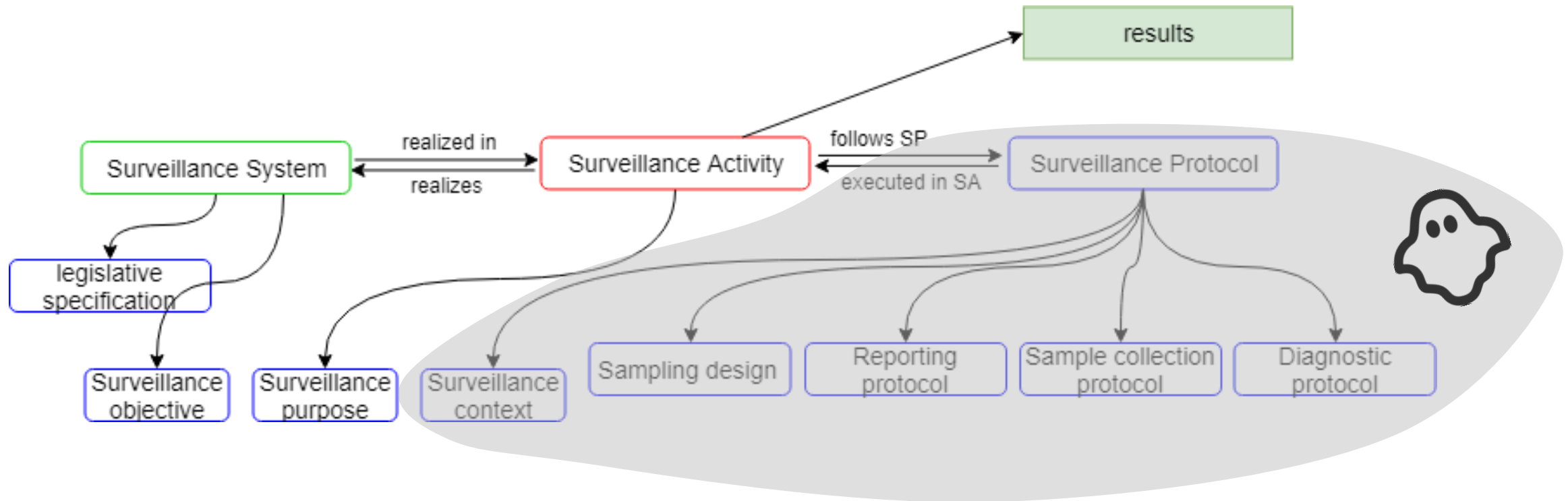
Surveillance system



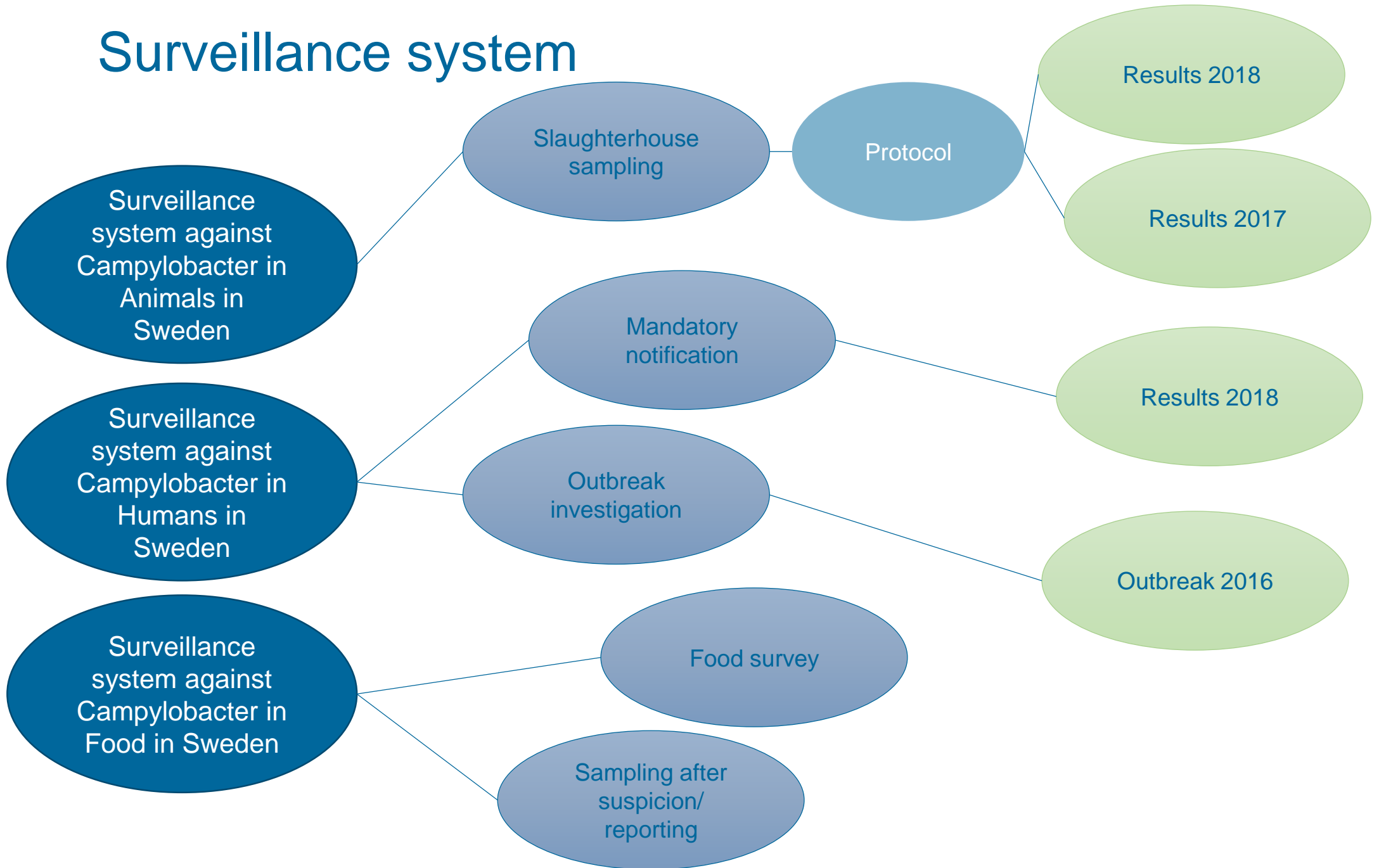
Surveillance system



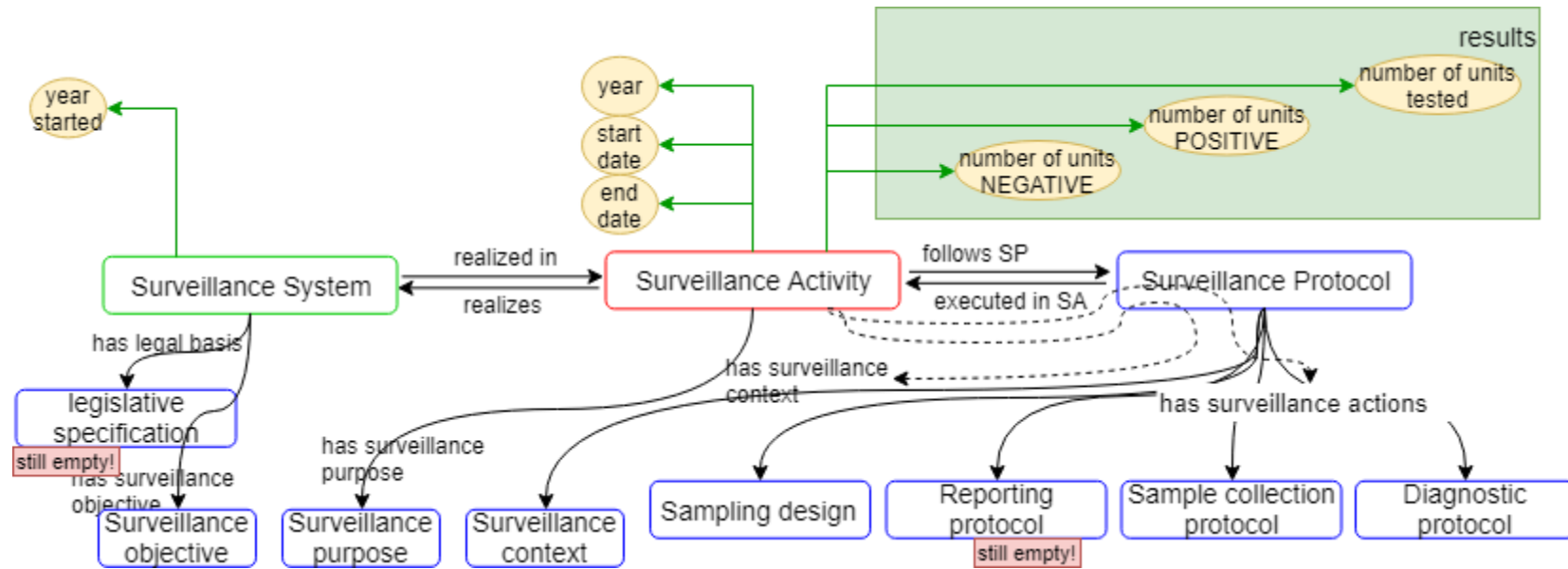
Surveillance system



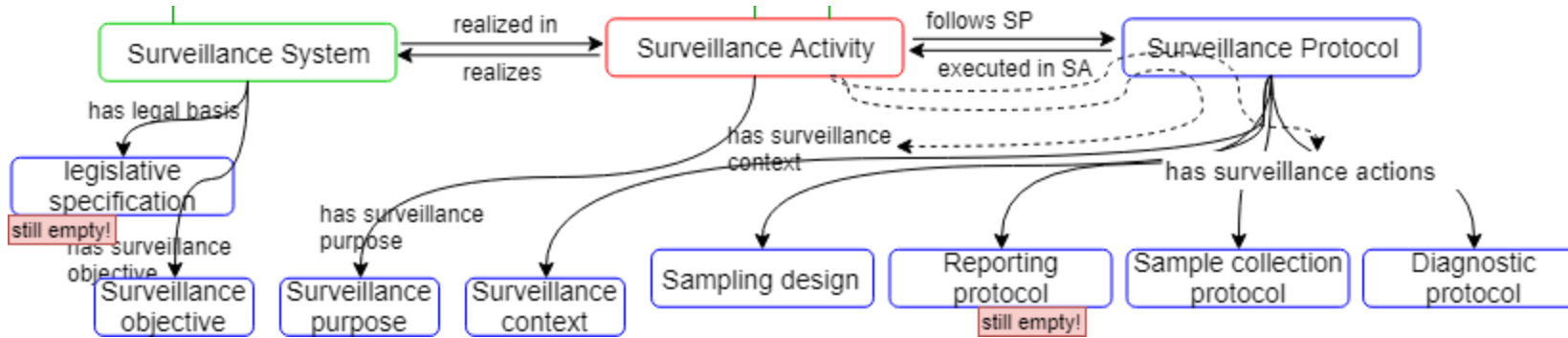
Surveillance system



Results and numerical values



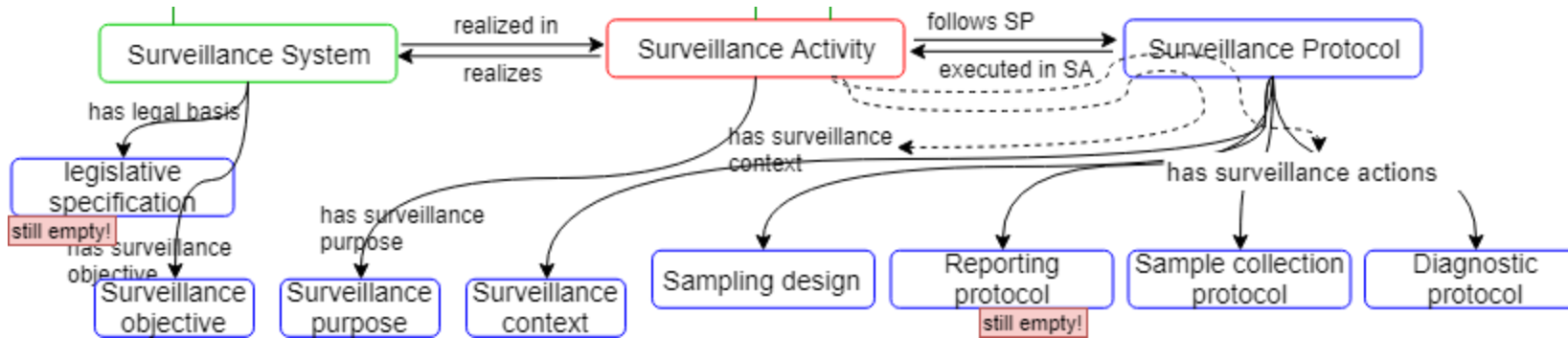
Surveillance objective x purpose



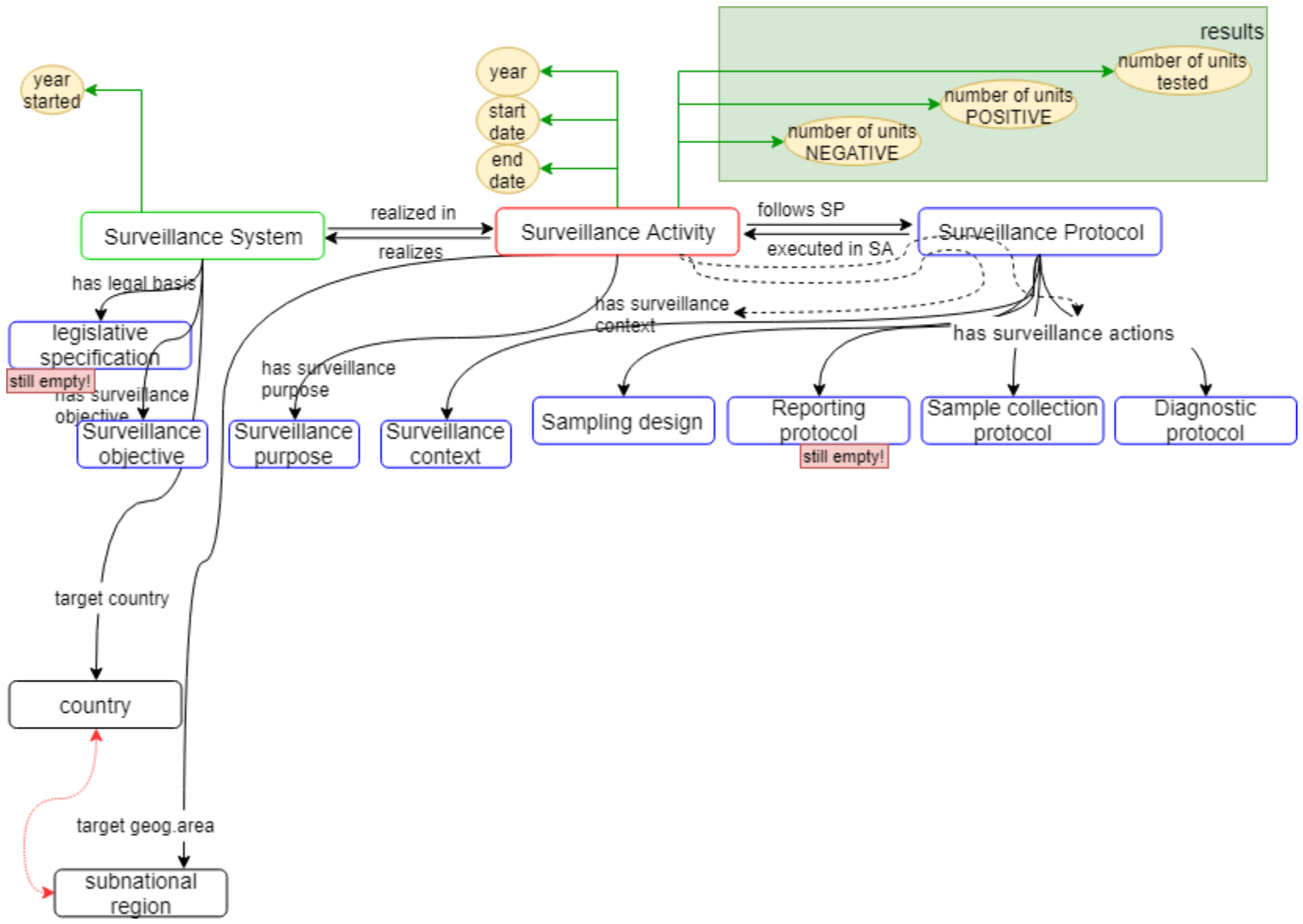
Surveillance objective	Surveillance purpose
case detection	verify success
demonstration of disease freedom	maintain freedom
early detection	detect introduction
prevalence estimation	control outbreak
	inform intervention
	detect changes
	control
	eradicate

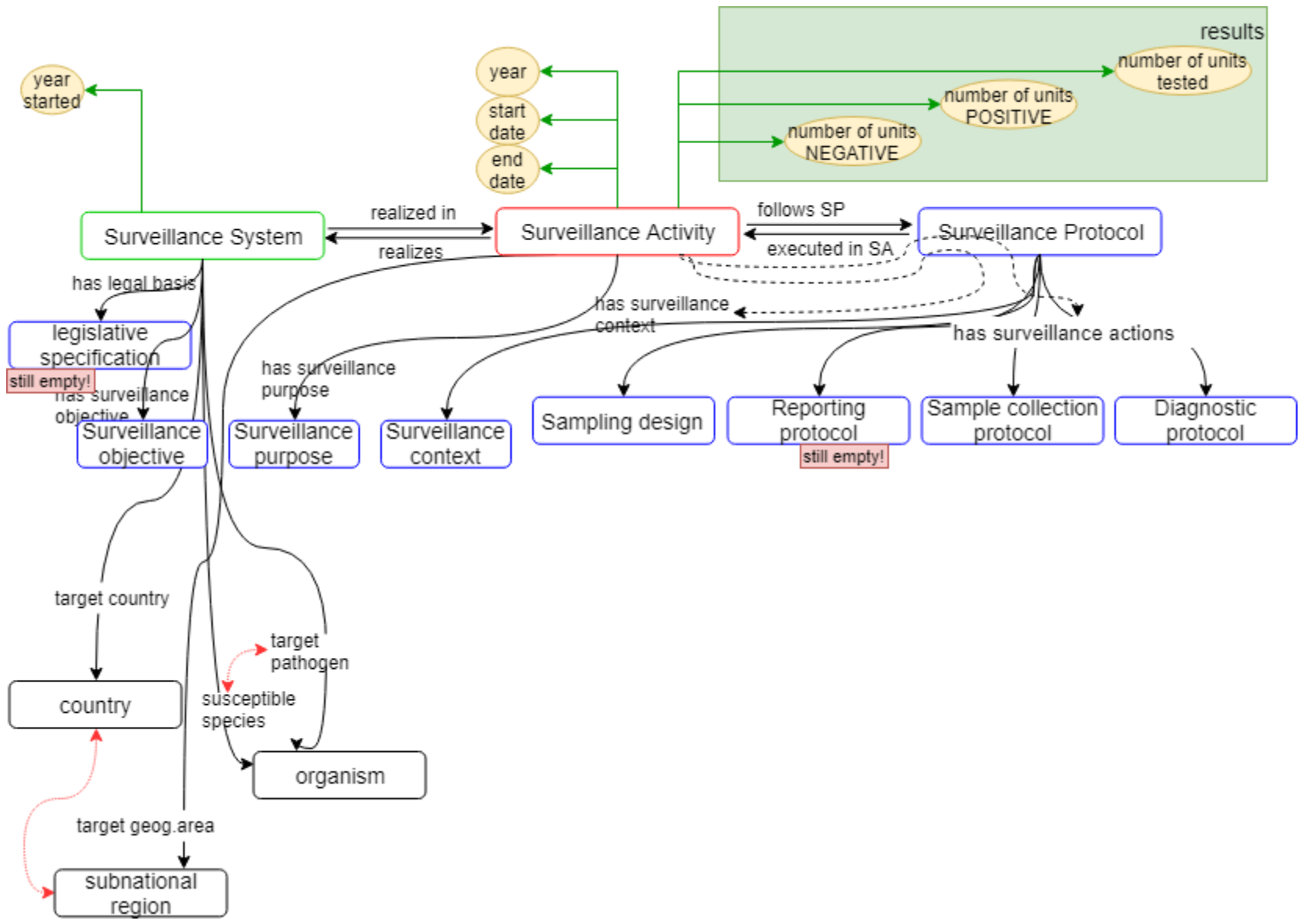
These follow the AHSURED guidelines:
<https://github.com/SVA-SE/AHSURED/wiki>

Surveillance context



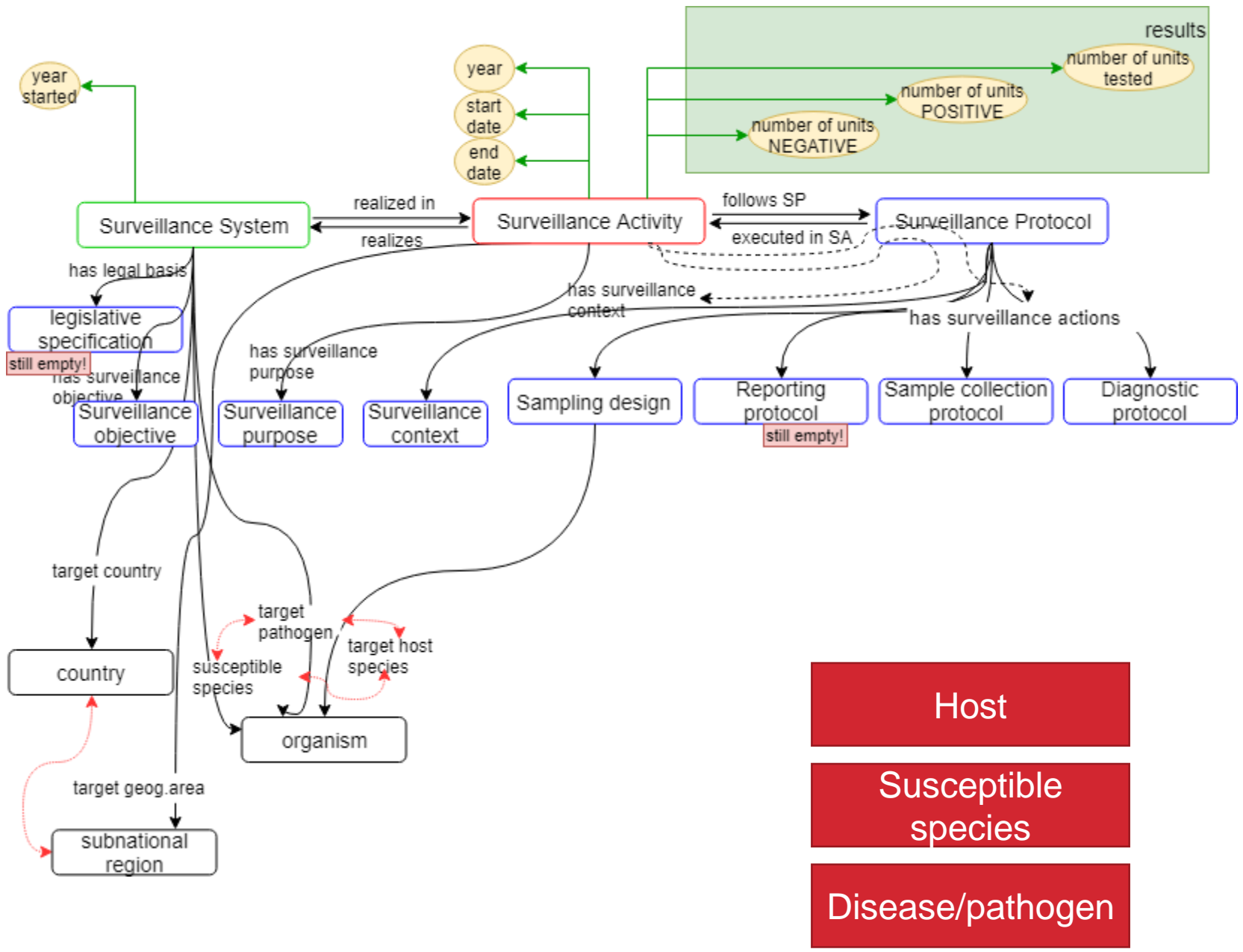
Clinical investigations'	Monitoring - EFSA specifications'	Sentinel surveillance'
Continuous data collection'	Monitoring - passive'	Surveillance
Control and eradication programmes'	Official (EU) programme'	Surveillance active'
Diet study'	Official (National and EU) programme'	Surveillance passive'
EU increased control programme on imported food'	Official (National) programme'	Survey
Indicator-based surveillance'	Other/ Combination of several programmes'	Survey - EU baseline survey'
Industry/ private programme'	Outbreak investigation'	Survey - national survey'
Monitoring	Participatory surveillance'	Syndromic surveillance'
Monitoring - active'	RASSF alert notification'	Unspecified

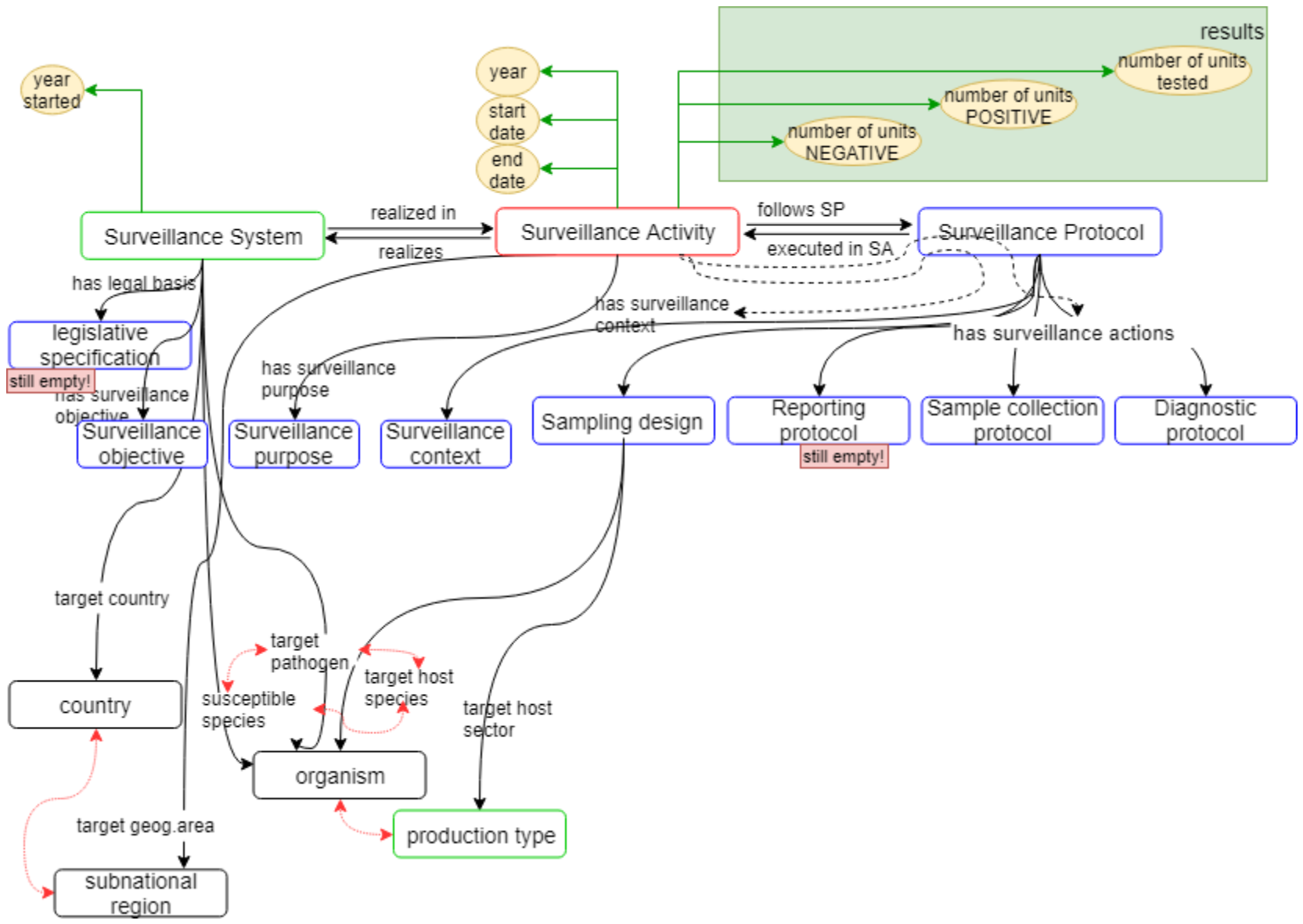


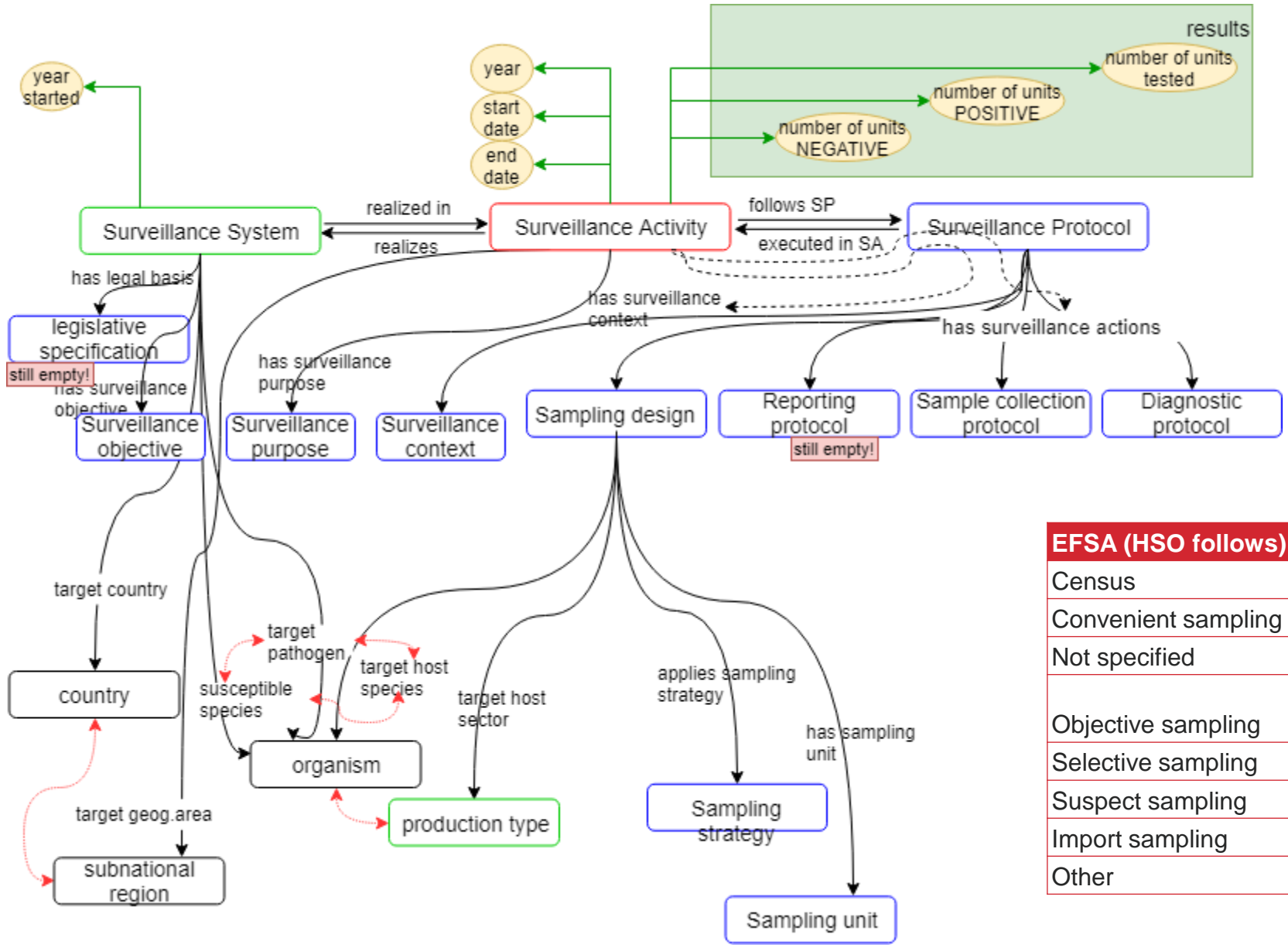


Surveillance Protocol

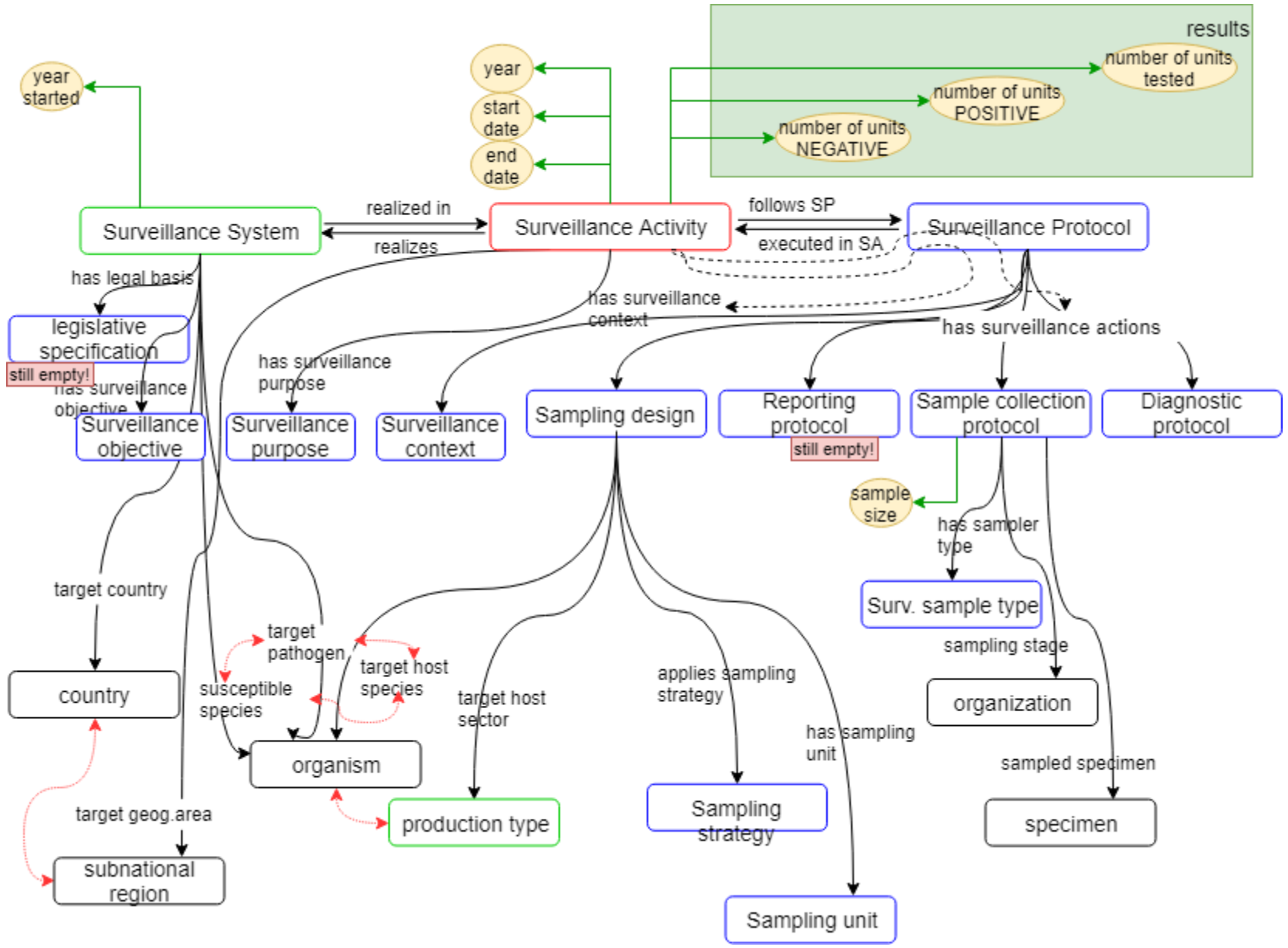
Sampling design	Reporting protocol	Sample collection protocol	Diagnostic protocol
Target species	Reporting obligations	timeline	Assay type / indicator
Target sector	Reporting trigger	Surveillance sampler	assay
Sampling strategy	Case classification	Sampling stage	pooling
Sampling unit	Case definition	Sample type/specimen	
	Reporting actors		
	Date used for statistics		

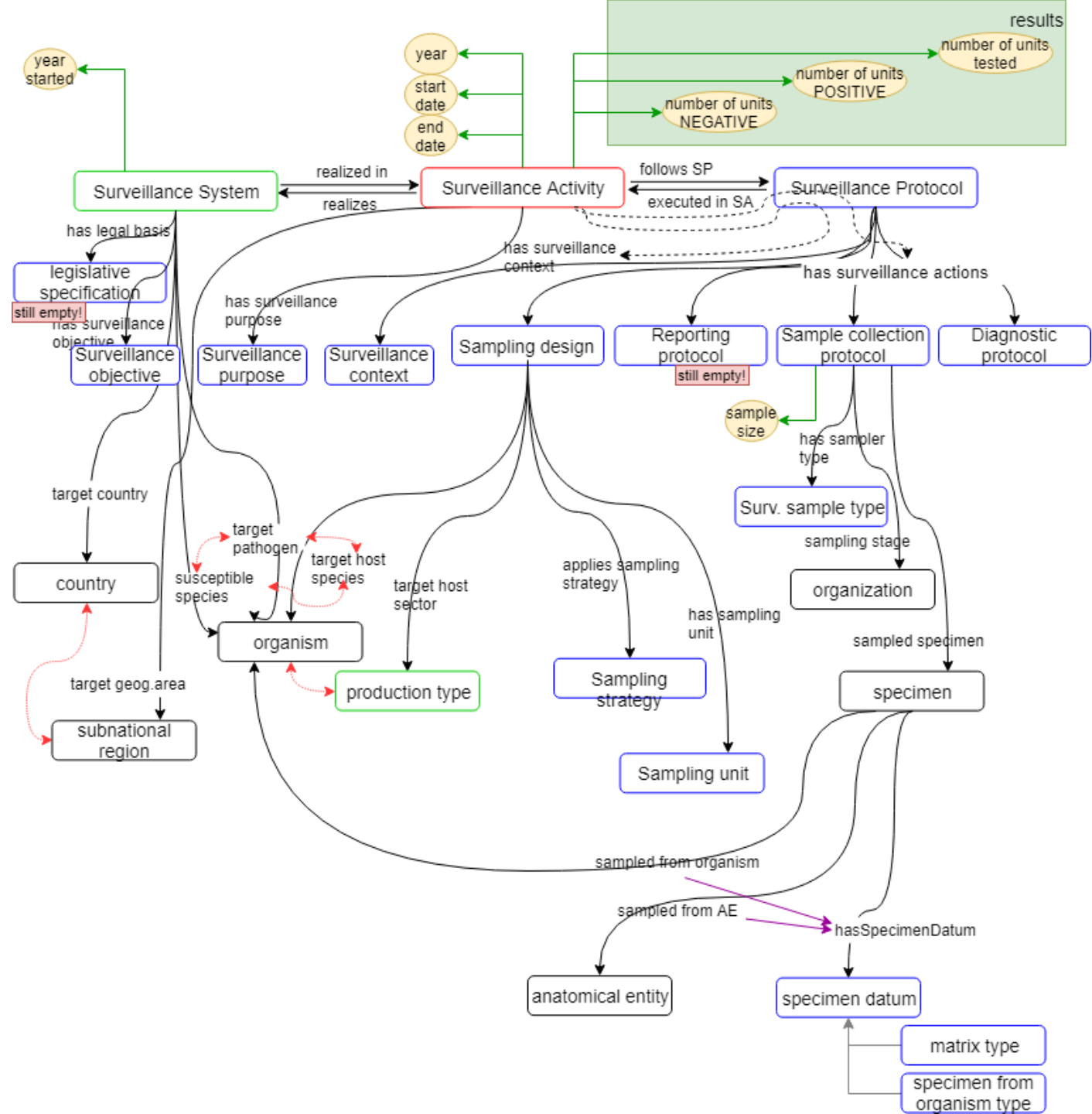






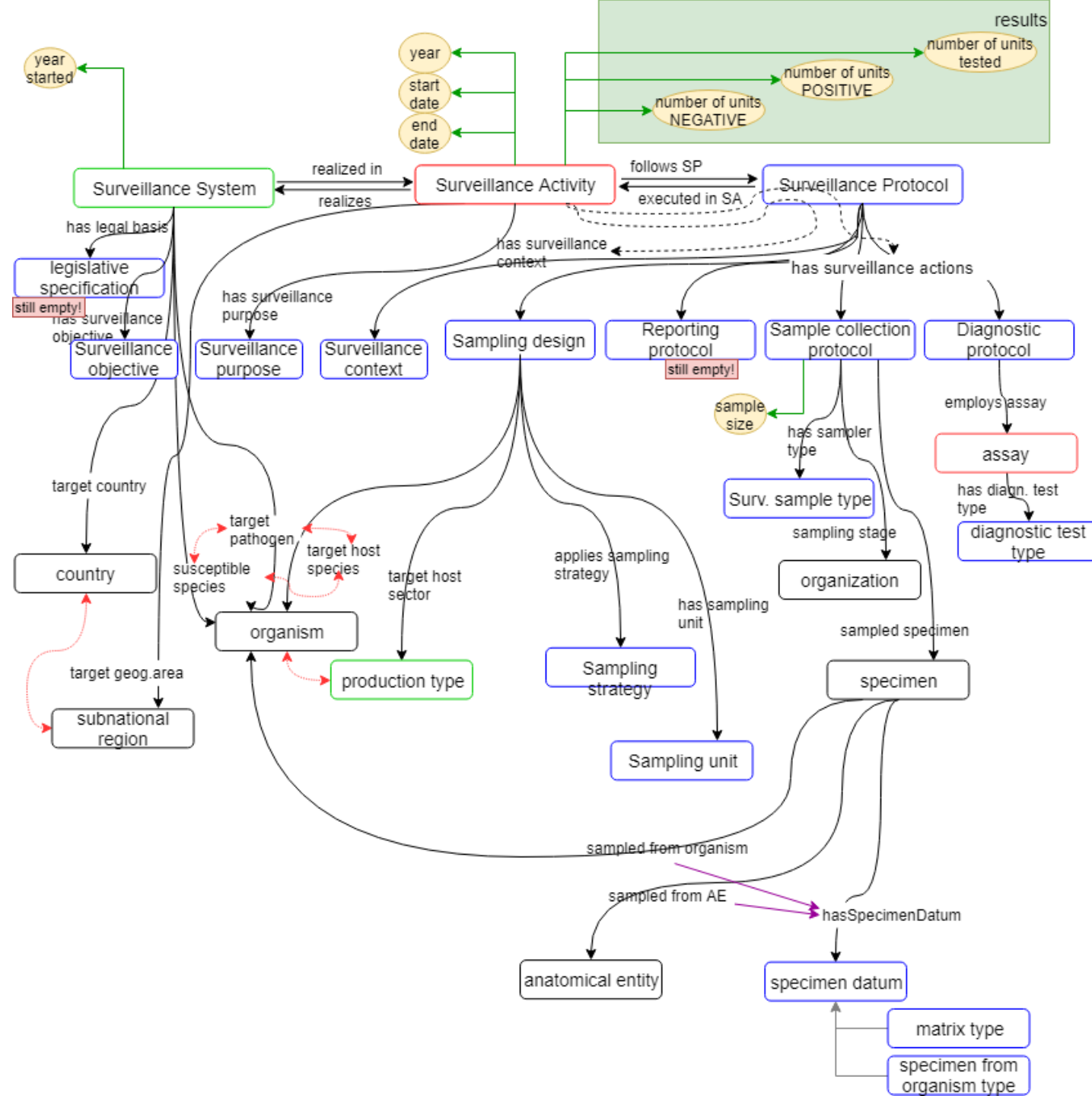
EFSA (HSO follows)	AHSURED
Census	census
Convenient sampling	convenience
Not specified	
Objective sampling	Simple random and systematic random
Selective sampling	risk-based
Suspect sampling	purposeful
Import sampling	
Other	





Specimen EFSA

animal sample
animal sample - blood
animal sample - brain
animal sample - caecum
animal sample - cloacal swab
animal sample - ear
animal sample - eggs
animal sample - eggshells
animal sample - faeces
animal sample - fleece
animal sample - foetus/stillbirth
animal sample - hide
animal sample - lymph nodes
animal sample - meat juice
animal sample - milk
animal sample - nasal swab
animal sample - organ/tissue
animal sample - placental swab
animal sample - rectum-anal swab
animal sample - tonsil
animal sample - vaginal swab
environmental sample
environmental sample - air
environmental sample - boot swabs
environmental sample - boot swabs and dust
environmental sample - delivery box liner
environmental sample - dust
environmental sample - fabric swab
environmental sample - hatcher basket liner
feed sample
food sample
food sample - blood
food sample - carcass swabs
food sample - meat
food sample - milk
food sample - neck skin
food sample - tonsil

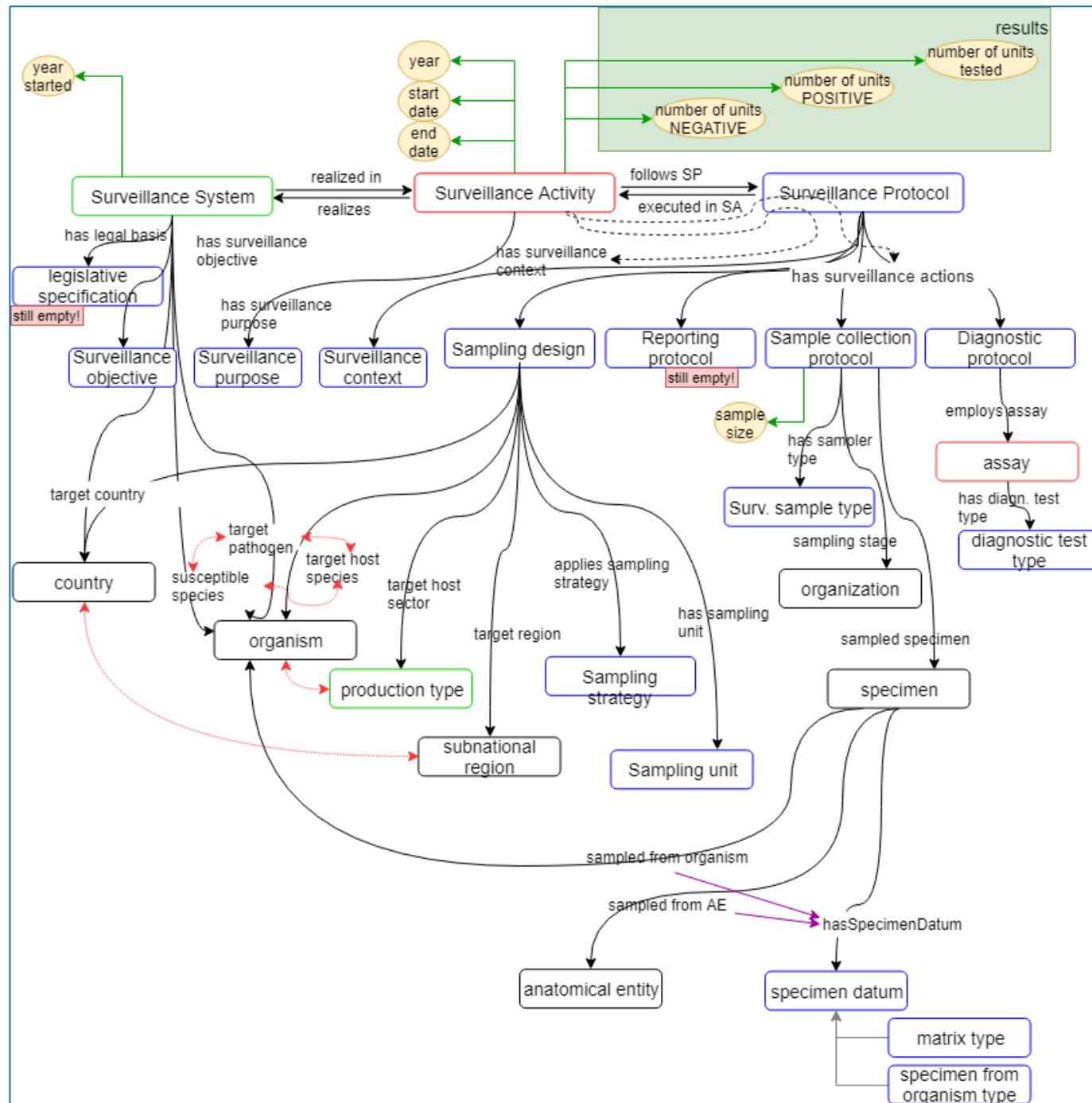


has diagnostic test type
Detection
Serotyping
Phagetyping
Susceptibility test
Speciation
Screening
Quantification
Confirmation
Determination
Enumeration
Isolate characterisation
Discriminatory test
Molecular characterisation/genotyping



Goal: attach context to data

Follow CRAS on the context/meta-data specifications





Ontology – Data-driven Surveillance | x +

Inte säker | datadrivensurveillance.org/ontology/

DATA-DRIVEN SURVEILLANCE

Translating data into information for health surveillance

DDS Syndromic Surveillance Ontology ▾ R packages ▾ Resources ▾ Contact ▾

ONTOLOGY

*An ontology defines a common vocabulary for researchers who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them.*Noy & McGuinness

Read more about ontologies in this [quick background for health surveillance](#), or this [detailed ontology manual](#).

Two Introductory videos have been prepared for those wanting to get involved in Ontology development:

- 1) Basics of ontologies and knowledge models ([WATCH HERE](#))
- 2) The use of ontologies in health surveillance ([WATCH HERE](#))

Read more about [ORION](#), an European funded project that promotes one health surveillance data harmonisation.

In particular, [ORION's WP3 is focused on promoting data interoperability, and on the use of ontologies to support the practice of surveillance.](#)

Two complementary ontologies are being developed to support data (re)use in health surveillance:

- the [ANIMAL HEALTH ONTOLOGY \(AHO\)](#) models the structure of the animal population, as well a

datadrivensurveillance.org/ontology



Health Surveillance Ontology (HSO) x +

Inte säker | datadrivensurveillance.org/health-surveillance-ontology-hso/

DATA-DRIVEN SURVEILLANCE

Translating data into information for health surveillance

DDS Syndromic Surveillance Ontology R packages Resources Contact

Communication and Involvement

[HSO is on GitHub](#)

and on [BioPortal](#).

Contact us writing to hso@datadrivensurveillance.org.

Documentation and resources

- [full documentation of all ontology concepts and entities \(Excel\)](#)

- [descriptive documentation of concepts \(Word\)](#)

- Webinar 2019-09-04

Project management and structure

This project is managed by the Swedish National Veterinary Institute. This project started as the Animal Health Surveillance Ontology, funded by the Swedish Innovation Agency – Vinnova. It has evolved into an ontological framework composed of HSO, as well as an ontology focus on animal health data sources ([visit AHO](#)).

Current core members:

- Fernanda Dórea, project leader: National Veterinary Institute, Sweden

- Crawford Revie: University of Prince Edward Island, Canada

- Ann Lindberg: National Veterinary Institute, Sweden

- Eva Blomqvist: Linköping University, Sweden

- Patrick Lambrix: Linköping University, Sweden

- Karl Hammar: Jönköping University, Sweden

Help and advice from <https://genepio.org/>



Next steps

Review categories and concepts



Surveillance objective

System description: AH

System description: FS

System description: PH

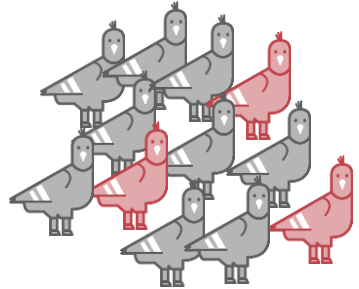


Surveillance Protocol

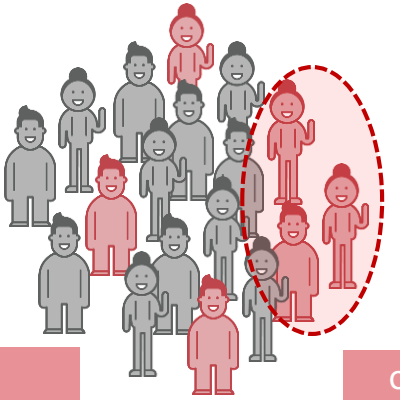
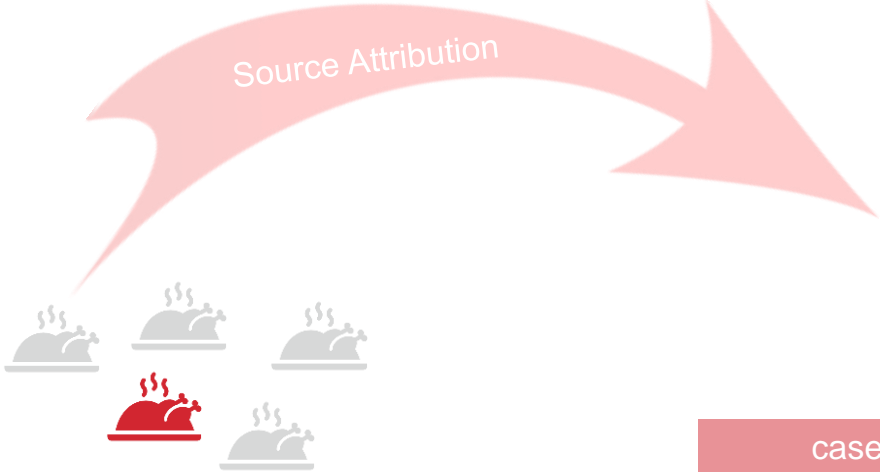
Sampling design

Reporting protocol

Sample collection protocol



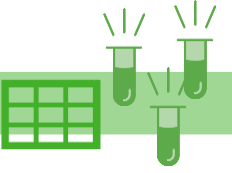
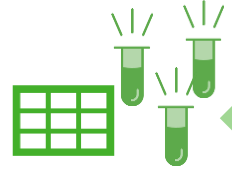
prevalence



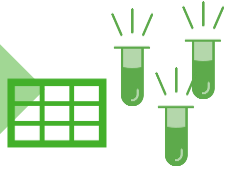
cases

outbreaks

Diagnostic protocol

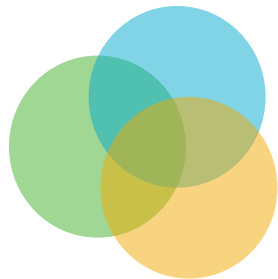
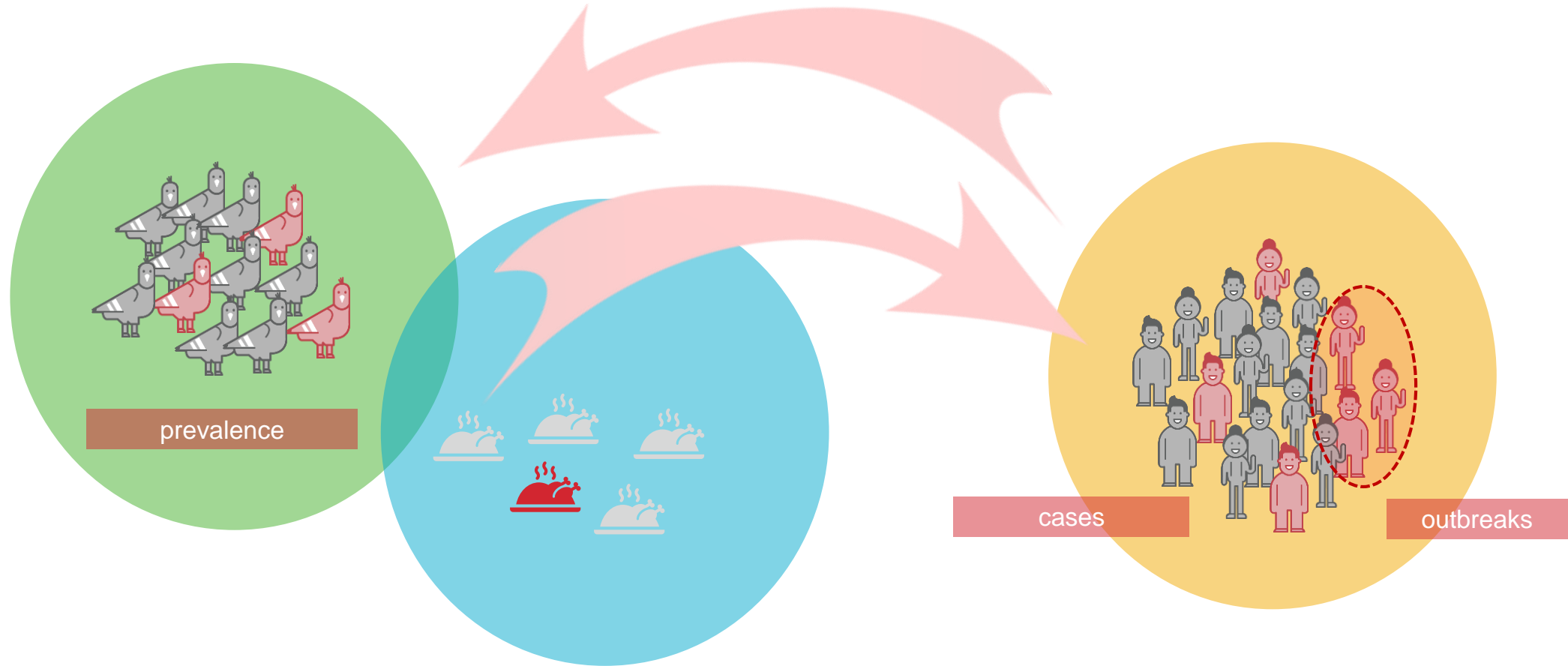


Data about the samples / individual results



Results of aggregated analyses





One Health: what it even is?
What information is shared? WHEN? What for?
What impact does it have? How does it
contribute to decision making?



Data workflows

Where do we see needs/opportunities related to

- 1) Attaching context to the data
- 2) Ability to point software to data
- 3) Data reuse and interoperability, including to external sources
 - Linking data WITHOUT putting datasets together
- 4) Improve extraction of information and knowledge, in a ONE HEALTH context



Next steps

Continue with data samples

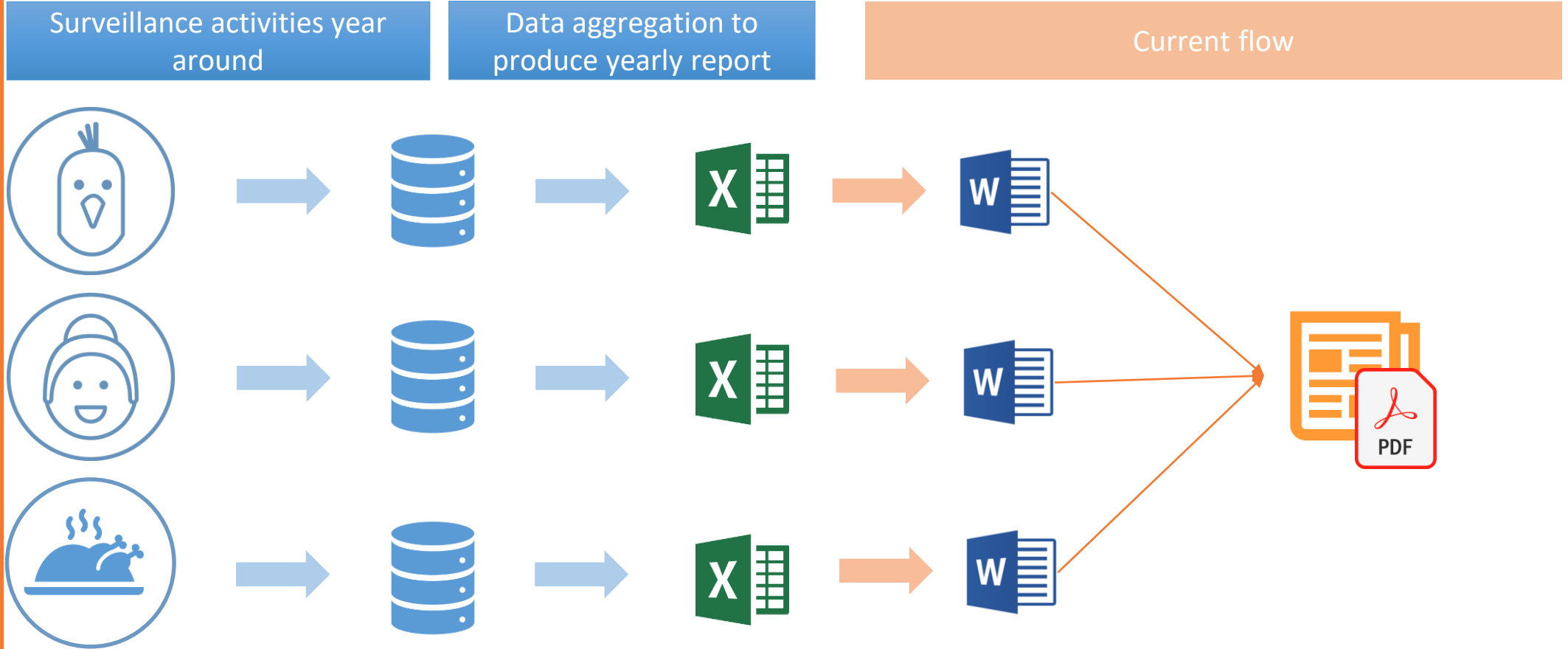
- Other data models
- More public health
 - Zoonoses reports EFSA/ECDC

Pilots identify more communication needs

Test ontology in practice on the pilots needs and improve based on user case (as opposed to expert review of lists?)

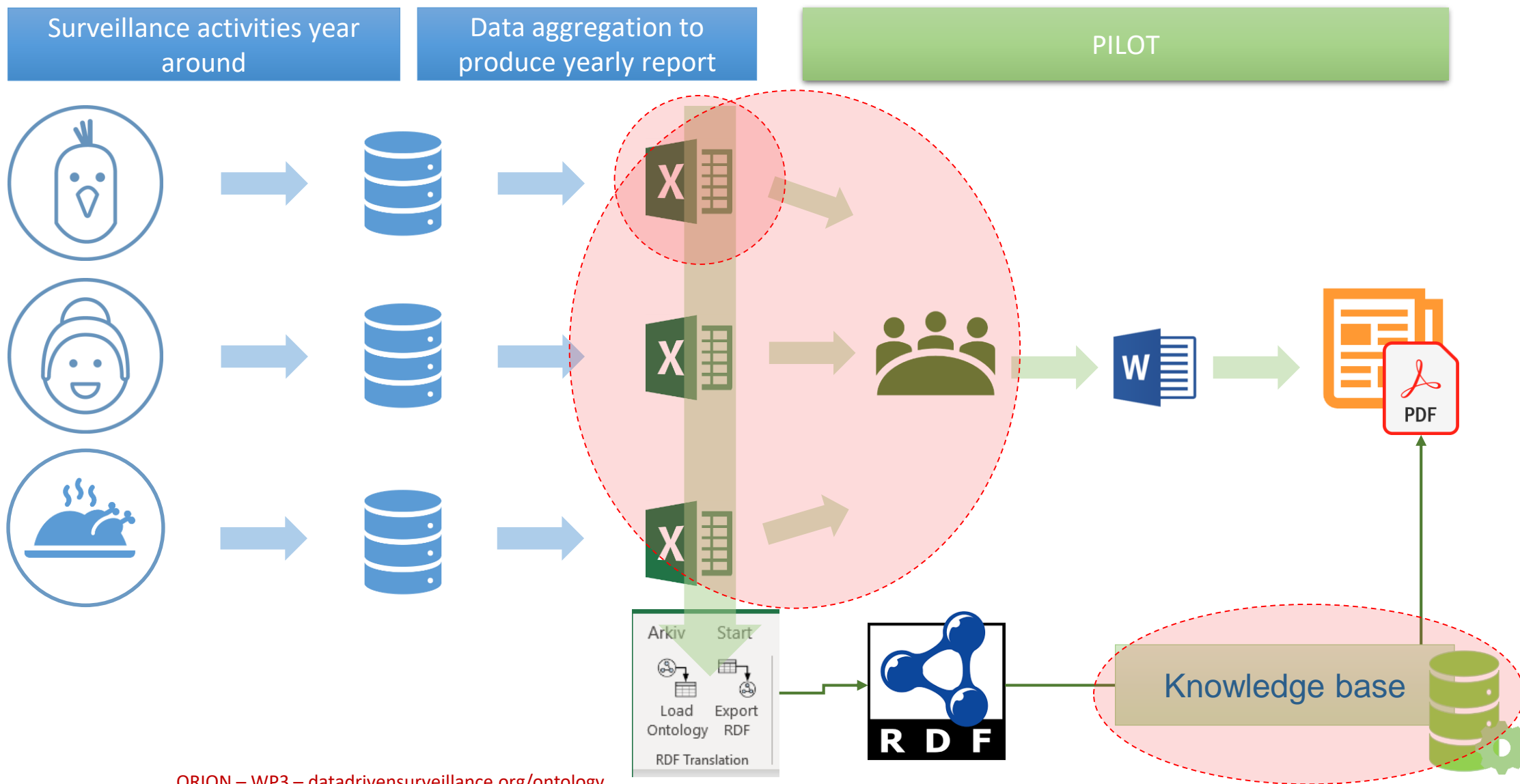


Example of the Swedish pilot on WP3 data solutions





Example of the Swedish pilot on WP3 data solutions





Browse on Bioportal

<http://bioportal.bioontology.org/ontologies/HSO>



Use in practice

Excel templates

Reasoning

Publication

Consumptions

Thank you for your attention!

fernanda.dorea@sva.se

www.datadrivensurveillance.org/ontology



@OneHealthEJP



/company/h2020-One-Health-EJP



OneHealthEJP.eu