Annexes

Annex A: Authorised vaccines available in GB and NI

A.1. Vectormune HVT-AIV concentrate and solvent for suspension for injection for chickens

For the active immunisation of one-day-old chickens and provides protection against:

- Mareks's Disease (MD) virus (reducing mortality, clinical signs and lesions)
- HPAI virus of the H5 subtype (reducing mortality, clinical signs, and virus excretion)

Features and considerations of this vaccine are as follows:

- onset of immunity for HPAI H5: 2 weeks of age
- duration of immunity for HPAI H5: 19 weeks
- the vaccine is for subcutaneous use and the vaccination schedule is one single dose
- the use of appropriate diagnostic tools allows for DIVA
- the vaccine has shown efficacy against HPAI of the contemporary H5 clade 2.3.4.4b subtype
- in the EU, and therefore in NI, the vaccine is authorised solely for HPAI. Claims for other components, like MD, are not included. In GB, these restrictions do not apply

A.2. Innovax-ND-H5 concentrate and solvent for suspension for injection for chickens

For the active immunisation of one-day-old chicks or 18–19 day-old embryonated chicken eggs and provides protection against:

- MD virus (reducing mortality, clinical signs and lesions)
- Newcastle disease (ND) virus (reducing mortality and clinical signs)
- HPAI virus of the H5 subtype (reducing mortality, clinical signs and virus excretion)

Features and considerations of this vaccine are as follows:

- onset of immunity for HPAI H5: 2 weeks
- duration of immunity for HPAI H5: 12 weeks
- the vaccine is for subcutaneous and in ovo use and the vaccination schedule is one single dose
- the use of appropriate diagnostic tools allows for DIVA
- the vaccine has shown efficacy against HPAI of the contemporary H5 clade 2.3.4.4b subtype
- in the EU, and therefore in NI, the vaccine is authorised solely for HPAI. Claims for other components, like MD, are not included. In GB, these restrictions do not apply

A.3. Innovax-ND-H5 concentrate and solvent for suspension for injection for chickens

For the active immunisation of chickens and provides protection against:

- Avian influenza type A, subtype H5

Features and considerations of this vaccine are as follows:

- onset of immunity: efficacy has been evaluated on the basis of preliminary results in chickens. Reduction of clinical signs, mortality and excretion of virus after challenge were shown by 3 weeks after vaccination
- duration of immunity: not established. Serum antibodies could be expected to persist for at least 1 year after administration of 2 doses of vaccine
- the vaccine is for subcutaneous or intramuscular use
- if the circulating avian influenza field virus has a different N component to the N2 included in the vaccine, it may be possible to differentiate between vaccinated and infected birds by using a diagnostic test to detect Neuraminidase antibodies
- the vaccine does not contain a contemporary H5 clade 2.3.4.4b antigen. As such, a lack of antigenic relatedness in H5 may impact upon level of protection
- the vaccine has full marketing authorisations for use in GB and NI

Annex B: Product profiles for potential vaccines

Table B.1: Product profiles for potential vaccines (as supplied by Boehringer Ingelheim, CEVA International, MSD Animal Health and Zoetis)

Company	Boehringer Ingelheim	Boehringer Ingelheim	CEVA International	CEVA International	MSD Animal Health	MSD Animal Health	Zoetis	Zoetis
Name of vaccine	Volvac® BEST	Vaxxitek® HVT+IBD+H5	Vectormune® AI (rHVT-HA5)	Respons® AI H5	Nobilis® Influenza H5N2	Innovax®-ND-H5	H5N3 RG (previously also authorised in EU as Poulvac® FluFend H5N3 RG)	H5N1 RG
Diseases (Strains)	Avian Influenza A (H5) Newcastle Disease	Avian Influenza HVT IBD	Avian Influenza A (H5) HVT	saRNA Vaccine (SRV)	Avian Influenza A (H5)	Avian Influenza HVT Newcastle Disease	Avian Influenza A (H5)	Avian Influenza A (H5)
Type of vaccine	Recombinant inactivated subunit vaccine	COBRA* vaccine (vector)	HVT vector vaccine	Self-amplifying RNA vector	Inactivated whole AI virus antigen (H5N2)	HVT vector vaccine	Inactivated recombinant vaccine	Inactivated recombinant vaccine

Company	Boehringer Ingelheim	Boehringer Ingelheim	CEVA International	CEVA International	MSD Animal Health	MSD Animal Health	Zoetis	Zoetis
Mode of application	Single dose (subcutaneous injection of healthy birds at 10 days of age)	Single dose administered in hatchery (day 0)	Single dose administered subcutaneously in hatchery on day of hatch or *in ovo*.	Two-doses intramuscular injection at day 1 and day 28	Two doses 4-6 weeks apart. 1st dose from days old by subcutaneous or intramuscular injection (subcutaneous only if under 14 days old)	Single dose administered subcutaneously in hatchery on day of hatch or *in ovo*.	Intramuscular or subcutaneous injection depending on the target species. Two doses 3 weeks apart from day of age (ducks) and from 3 weeks of age (chickens) and at least 4 weeks before onset of lay (per previously authorized EU SPC)	Subcutaneous injection: one dose from 3-4 weeks of age, optional second dose 3-4 weeks later
Species	Chickens	Chickens, data available for use in turkeys	Chickens	Ducks, geese, chickens	Chickens	Chickens	Chickens, ducks (per previously authorised EU SPC)	Chickens

Company	Boehringer Ingelheim	Boehringer Ingelheim	CEVA International	CEVA International	MSD Animal Health	MSD Animal Health	Zoetis	Zoetis
Status	Commercially available and temporary licence in France	Licensed in the US	Commercially available and licenced in USA, temporary licence in France, in process of gaining EU authorisation	Temporary licence in France	Commercially available and licenced in Europe	EU authorisation	Commercially available. Authorised in the US other non-EU countries	Commercially available. Conditional authorisation in US

SPC – Summary of product characteristics

Annex C: Overview of trials with recently assessed H5 vaccines

This overview is based on a review of available data but for a detailed analysis it is recommended that the reader contacts the authors directly.

Table C.1: Top level overview of recently published vaccine trials

Commercial name	Company	HA origin?	Type of vaccine	Recent trials	Top level outcome
Vectormune HVT-AIV	Ceva Animal Health Ltd (CEVA)	A modified H5 from the **clade 2.2** HPAI H5N1 strain[a]	Live HVT	**NLD Study 1:** Single inoculation in day old rearing layers **NLD Study 2:** Single inoculation or with Vaxxitek IBD+H5 prime (@ 12 weeks)	**NLD Study 1:** No mortalities or transmission detected **NLD Study 2:** No mortality or disease group challenged at 8 weeks. Marked reduction in shedding. In 24-week old challenge group both shedding and transmission detected.
RESPONSE AI H5	CEVA	Unclear- stated Amplicon (H5) from **clade 2.3.4.4b**	Synthetic RNA Vaccine against H5	**DEU:** RESPONSE AI H5 prime and boost in geese at 6 and 10 weeks **FRA:** Homologous boost plus as a boost to VOLVAC B.E.S.T. prime	**DEU:** No seroconversion until boost then 50% seroconverted- one antibody negative goose succumbed to infection- the remaining 9 geese survived and excreted only vRNA. **FRA:** Full field trial results unavailable.

Commercial name	Company	HA origin?	Type of vaccine	Recent trials	Top level outcome
Innovax-ND-H5	MSD Animal Health UK Limited	Synthetic HA based on clade 2.2 viruses from birds and cats in 2005.	Live HVT	**NLD Study 3:** Field pilot in commercial laying farms started in spring 2025. Eggs and products confined to the home market.	**NLD Study 3**: Trial ongoing
Vaxxitek HVT+IBD+H5	Boehringer Ingelheim (BI)	C.O.B.R.A.* H5 antigen derived from a human associated **clade 2** H5N1 virus.	Live HVT	**NLD Study 1:** Single inoculation in day old rearing layers **NLD Study 2:** Single shot or with VOLVAC B.E.S.T. boost (at 12 weeks)	**NLD Study 1:** No mortalities or transmission detected. **NLD Study 2:** No mortality or disease in group challenged at 8 weeks. Marked reduction in shedding in vaccinated birds. Reduction in mortality in 24-week old challenge group compared to controls. Shedding and transmission seen. VOLVAC B.E.S.T. boost reduced transmission to <1 and no mortality.
VOLVAC-B.E.S.T. AI + ND	Bohringer Ingleheim (BI)	C.O.B.R.A. optimized HA gene derived from **clade 2.3.2** H5N1[b]	Baculovirus Expression System Technology	**FRA:** Used alone at 10 days or with RESPONS AI H5 booster in ducks **DEU:** Homologous prime boost in Geese at 10 and 14 weeks.	**FRA:** Clinical disease seen with single inoculation – better outcome with either the same boost or a different vaccine as a booster vaccination. **DEU:** 90% seroconverted after prime. 100% after boost. Birds NOT challenged

Commercial name	Company	HA origin?	Type of vaccine	Recent trials	Top level outcome
Vaxigen Flu-H5N8	Avimex, CDMX, Mexico	HA and NA genes of the H5N8 virus[c] in PR8.	Inactivated oil-adjuvanted vaccine	**DEU:** Homologous prime boost in Geese at 6 and 10 weeks.	**DEU:** No seroconversion on prime; 40% seroconversion following boost; Not challenged
KNewH5	Avimex	(H5) [2.3.4.4b]- strain ND	Recombinant NDV	**DEU:** Homologous prime boost in Geese at 6 and 10 weeks	**DEU:** 20% seropositive on prime; 80% seropositive on boost; Not challenged
Nobilis LPAI H5N2 vaccine	MSD Animal Health UK Limited	H5N2 subtype[d]	Inactivated (killed)	**NLD Study 1:** Rearing layers given a single inoculation at 8 days	**NLD Study 1:** Clinicals and mortality-some transmission in one group (40% mortality in directly infected; 30% in contact mortality)
Avian Influenza Vaccine	Zoetis	Reverse genetics based H5N2[e] PR8 backbone	Killed virus for use in chickens	**DEU:** Homologous prime boost in geese at 6 and 10 weeks.	**DEU:** 20% seropositive on prime; 70% seropositive on boost; All survived; All excreted viral RNA but no virus isolated.
DNA Vaccine	Huvepharma	Based on a 2.3.4.4c clade H5Nx virus[f]	DNA vaccine	**NLD Study 1:** Rearing layers 14 days vaccinated. Challenged at 8 weeks	**NLD Study 1:** Clinical disease seen and mortalities recorded.

*C.O.B.R.A.- Computationally Optimized Broadly Reactive Antigen

[a] 'Based on' A/Swan/Hungary/4999/2006 (EPI177883)

[b] COBRA based on A/duck/China/E319-2/2003 (EPI3740)

[c] A/green-winged teal/Egypt/877/2016 (EPI_ISL_267136)

[d] A/duck/Potsdam/1402/86 strain

[e] A/turkey/Indiana/22-003707-003/2022 H5; A/chicken/Egypt/D5490B/2012 N2

[f] A/gyrfalcon/Washington/41088-6/2014 strain

Table C.2: References

Country	Species	References
France (FRA)	Ducks	Experimental evaluation of clinical protection and virus excretion Resume of Experimental evaluation of transmission among vaccinated ducks after challenge at 7 weeks of age Promising outputs from field vaccination trials

Netherlands (NLD)	Rearing layers	**NLD Study 1:** Transmissiestudie met vier vaccins tegen H5N1 hoogpathogeen vogelgriepvirus (clade 2.3.4.4b) **NLD Study 2:** Progress report: transmission study testing HVT-based H5 vaccine against highly pathogenic avian influenza (HPAI) H5N1 virus (clade 2.3.4.4b): First report, 8-weeks post vaccination with VAXXITEK HVT+IBD+H5 Progress report: Transmission study testing HVT-H5 vaccine against highly pathogenic avian influenza (HPAI) H5N1 virus (clade 2.3.4.4b): Second report, 24-weeks post vaccination Vectormune HVT-AIV vaccine
Germany (DEU)	Fattening geese	Immunogenicity and Protective Efficacy of Five Vaccines Against Highly Pathogenic Avian Influenza Virus H5N1, Clade 2.3.4.4b, in Fattening Geese

Annex D: Laboratory designation

All relevant requirements of the designation of an Official Laboratory (OL) under the OCR must be met including notably the laboratory must successfully pass upon request by the NRL, relevant inter-laboratory comparative tests or proficiency tests that are organised for the analyses, tests or diagnoses they will perform in their role as an OL. In addition to operating in accordance with the standard EN ISO/IEC 17025 and be accredited for the relevant diagnostic assays and procedures in accordance with that standard by the United Kingdom Accreditation Service (UKAS).

The laboratory must also meet any other relevant legislative requirements including those set out in relation the Specified Pathogens Orders (SAPO), the Control of Substances Hazardous to Health Regulations 2002 (as amended) (COSHH), the approved classification of biological agents as set out by Advisory Committee on Dangerous Pathogens (ACDP), and schedule 5 of the Anti-terrorism, Crime and Security Act 2001 (as amended) and the control set out in Part 7 of the Anti-terrorism, Crime and Security Act 2001 (Extension to Animal Pathogens) Order 2007.

Further information on diagnostic testing, controls and reporting obligations for avian influenza virus including the requirements any potential OL would need to meet can be found in Defra's Avian influenza and influenza of avian origin: diagnostic testing, controls and reporting obligations guidance published on gov.uk.

In support of any OLs designated to support avian influenza vaccination efforts, appropriate data handling systems will be essential to enable data capture, orchestration and analysis of vaccination records and surveillance information.

Data systems supporting any avian influenza vaccination campaign and OL network need to be both proportionate and appropriate to the task at hand, whist not introducing undue burdens on the OLs or Competent Authorities.

The scale of any OL network in relation to avian influenza vaccination will be highly dependent on how commercially viable this diagnostic testing is to private laboratories.

Any diagnostic laboratory interested in pursuing designation as an OL for avian influenza virus diagnostic testing, should contact ah.official.laboratory.designation@defra.gov.uk to discuss the requirements and potential official laboratory designation. Laboratories should include the following information in their correspondence:

- the name and address of the laboratory site(s) proposed for designation
- the name and address of the headquarters of the laboratory if different from the above
- the name and contact details of the nominated contact person for all laboratories proposed to be designated
- the type of testing you wish to undertake under an OL designation
- the purpose of testing you wish to undertake under an OL designation
- whether you wish to undertake diagnostic testing as an OL on samples from animals located in Great Britain, Northern Ireland, or both
- the laboratory site(s) proposed for designation's current UKAS accreditation status (or if relevant Irish National Accreditation Board (INAB) accreditation status) (outline

whether the laboratory would be willing to commit to achieving EN ISO/IEC 17025 accreditation for assays and methodologies relevant to the laboratories' potential designation as an OL)

- the laboratory site(s) proposed for designation's ACDP's COSHH classification regime containment status
- the laboratory site(s) proposed for designation's SAPO containment level licensing status

Annex E: Cost benefit analysis inputs, assumptions and impacts

Annex E1 – Modelling details, sensitivities, inputs and assumptions

Cost of purchasing and administering the vaccine

Table E1.1: Assumptions and data sources used to estimate the cost of purchasing and administering the vaccine

Variable	Value	Source
Dosage cost	£0.04 - £0.08 per dose (depending on if vaccinating day old or *in ovo*)	Industry estimates
Labour and machinery charge	£20 (fixed for day old vs *in ovo*)	Industry estimate
Poultry keeper hours required to vaccinate	0.25 to 1.25 hours of poultry keeper time required per 1,000 vaccines	Industry estimates
Cost per hour of poultry keeper time	£12.21	Annual Survey of Hours and Earnings (ASHE) 2022, ONS

Cost of additional EU surveillance

Table E1.2: Assumptions and data sources used to estimate the cost of additional EU surveillance

Variable	Value	Source
Vet travel time	2.5 hours (assumes 100 miles on average)	APHA
Vet swabbing time	30 minutes per 60 birds	APHA
Vet blood sampling time	2 hours per 60 birds	APHA
Vet cost	£125 per hour	APHA
Cost of swabs/gloves/ consumables	£6 per epi unit	APHA
Cost of biobottle	£14.26	APHA
Cost for courier from farm to lab	£30 per 6 epi units	APHA
PCR test cost	£43.68 per pool of 5	APHA
Serology test cost	£13.08 (no pooling assumed)	APHA

Number of farms and birds vaccinated

The number of birds vaccinated each year is estimated based on the assumptions in Table 6 below. These numbers have been collated by and verified with the Taskforce. We assume that breeders will require a second dose.

Table E1.3: Premise-level assumptions: Poultry meat sector (based on the number of Red Tractor accredited premises and BPC members)

	Number of farms (UK)	Average epi units per farm	Average birds per epi unit	Average flocks per year
Broiler breeders (Rear)	129	4.0	9,000	2.0
Broiler breeders (Lay)	304	4.0	8,000	1.0

Meat chickens	1,127	7.0	25,600	8.0
Turkey breeders (Rear)	33	4.0	2,500	1.6
Turkey breeders (Lay)	49	4.0	2,500	2.6
Meat turkeys (Hens)	76	3.5	5,000	3.2
Meat turkeys (Stags)	76	3.5	5,000	2.1
Seasonal turkeys	800	1.5	600	1.0
Duck breeders (Rear)	7	3.0	2,836	1.0
Duck breeders (Lay)	10	3.0	2,836	1.0
Meat ducks	32	4.8	9,0	7.0
Free range broilers	273	4.0	6,000	5.0
Organic broilers	150	6.0	6,000	3.7
Geese	80	2.5	3,000	1.0

Table E1.4: Farm-level assumptions: Egg sector (based on the number of BEIC Lion Code accredited premises)

	Number of farms (UK)	**Average epi units per farm**	**Average birds per epi unit**	**Average flocks per year**
Lion breeder (rear)	9	2.7	12,000	2.7
Lion breeder (lay)	30	2.7	12,000	1.0
Lion pullet rearing	307	2.7	16,000	2.7
Lion layers	1,274	2.5	16,000	1.0
Non-Lion sites (>1k birds)	355	2.5	16,000	1.0

Table E1.5: Farm-level assumptions: Game sector (based on the number of GFA member premises)

	Number of farms (UK)	Average epi units per farm	Average birds per epi unit	Average flocks per year
Game breeding	125	16.7	5,000	1.0
Game rearing	300	3.3	9,000	1.0

Further outbreak cost inputs and assumptions

Table E1.6: Government cost assumptions

Variable	Value	Source
APHA hourly wage	£22.78	APHA
Overtime uplift	40%	APHA
Hours in a day	7.5	HM Treasury
Working days in a year	220	APHA
Vet day rate	£450 (the midpoint of a £300-£600 range provided)	APHA
Tech day rate	£350	APHA
Vet visits per day	4	APHA
Cost for additional Vi6 laboratory staff	£631	APHA

Variable	Value	Source
Transport and disposal and culling	*2020 to 2021:* T&D: £0.09m Culling: £1.4m *2021 to 2022*: T&D: £2.8m Culling: £5.9m *2022 to 2023:* Combined: £29m	APHA

Table E1.7: Surveillance cost assumptions

Variable	Value	Source
Number of samples per IP	2	APHA
Birds sampled per IP	60	APHA
VAT rate	20%	HMRC
Cost of 60 oropharyngeal (without VAT)	£488.40	APHA
Cost of 60 oropharyngeal + 60 cloacal swabs (without VAT)	£976.80	APHA
Absorbent sheets	£0.15	APHA
Security seal labels	£0.07	APHA
Grip seal bags	£0.03	APHA
30 litre Biotherm box	£27.66	APHA
Swabs	£0.88	APHA
Cable ties	£0.02	APHA

Yellow sacks	£0.51	APHA
Green top Pathopak 3lt complete	£8.88	APHA
Box only for green 3lt bio bottles	£4.00	APHA

Table E1.8: Secondary cleaning and disinfecting costs

Variable	Value	Source
Secondary C&D cost per IP (maximum)	£86,926	NFU C&D Report (2025)
Secondary C&D cost per IP (minimum)	£32,675	NFU C&D Report (2025)

Table E1.9: Avian influenza prevention zone (AIPZ) housing measures costs

Variable	Value	Source
Poultry premises <100 birds	Low: £9 High: £86	Assessment of premises-level biosecurity measures after an outbreak of avian influenza in the United Kingdom, 2011. Based on data from the 2007 outbreak.
Poultry premises >100 birds	Low: £234 High: £733	As above

Table E1.10: Trade shock inputs and assumptions

Variable	Value	Source
Production shock	5%	UKAMM model
Change in production value	-5%	UKAMM model
Consumption shock	Pre-Shock	UKAMM model
Total export value of affected trade	£325,412,000	European Commission Trade Barriers data

Table E1.11: Further modelling assumptions

Assumption	Description	Assessment
Past outbreaks are a reasonable proxy for future outbreaks	The analysis uses outbreak data from previous outbreaks from 2020-23	This was a particularly severe set of HPAI outbreaks. Future outbreaks may be less severe which would reduce the benefits of vaccination. Nonetheless, the risk of HPAI is rising and so this is a reasonable estimate, though further scenario modelling could help to validate this assumption.
Vaccine uptake is 100%	The analysis assumes every commercial premise allowed to vaccinate, will vaccinate.	An assessment of expected uptake has not been conducted but this is expected to overstate vaccination costs and benefits, particularly any benefits derived from reaching a critical mass of vaccination.
Vaccination is 100% effective	The analysis assumes that the vaccine completely avoids an outbreak	It is possible that an outbreak can still occur due to vaccines not being 100% effective. This would reduce the benefits of vaccination. There is also the possibility that vaccination, through masking symptoms, weakens the effectiveness of surveillance activities (though the proposed EU surveillance costs, which are modelled, should theoretically mitigate this risk).
Poultry are vaccinated annually	The analysis assumes that in each appraisal year, poultry receive doses of the vaccine.	This is a reasonable assumption in most cases given the short time for which most poultry are kept. However, in specific cases it may overestimate the cost of vaccination (for example if poultry is kept for longer)
10-year appraisal period using 3.5% discount rate	Impacts of vaccination are appraised over a 10-year period meaning the effects of the proposal are monitored until 2035. Future impacts are discounted at a rate of 3.5% to account for Social Time Preference	A 10-year appraisal period is an appropriate appraisal period as disease outbreak impacts do not tend to last longer than 10 years (this would be very extreme). 3.5% discount rate is consistent with Green Book standards.

Assumption	Description	Assessment
Outbreaks happen annually for the full appraisal period	Benefits are appraised over a 10-year period, and it is assumed an outbreak happens in each of these years.	Since the H5N1 strain was discovered, in 1996, there has been on average an outbreak every 5 to 6 years. However, experience from recent years does suggest the rate at which outbreaks are occurring is increasing significantly.
Where compensation data maps to multiple poultry production groups an even split is assumed.	When mapping compensation values for sectoral impacts a simplifying assumption is made regarding the proportions of birds belonging to a given group assuming an even split. For example, birds in the 'Chicken – Broiler/layers' category mapped to both 'Broilers' and 'Laying hens' and so it is assumed here the split is 50/50.	The effect of this is expected to be minimal as the majority of poultry map to a single group. However, this is noted here as a limitation in the granularity of the data which would have minimal effect on the accuracy of the sectoral breakdown of impacts.
Trade costs remain in year 1 if outbreak persists	The analysis assumes that the trade shock will be the same in each year there is an outbreak. Tail effects do not accumulate over time.	Trade costs may be higher in later years as the impact of multiple trade shocks cumulates. Therefore, this is likely an under-estimate of the trade benefits of annual vaccination over the appraisal period.
Trade impacts remain the same for each outbreak year	The production shock faced in each of the past outbreaks used in this analysis is assumed to have been the same in each scenario: a 5% production shock.	This will likely overestimate the impact of the 2020 to 2021 outbreak since only a relatively small number of premises were affected in this outbreak. However, it was not proportionate to individually model the trade impacts of each outbreak.
Infections were not biased towards smaller or larger premises (exogeneity of outbreak shock)	It is assumed that there is no reason to believe that premise-level characteristics such as size influence the likelihood of a premise being infected.	This assumption justifies use of the "Number of IPs" as a means of assessing the scale of the production shock. If larger premises are more likely to be infected then <5% of IPs could make up more than 5% of overall production value (and vice versa for smaller businesses)

Assumption	Description	Assessment
Housing measure costs assume that all free-range premises are placed under housing measures for each outbreak year	It is assumed that all premises across all regions will be affected in the same way by housing measures	In reality these housing measures can be regionalised and may not affect all premises for the same period of each year. Therefore, this likely upwardly biases the cost of housing measures.
Housing measure costs assume the same proportion of free range and non-free range premises across all sectors and nations	The analysis takes data from the poultry register on the proportion of egg production premises that are free range (and would therefore face housing measures) and those that are not and applied this percentage to the industry as a whole.	Since the vast majority of poultry farms in the UK are free range (including organic) it would not be proportionate to perform further, more granular research, into the split across different poultry sectors. Any mis-estimation will likely be fairly small and low impact on the overall costs.

Annex E2: Monetised impacts and assurance

Table E2.1: Summary of monetised disease outbreak impacts

Impact	Description of impact	Impact Confidence Assessment
Poultry lost	The sum of the values of poultry dying from HPAI or healthy birds culled as a preventative measure based on recent outbreak data. These costs are borne by industry but are mostly rebated by the compensation provided by government (as well as any insurance that keepers may have - though this is not monetised).	***Medium to High*** – estimated from recent outbreak data.
Secondary cleansing and disinfection	The cost of conducting the cleansing and disinfection process required before infected premises become active again after restrictions were implemented. This is the product of NFUs published cost estimate and the number of premises.	***Medium***– based on recent NFU report estimates. However, the data has a large range and uses some simplifying assumptions.

Impact	Description of impact	Impact Confidence Assessment
Housing measures	The cost of implementing the avian influenza prevention zone (AIPZ) and the housing measures which may be included within it. It is calculated as the product of the monthly costs to premises and the number of farms affected.	***Low to Medium*** – based on historic data, however the unit cost assumptions refer to the 2007 outbreak. It has been assumed that the proportion of free range, organic, enriched cage and barn farms are consistent in all nations and sectors.
Movement restrictions	The costs associated with premises being restricted from moving poultry. These include biosecurity assessment visits, any requirements for poultry movements and swabbing costs as well as costs of PCR testing visits. The calculations don't incorporate the opportunity cost of movement restrictions.	***Low*** – Based on 2021 to 2022 veterinary data. Data has not been internally validated by Defra or APHA.
Trade restrictions	The reduced production value of UK exports for producers, defined by a cost equilibrium model. This captures the impact of trade restrictions placed on animals and related produce by a UK disease outbreak. This particularly applies to those countries not accepting regionalisation. For a more detailed breakdown of the trade analysis, see Annex E2.	***Medium*** – Based on UKAMM-Defra's best available agricultural trade simulation model. It makes assumptions on trade responses based on historic behaviour and uses assumptions on how an outbreak will affect production.
Compensation to keepers	The amount paid by government and to keepers, after culling requirements are set by government.	***Medium to High*** – Based on recent outbreak data.
Government staff	Government costs is a function of the number of hours spent on an AI outbreak multiplied by an hourly wage rate.	***Medium*** – Based on real historic data however some simplifying assumptions have been made (notably standard hourly wage rate is applied for all staff and the high scenario is based on scaling the central scenario rather than actual data).

Impact	Description of impact	Impact Confidence Assessment
Operational	Sums the cost to cull, transport and then dispose of animals based on historic outbreak data.	***Medium*** - Based on historic Defra and APHA figures. Some simplifying assumptions made where data is missing (for example, lower bound estimate of fixed costs when Scotland did not have a meaningful outbreak in 2020 to 2021)
Surveillance	The cost to test and process HPAI samples taken on farms. This includes the costs of the sampling materials themselves as well as the labour costs of veterinary and laboratory time. These are calculated as day rates and multiplied by the number of samples taken (it is assumed one visit a day is possible)	***Medium*** - Based on APHA unit cost estimates for 2021 to 2022. Upper bound estimates of costs are used where information is imperfect meaning these are likely an overestimate. For 2020 to 2021 and 2022 to 2023 these costs are scaled based on the relative number of IPs.

Table E2.2: Summary of monetised intervention costs

Impact	Description of impact	Confidence Assessment
Vaccinations	Vaccination cost estimates are made up of 2 components: (1) The cost of resource and staff time associated with the delivery of vaccines by both vets and keepers; and (2) Unit costs for material and admin costs per bird are multiplied by the number of each bird-type requiring vaccination.	***Medium*** - Based on a combination of historic data from past outbreaks as well as data provided by private companies and data collated by the Taskforce.
EU Surveillance	The cost of ensuring that compliance with proposed EU surveillance requirements to continue trade. This includes the costs of collecting samples, transport to laboratories and processing. These inputs are provided by members of industry within the Taskforce.	***Medium*** – Data is based on expert input. However, figures have not been extensively independently validated by Defra or APHA.

Annex E3: Modelling the trade impacts of a HPAI outbreak

UKAMM (UK Agricultural Market Model) is a dynamic partial equilibrium model that projects "economic relationships in the arable crops, livestock, dairy, oilseed processing and sugar sectors." [1]

Therefore, given our data suggests that fewer than 5% of premises were infected in each outbreak we decided to commission the UKAMM modelling team to estimate the impact of a 5% shock to production. We believe this is an appropriate shock level to apply as, although fewer than 5% of premises were affected, this does not count the number of premises that would have faced production shocks as a result of being caught in Surveillance Zones. We therefore believe this is still a relatively cautious estimate of the overall production shock.

UKAMM then calculates the associated change in production value for a 5% fall in production, which in the scenario we used was a 5% fall in production value, driven by production and producer prices deteriorating, coupled with diminishing exports, exerting downwards pressure on production value. We applied this production value reduction to the average export value across the period 2020-24. This gave us an overall fall in export value of £16 million annually.

We assume the same level of trade impact for each year of the outbreak. This likely overestimates the lower bound 2020 to 2021 outbreak impact since fewer than 1% of premises were affected in that year. However, given the time and resource intensity of running the UKAMM model, it was not considered proportionate to model individual scenarios for each outbreak year.

Annex E4: Additional vaccination breakdown

In calculating the total cost of in ovo and day-old vaccination we use a number of assumptions set out in full in Annex E3, above. What is important to note is that we assume that in ovo vaccination within breeders requires double the dosage of day-old vaccinations. This means that the cost of vaccine materials is always higher for *in* ovo vaccination.

In reality, this would be counter-balanced in some cases by the lower handling costs associated with *in ovo* vaccination. However, due to data limitations we use a fixed handling cost per bird for both types of vaccination. This is likely, therefore, to overestimate the cost of handling *in ovo* vaccination and underestimate the cost for day-old vaccination. This suggests that the estimate for vaccination costs that we use in our core analysis, above, is not in fact cost-minimising.

[1] For further information on the assumptions underpinning the model's projections see the UKAMM (2021) web page on Gov.uk: UK Agricultural Market Model (UKAMM) - GOV.UK

Table E4.1 below sets out our estimated maximum possible cost of vaccination if all keepers decided to opt for *in ovo* vaccination.

Table E4.1: Upper bound costs of vaccination

Total cost range (£millions)	**Max** ***In ovo* + Separate**
Broilers	£252
Turkeys	£3
Laying hens	£10
Breeders	£3
Ducks	£1
Undefined	£1
Total cost	£245

As a sensitivity test, the handling costs were cut the handling costs by 50%. This only reduced overall vaccination costs by 7%. Therefore, despite table E3.1 likely representing an overestimate of total *in ovo* vaccination costs, taking account of the reduced handling costs is unlikely to have a substantive impact on the overall value for money assessment.

Annex F: Turkey trial outline

Trial outline

The Taskforce recommends that a UK-based vaccination trial is essential to generate robust, context-specific evidence. This should be designed in such a way as to provide further information on: vaccine efficiency and duration of immunity; practicalities of vaccine administration, including age, dosage, and delivery method; performance of surveillance systems and DIVA compatibility; and behavioural responses from turkey producers and the insurance sector, which are critical for understanding likely uptake and sustainability. To achieve this, close working with EU counterparts to understand what they might want to do, and how we can complement rather than duplicate, will be essential.

This should be a fully contained trial in turkeys only. This would be conducted in dedicated facilities and include both field and laboratory components. The trial must assess vaccine performance under UK-specific conditions, including immune response, duration of protection, and the feasibility of different vaccination protocols. Surveillance strategies should also be tested, including the use of dead birds and DIVA-compatible tools.

In addition to addressing these evidence gaps, the trial would serve as a low-risk, high-value pilot to inform the Taskforce's recommendations. It would allow both government and industry to test operational readiness, including vaccine supply logistics and workforce training. The trial would also provide an opportunity to engage early with trading partners on the development of surveillance and certification protocols, helping to mitigate potential trade disruptions – of both the trial and any future vaccination policy change.

Evaluation design

Alongside vaccination performance trials, it is necessary to understand the feasibility of a broader vaccination programme. This includes an understanding of the requirements for surveillance, for example the range of costs of testing, the minimum number of tests conducted a year to make the capability sustainable (including accounting for seasonality), the maximum number of tests that can be conducted a year, the number of labs which will need to be upskilled and undertake proficiency panel testing to demonstrate capability to test both in government and private labs. There should also be engagement with the avian industry to understand their appetite to vaccinate, given the associated costs.

These factors provide important bounds within which a wider vaccination programme could be enabled, if the vaccine trial is found successful. If uptake rates were expected to be very high and testing capacity low, then access to vaccination may need to be targeted. If the uptake rate was expected to be very low, then the investment in testing capacity etc. may not be proportionate.