Advice on emergency culling for the depopulation of poultry affected by high pathogenic avian influenza (HPAI) – consideration of ventilation shutdown (VSD)

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Animal Welfare Committee (AWC) Opinions

AWC Opinions are short reports to Government[1] on contemporary topics relating to animal welfare. They are based on evidence and consultation with interested parties. They highlight particular concerns and indicate issues for further consideration by Governments and others.

AWC is an expert committee of the Department for Environment, Food and Rural Affairs in England and the Devolved Administrations in Northern Ireland, Scotland and Wales. More information about the Committee is available at https://www.gov.uk/government/groups/animal-welfare-committee-awc

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The links between the health and wellbeing of farmers and farm animal welfare, 2017

[1] Where we refer to "Government" we are addressing the Department for Environment, Food and Rural Affairs in England, the Scottish and Welsh Governments, the Northern Ireland Assembly and other responsible Government Departments and Agencies.

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Scope

1. UK governments have asked the Animal Welfare Committee (AWC) to advise on the emergency culling method of ventilation shutdown (VSD) for depopulation of poultry. The context for this current advice is the high numbers of birds and premises affected by high pathogenic avian influenza (HPAI) over 2021, 2022 and 2023.

2. Poultry species included in the scope of the advice are largely intensively kept meat/layer chickens and turkeys depopulated for HPAI disease control purposes across the UK. Some depopulation methods may be less suitable for other species such as geese and ducks.

3. Government asked AWC to advise it on criteria for deciding when the government may be justified in granting a derogation under Article 18 of retained Regulation 1099/2009 on the protection of animals at the time of killing (PATOK) to use a non-Annex I method of stunning for depopulation due to exceptional circumstances, such as threat to human health or where it is necessary for disease eradication purposes.

4. Government asked for AWC's expert analysis of the animal welfare implications of the use of VSD as a method of depopulation for intensively kept meat or layer chickens and turkeys, including the animal welfare impacts and ethical views on the use of VSD as against birds dying of HPAI. This should include VSD use in different scenarios such as potential HPAI spread on a multiple shed farm (where many sheds may be housing healthy birds); or the rate of spread within an unhealthy shed.

5. If use of VSD were to be contemplated, government wished to understand what safeguards may be needed and what actions could be taken to minimise suffering. This could include the additional use of CO_2 or heat.

6. Government also wanted advice on the viability of using an oral sedative or anaesthetic to:

- cull birds at scale in AI outbreaks
- mitigate adverse effects on animal welfare resulting from VSD

Advice was requested on whether alpha-chloralose or similar products may be effective for these uses. AWC were to decide on the issues to review in connection with assessing viability of products, e.g. mode of action, birds' consumption of medicinal products, legislation.

Background

7. In 2006, the Farm Animal Welfare Council (FAWC) issued advice on the use of ventilation shutdown as a killing method for poultry in disease control situations. FAWC considered it to be a last resort option. In April 2006, VSD was made legal under Ministerial discretion by The Welfare of Animals (Slaughter or Killing)

(Amendment) (England) Regulations 2006. The 2006 Regulation was revoked by the Welfare of Animals at the Time of Killing (England) Regulations 2015 (WATOK) in 2015. VSD has not been legal in any other part of the UK.

8. Since 2006, there have been significant changes in the legislation with the introduction of Council Regulation (EC) No 1099/2009 on the protection of animals at the time of killing (PATOK) and its implementation and enforcement by the Welfare of Animals at the Time of Killing (England) Regulations 2015 (WATOK), and similar legislation in other countries of the UK. These two regulations made the use of VSD as a stunning/killing method illegal in England and revoked the 2006 Regulation, respectively.

9. In addition, there have been further alternative methods made available for poultry culling over the last two decades, most notably gas-operated percussive devices (such as the Turkey Euthanasia Device), containerised gas units (CGUs) and whole-house gassing (WHG).

10. At the height of HPAI disease spread in October 2022, delays between confirming HPAI and culling of birds taking place had increased to 7 days. More recently, these delays have decreased back down to within the Animal and Plant Health Agency (APHA) target of 48 hours, due to the use of WHG and the targeting of priority premises. There is still scope within the current outbreak, or in future, for infection rates to rise again and to place significant pressure on the ability of APHA and contractors to keep pace using the current approved depopulation methods.

11. There are a range of culling methods that APHA and their contractors are using to humanely kill birds on infected premises. Mechanical percussive devices are more suitable for small flocks, while CGUs and more recently WHG are being used on larger premises. Capacity for WHG is increasing among contractors.

12. In light of the unprecedented scale of HPAI during the 2022-23 (or "current") outbreak, industry approached Government about the use of VSD, potentially in combination with some form of sedative such as alpha-chloralose. VSD is not a legal stunning/killing method and the scope for derogation is limited by the provisions of PATOK.

13. VSD has been considered during severe disease outbreaks in the past, However, it has not been used because it is a legal requirement that '*animals shall be spared any avoidable pain, distress or suffering during their killing and related operations*', and no derogation has been justified. Apart from the animal welfare concerns around its use, not all poultry accommodation would be suitable for VSD just as not all sheds are suitable for WHG.

14. On the use of alpha-chloralose or other sedative/anaesthetic prior to VSD, AWC is aware that there are practical challenges of achieving effective sedation in a large-scale cull and it is untested whether it can effectively produce unconsciousness and insensibility to pain of all birds in a flock subject to HPAI infection. It is also untested how VSD, a method of culling which induces hyperthermia, would interact with the hypothermia caused by alpha-chloralose. AWC's advice has been requested

on whether the use of other sedatives/anaesthetics before VSD is likely to reduce suffering to an acceptable level.

Previous advice and guidance

15. Previous FAWC advice on VSD was published in 2006[2]. FAWC recognised that a situation could arise where there is no option but to compromise the welfare of a particular flock for the greater benefit of the national flock and/or public health. FAWC noted the requirements in the 2006 Regulations prescribed for the use of VSD (now revoked), including the written authority of the Secretary of State.

16. In addition, FAWC wanted assurance prior to any use of VSD that:

- the benefits were substantial and clearly outweighed any harms;
- VSD would only be used in situations where expert assessment indicated that death would be reasonably rapid, and no alternatives were available;
- an available backup method was in place to destroy humanely those birds found not to have been killed by VSD; and
- any use of VSD was well documented and results fed back rapidly to inform future decisions and to improve the contingency plan.

17. FAWC produced further advice on contingency planning in 2012[3]. Here, FAWC advised that there is a moral duty to protect the welfare of farm animals and prevent unnecessary suffering, including in disasters and emergencies (paragraph 48). They recommended that any contingency plans should include protection of animal welfare as well as consider humane methods of slaughter and carcase disposal (paragraph 68). FAWC recognised that in an emergency it might not be possible to use humane killing methods that are available under normal circumstances (paragraph 9). However, this opinion was considering a disaster (force majeure) context where animal housing is destroyed, access to animals and infrastructure is impaired, the owner is not present, or resources are limited due to human or other needs, rather than a situation primarily relating to controlling infectious disease.

18. AWC continues to support the recommendations from the 2012 FAWC Opinion on contingency planning for animal welfare in disasters and emergencies that are included within the National Contingency Plan[4]. These are

- recommendation paragraph 59 ‘Planning at all levels for disasters and emergencies should take into account potential hazards to farm animal welfare. National/regional civil and animal health contingency plans should explicitly address protection of farm animal welfare.’;
- recommendation paragraph 61 ‘Contingency plans for farm animal welfare should be proportionate to the risk and should include an inventory of capabilities and resources.’; and

[2] [ARCHIVED CONTENT] Farm Animal Welfare Council (nationalarchives.gov.uk)
[3] FAWC opinion on contingency planning for farm animal welfare in disasters and emergencies - GOV.UK (www.gov.uk)
[4] UK contingency plan for exotic notifiable diseases of animals - GOV.UK (www.gov.uk)

- recommendation paragraph 62 ‘Partnerships with clearly defined roles and responsibilities should be forged between non-governmental organisations and others to provide assistance in disasters and emergencies.’.

19. Current Government guidance on avian influenza can be accessed online[5].

Number of animals and types of accommodation involved

20. ‘Seasons’ for recording of HPAI cases run from 1 October to 30 September. Numbers of sites and birds impacted by HPAI in Great Britain in 2020/2021 were over 1 million birds on nearly 80 premises; 2021/2022 3.17 million birds on 152 premises; and 2022/2023 (to 17 April 2023) 5.22 million birds on 177 premises. In previous years HPAI case numbers were much lower.

21. Poultry accommodation types include sheds with either floor-based systems (mostly meat chickens, ducks, geese and turkeys), floor and raised slatted systems, floor and multi-tier areas (mostly laying hens); and all of these can also accommodate free-range poultry with popholes at bird level to the outside. Laying hens are also found in colony cage systems of up to eight tiers of cages in larger sheds, some containing more than 100,000 birds per shed. Some older sheds may still have deep pit systems where there are large voids below the living accommodation that can complicate sealing. Turkeys and other poultry are also housed in partially open sheds where sealing is not possible. VSD could only practically be used at premises where poultry are housed in buildings that can be sealed.

Legal context

22. Annex I of PATOK contains the stunning methods permitted by the legislation and Article 4(1) requires that “*animals shall only be killed after stunning in accordance with methods and specific requirements related to the application of these methods set out in Annex I”*. It is preferable that when culling for disease control, these stunning methods also lead to the death of the animals to negate the need for further intervention.

23. Article 4(2) of PATOK allows that Annex I stunning methods may be amended to take account of scientific and technical progress, but any such amendments must ensure a level of animal welfare at least equivalent to that ensured by existing methods.

24. Article 18 of PATOK relates to depopulation, which is defined as “*the process of killing animals for public health, animal health, animal welfare or environmental reasons under the supervision of the competent authority*”. Article 18(1) requires the

[5] https://www.gov.uk/guidance/avian-influenza-bird-flu

competent authority responsible for a depopulation operation to establish an action plan before the operation commences. That plan should include stunning and killing methods and operating procedures aimed at ensuring compliance with PATOK. Article 18(2) requires the competent authority to ensure the operations are carried out in accordance with the plan and take appropriate action to safeguard the welfare of the animals in the best available conditions.

25. Article 18(3) provides a limited derogation as follows: -
"*For the purposes of this Article and in* ***exceptional circumstances****, the competent authority may grant derogations from one or more of the provisions of this Regulation where it considers that* ***compliance is likely to affect human health or significantly slow down the process of eradication of a disease****.*".

26. Therefore, a derogation should only be used in exceptional circumstances and the Secretary of State in England, or relevant Ministers in other administrations, would need to be satisfied that any derogation from the rules was necessary to protect human health or to manage disease. Where a derogation is granted under Article 18(3) of PATOK, a notice of the decision must be published in accordance with Regulation 29 of WATOK, or equivalent legislation in other administrations. New legislation would not be necessary to rely on Article 18(3).

Animal welfare impacts of depopulation methods

27. While individual bird welfare is a primary concern in depopulation for disease control, these situations are characterised by strong competing interests including the protection of public health and the need to control the spread of disease to other poultry and wildlife. The prioritisation of these goals depends on the virulence and zoonotic potential of the disease involved and the availability of culling methods, which themselves are subject to practical and economic constraints, especially in large outbreaks.

28. Even when significant efforts are made to protect bird welfare, the outcomes achieved for infected birds may not be equivalent to best practice at slaughter because of time pressure, challenging local conditions, availability of personnel and equipment and the need to minimise the risk to human health. Thus, bird welfare outcomes are affected by the depopulation method used, each of which has strengths and weaknesses (McKeegan 2018[6]) and any time delays in implementing the method used. Efficacy is also crucial because, to achieve effective disease control and prevent further welfare harm, all the birds must be killed. However, some welfare challenges are avoided or minimised with particular depopulation methods, e.g., no handling with WHG, no fasting or transport associated with on-site killing.

29. In large commercial settings, it is not practically possible to identify individually infected birds within a given shed and then cull only these. Moreover, some birds may be asymptomatic on inspection but still be infected. In any culling situation, it is likely

[6] Advances in Poultry Welfare, Chapter 17 Mass depopulation, Dorothy McKeegan, University of Glasgow, 2018. DOI: http://dx.doi.org/10.1016/B978-0-08-100915-4.00017-8

that both infected and uninfected birds will be killed and for some notifiable diseases, including HPAI, it is a legal requirement to cull all birds on an infected premises.

Animal welfare impacts of HPAI

30. There has been no definitive work published on the welfare impacts of HPAI. Birds infected with HPAI can rapidly become very sick and distressed. The signs of HPAI in chickens and turkeys can be variable and include respiratory and neurological signs, usually with high morbidity and mortality (Avian influenza: guidance, data and analysis - GOV.UK (www.gov.uk).

31. All these signs and symptoms cause distress and suffering to the individual bird. From observation of flocks affected by the current H5N1 strain of HPAI, the birds become quiet and lethargic, and death usually follows within 24 hours of the onset of clinical signs. Impacts on different species and life stages vary. The welfare impacts of other strains of HPAI may differ in degree of suffering and time to death.

Decision making framework

32. In animal production, there are potential extraordinary disease events which require emergency contingency planning. The Contingency Plans for Exotic Notifiable Diseases of Animals for the UK (2021)[7], England (2022)[8] and Wales (2018)[9], the Exotic Animal Disease Continency Framework Plan for Scotland (2022)[10] and the Contingency Plan for Epizootic Disease for Northern Ireland (2018)[11] set out how government will deal with such events.

33. To control the spread of notifiable disease, any depopulation process has to be conducted in a timely manner and the welfare considerations have to both include the individual animal and the entire flock.

34. To determine the appropriate depopulation methods for any emergency situation, several considerations need to be considered and a "harms/benefits" risk evaluation of such actions should be performed. Considerations include an assessment of the reason for depopulation (usually containment related to disease spread but may include response to a natural disaster or other unprecedented emergency), evaluation of welfare considerations (associated with the respective methods of depopulation vs the effect of the disease), evaluation of ethical considerations, assessment of human safety and any regulatory requirements. The choice of any of these depopulation methods will also have an impact on the wellbeing of farmers, stockkeepers and those personnel who undertake the killing.

[7] UK contingency plan for exotic notifiable diseases of animals - GOV.UK (www.gov.uk)
[8] Contingency Plan for Exotic Notifiable Diseases of Animals in England (publishing.service.gov.uk)
[9] Welsh Government Contingency Plan for Exotic Notifiable Diseases of Animals 2018
[10] Supporting documents - Exotic animal disease contingency framework plan: August 2022 - gov.scot (www.gov.scot)
[11] Contingency plan for Epizootic disease of animals | Department of Agriculture, Environment and Rural Affairs (daera-ni.gov.uk)

35. Practical considerations when evaluating depopulation options for HPAI or other poultry infectious disease include:

- severity of the disease situation and rate of spread;
- the welfare impact of the disease on the birds;
- the scale of culling, number of sheds and farms involved, compared to the government's preparedness and availability of government vets and other staff to undertake and supervise diagnosis, management and culling of infected flocks;
- the infrastructure of the buildings which can dictate the methods that can be applied;
- health and safety of operatives and the wider public;
- availability of equipment for the preferred method and the availability of the resource for the function of equipment and personnel to use and monitor this equipment; and
- availability of suitable methods of carcase collection and disposal.

Depopulation Method Categories

36. A preferred method for culling is one listed in Annex I of PATOK.

37. Methods of culling not listed in Annex I, such as ventilation shutdown, may be considered in very exceptional circumstances if the preferred method is not feasible to use in the specific circumstances, and the harms/benefits analysis indicates that birds should be killed quickly to control disease spread and/or to alleviate/prevent further suffering to birds already affected by the disease (see Ethical analysis, paragraphs 64-72).

Ventilation Shut Down (VSD)

38. VSD is a method for the whole house culling of poultry. Sealing the vents in the housing and switching off the ventilation systems is intended to cause the temperature inside the house to rise rapidly due to heat produced by the live birds. The rate of temperature rise and the associated effectiveness of VSD as a method of killing birds depends on several factors such as bird age and size, stocking density, barn height, house volume, construction materials, insulation, etc. and external ambient temperature. Death of the birds is caused by hyperthermia as their core temperature rises to a fatal level.

39. Effective maintenance of a constant internal body temperature (thermoregulation) in homeotherms (birds and mammals) is crucial for survival. Body temperature is closely regulated by balancing internally generated heat with heat loss through the skin via peripheral vasodilation, sweating or panting (depending on the species). Hyperthermia and heat stress occur when the body cannot get rid of excess heat for any reason. In the case of VSD, the increases in ambient temperature and humidity cause a "thermal load" that overwhelms a bird's ability to cool itself down

(hence supplemental heat can hasten death by hyperthermia). When the ambient temperature exceeds the thermal comfort zone, the birds will start to experience distress and suffering. As heat stress progresses, continuous panting alters the acid-base balance in the blood (respiratory alkalosis) and triggers a physiological stress response (Mitchell and Kettlewell 1998[12]). Increased circulation to the skin and respiratory tract surface for thermoregulation results in under perfusion of other tissues/organs (e.g., kidney, liver, intestine) which leads to tissue damage and dysfunction. Panting causes dehydration and falling effective blood volume, which, coupled with circulatory changes, further compromises tissue perfusion. Acute heat stress also causes muscle damage which induces weakness and fatigue and releases myoglobin into the circulation causing renal failure. Collectively, these extreme physiological challenges cause multiple organ failure, compromising cardiac, respiratory and cerebral function. Ultimately, death is likely to be caused by heart failure or respiratory failure, secondary to central nervous system dysfunction. This complex process may be assumed to represent a profoundly negative experience for the bird, and potential welfare harms are likely to include anxiety, fear, pain, malaise, and breathlessness.

US experience of VSD

40. VSD has never been carried out for research or disease control purposes in the UK, but it has been used and studied in the US. The scientific literature remains limited, but nevertheless provides important data for welfare assessment. Trials have been carried out in single bird chambers, small rooms and poultry housing. Reported average times to death with VSD are 2.25 hours in meat chickens (Anderson 2019[13]), 3.75 hours in laying hens (Eberle-Krish 2018[14]) and 4.5-6 hours in turkeys (Anderson 2019). Estimates of time to loss of consciousness suggest that birds are conscious for 50-95% of this time (Anderson 2019). These durations are much greater than for all other depopulation methods, e.g., 3-minute dwell time in CGUs for chickens and turkeys to ensure death[15]; 12-20 minutes from introduction of gas to the shed to kill all birds by WHG[16]; and instantaneous captive bolt devices.

41. Final core body temperature following VSD has been measured in the range 45-46 ºC, which is as expected for lethal heat stress. However, studies of broilers, turkeys and laying hens have shown that VSD does not always result in an adequately high ambient thermal load (Anderson et al 2019; Eberle-Krish et al 2018). Additionally, as birds die, heat generation diminishes making further deaths less likely. VSD is therefore not 100% effective in establishing this thermal load, and some birds may

[12] Mitchell MA, Kettlewell PJ (1998) Physiological stress and welfare of broiler chickens in transit: solutions not problems! *Poultry Science* 77(12): 1803-1814.

[13] Anderson et al 2019 https://www.uspoultry.org/programs/research/search-abstracts/repository/BRF008%20Final%20Report.pdf

[14] Eberle-Krish, K.N., M. P. Martin, R. D. Malheiros, S. B. Shah, K. A. Livingston, and K. E. Anderson. 2018. Evaluation of ventilation shutdown in a multi-level caged system. J Appl. Poult. Res. http://dx.doi.org/10.3382/japr/pfy036

[15] APHA Standard Operating Procedures

[16] McKeegan et al 2011 https://pubmed.ncbi.nlm.nih.gov/22221230/

survive the process. Surviving birds must be identified and killed by an alternative method.

42. It is not known to what extent sick birds infected with HPAI may have altered susceptibility to heat stress, but disease control plans may also involve the killing of healthy birds in which case the findings from this research would apply.

VSD plus (VSD+)

43. VSD has been used together with supplementary heat, to increase the rate of rise of the temperature, or with cardon dioxide gas which has an anaesthetic effect on the birds. These options are often described as VSD+ and have been developed in an attempt to improve welfare outcomes and efficacy.

44. Supplemental heat has been shown to reduce time to death in meat chickens (to 1.8 hrs), laying hens (2 hrs) and turkeys (3hrs) (Anderson 2019; Eberle-Krish 2018) and can produce 100% lethality. Temperatures in VSD+ required to achieve an effective kill are extremely high (especially for turkeys, reportedly 84ºC, Anderson 2019), reaching levels that can cause equipment damage including to electrical components. In practice, the welfare outcomes of VSD+ will be highly dependent on the exact heating parameters. However, there is a risk that stratification of air will result in different temperatures within the shed, the coolest areas being at ground level. The use of fans to mix the air will reduce this risk. Some sheds will not have an inbuilt heating system, necessitating the sourcing of additional heating apparatus.

45. Another version of VSD+ has been investigated with the addition of CO_2 during VSD which introduces hypercapnic hypoxia as an additional mode of action of killing. Trials combining VSD and CO_2 exposure have consistently reported times to death that are shorter than VSD alone (1.5 hours, Eberle-Krish et al 2018), but these are delayed compared to WHG and also included incomplete culls (Anderson et al 2019). In the Eberle-Krish study with VSD+ CO_2, it took over an hour for the CO_2 level to reach 42%, so delivery was much slower than WHG. Such CO_2 exposure is likely to expose the birds to prolonged respiratory distress as well as heat stress. If CO_2 is available in sufficient quantity, then WHG is certainly a preferred approach, even though brief ventilation shutdown is part of the procedure for WHG. This is because when the increased CO_2 level alone is sufficient to achieve rapid killing, deliberately allowing the ambient temperature to rise does not affect the efficiency or speed of killing.

The use of anaesthetic agents as an alternative method for mass killing of poultry or for use as a sedative to protect welfare during the use of culling methods

46. In its current form, the legislation does not permit the use of anaesthetic agents for killing by routes of administration other than injection. A change in legislation or a

derogation would therefore be required to permit an overdose of an anaesthetic using a route and an anaesthetic agent appropriate for the size and species of bird.

47. For this to be a practicable method for killing large numbers of birds, without the need for individual handling or restraint, the method would require direct gaseous administration into a sealed shed, or the "self-administration" of the anaesthetic agent via the feed or water route.

48. The gaseous application of specific anaesthetic agents such as halothane or isoflurane is not practical. The health and safety risk, environment contamination and cost would be unacceptable.

49. There are several concerns about the potential effectiveness of voluntary consumption as a means of killing. In order to be killed, the birds must ingest a lethal dose of the drug prior to the onset of sedation or unconsciousness. Depending on environmental factors, such as temperature, birds that consume sublethal doses will recover.

50. In-feed administration of an anaesthetic agent would also have potential problems. It would require either a feed mill to be authorised, prepared and willing to handle specific medicated products and to have the facilities to mix the feed separately to routine mixes, or for the farm to have on-farm feed mixing equipment that can prepare medicated feed. There could be a delay in the milling and delivery of medicated feed to an infected farm which could have implications for both welfare and disease spread. The feed would have to be stored in and delivered from previously emptied feed bins to ensure that the medicated feed is not diluted and can be delivered quickly at the set dose. Furthermore, feed intake by sick birds would be significantly reduced compared to that of healthy birds.

51. It would be much more straightforward to add medication to a water system and in-water administration could be applied more rapidly than an in-feed approach. Infected birds tend to continue to drink water for a longer period after infection than they are willing to eat food, so this option could provide a more reliable method of medication.

52. In both cases, there are concerns that poor palatability may potentially reduce voluntary consumption of the agent by poultry[17]. However, it was suggested to AWC during evidence gathering that alpha-chloralose was palatable to both chicken and turkeys.

53. The challenges associated with reduced consumption levels could be offset by introducing a short period of "fasting" or "thirsting" prior to application to promote appetite/drinking (Humane Slaughter Association (HSA[18])), or the use of altered dark and light periods to promote feeding and drinking.

[17] Humane killing of nonhuman animals for disease control purposes. M Raj, Journal of Applied Animal Welfare Science, Volume 11 2008, Issue 2, pp 112-124

[18] Addition of anaesthetics to feed or water - Humane Slaughter Association (hsa.org.uk)

54. For both in-feed and in-water administration, plans would need to be in place both to ensure the safe disposal of any remaining medicated product and to ensure that there is no exposure of non-target animals and birds. Anaesthetic agents (particularly those requiring ingestion and absorption) are likely to be organic molecules, so would potentially accumulate in oils and biofilms. Careful cleaning processes would be required to ensure there is effective removal of these chemicals from the feeding and/or drinking water system and this must guarantee that no residue remains that could affect the subsequent flock.

55. Using in-feed or in-water intake methods would potentially result in non-uniform and inconsistent onset of unconsciousness across a whole flock. This could occur because of uneven uptake of the medication across the flock for a number of reasons including normal population effects, such as “pecking order”, and the potential for reduced feed and/or water intake due to morbidity associated with HPAI. As a result, there is an additional risk of pecking or injury to the comatose and semi-anaesthetised birds from any unanaesthetised birds in the house.

56. In housing with a significant three-dimensional structure, such as multi-tier laying accommodation, there is concern that partially sedated birds may fall from the system and become injured, during a period of incoordination following ingestion of any anaesthetic agent.

57. Sedation with an anaesthetic agent would normally cause a reduction in body temperature (hypothermia), so its use would be counterproductive for any killing method that included hyperthermia within its mode of action, as is the case with VSD.

Consideration of the use of alpha-chloralose

58. The use of alpha-chloralose has been considered, owing to its long-term use as an ingested anaesthetic agent for equines and as a rodenticide. At the present time, this product does not have a marketing authorisation as a veterinary medicine in birds.

59. The use of alpha-chloralose as a sedative could have a welfare benefit to chickens, hens and turkeys in some situations. However, where Annex I methods are immediately available for use, alpha-chloralose should not be used if obtaining, mixing and offering it to the birds would significantly delay depopulation.

60. The lethal dose of alpha-chloralose for the different poultry species has not been determined. However, in one study, 50% of rats were killed by a dosage of over 300mg/kg while 100% were killed by 2000mg/kg.[19] The HSA guidance[20] suggests that dosing birds with alpha-chloralose does not result in death and that a secondary method of killing anaesthetised birds is required.

[19] https://echa.europa.eu/documents/10162/da64beb1-10ff-f0bf-85b5-470ed7f9d215

[20] https://www.hsa.org.uk/addition-of-anaesthetics-to-feed-or-water/addition-of-anaesthetics-to-feed-or-water

61. Alpha-chloralose could be used as a sedative for healthy birds which do not have access to high perches (see paragraph 56), and which are to be killed because they are on an infected premises. Healthy birds will be reliably drinking, and any sedation resulting from consumption of sedative will be expected to reduce stress associated with a depopulation process. Sedation of the birds is likely to reduce the amount of CO_2 needed in the gas killing process. This, in turn, could release gas resources for use on other premises and reduce the amount of CO_2 released into the immediate environment. Sedation would reduce the stress involved in any culling method that involved handling.

62. The use of alpha-chloralose as a sedative would not necessarily be beneficial in VSD as sedated birds release less latent heat and the ambient temperature required for killing the birds may not be reached.

63. The majority of substances that could be orally administered instead of alpha-chloralose, are controlled drugs (e.g., opioids, benzodiazepines, barbiturates) with abuse potential. In addition, these agents would not ordinarily be expected to cause a depth of anaesthesia resulting in death. At the moment we are not aware of any suitable alternative anaesthetic agents.

Ethical analysis

64. In line with its previous work and Opinions, the ethical approach which AWC has adopted in considering this issue is a primarily utilitarian one in which the human use of animals is considered permissible to benefit society, providing that animal welfare is safeguarded in accordance with national and, where relevant, international legislation. That utilitarian approach is qualified in that the justifiability of harms is considered in relation to both the magnitude and importance of the benefits that accrue. However, there are some harms which, due to their severity, should not be inflicted upon animals.

65. VSD is known to compromise bird welfare more than other available methods of mass killing of poultry. It is acknowledged that in situations requiring the emergency depopulation of poultry, it can be difficult to maintain welfare standards equivalent to those required during non-emergency slaughter. Nonetheless, the utilitarian ethical imperative is to minimise welfare harms, consistent with national and, where relevant, international animal welfare legislation. It follows that the least welfare-compromising method of killing, the ‘preferred method’, should be deployed. When choosing a method, consideration should be given to aversive reactions and to the severity and duration of suffering and pain, all of which should be minimised.

66. Government has a legal and ethical responsibility to undertake and implement contingency planning to ensure that sufficient approved methods of poultry culling listed under Annex I of PATOK are available for a foreseeable worst-case scenario (i.e., previous peak case load) should the need for emergency depopulation arise. It is the view of AWC that in a utilitarian ethical analysis, the legislation provides a basis for weighting harms to animal welfare more heavily than the economic costs (harms) of contingency planning and preparations for deploying approved culling methods within agreed timescales.

67. It follows that a lack of adequate contingency planning and economic arguments are not ethically acceptable reasons for using methods of killing not listed in Annex I of PATOK for disease eradication purposes. Contingency planning should ensure that there is a sufficient variety of Annex I methods and the availability of equipment and personnel to implement them effectively. This would ensure that if there is a failure in the supply chain preventing the use of some methods then others can be readily deployed.

68. There are multiple methods of culling that result in lesser harm than using VSD. Furthermore, as the need to avoid unnecessary adverse bird welfare effects is prioritised through law, those less harmful methods should be used whether or not they are more expensive or more difficult to implement than VSD.

Ethical analysis for the protection of human health

69. A situation of severe zoonotic threat might provide an ethical justification for government to grant a derogation allowing the use of a method of killing which is not currently listed in Annex I of the PATOK if the outcome cannot be realised using any existing Annex I method. The ethical justification for using a non-Annex I method in such circumstances would then be as follows: (i) unnecessary bird suffering must not be allowed (ii) the non-Annex I method causes suffering in excess of that caused by Annex I methods ***but*** (iii) such suffering is not 'unnecessary' *if* the non-Annex I method is the only method which offers significant additional benefits to protecting humans against severe disease.

Ethical analysis of the use of VSD to protect human health

70. Were a situation to arise whereby VSD could be used to protect humans from severe disease and no existing Annex I method could do so, or, despite adequate preparedness, the resource available to enable the use of Annex I methods was insufficient to protect humans against severe disease, then the animal suffering associated with VSD would be necessary to protect human health. This would provide an ethical justification for the use of VSD. The concept of 'adequate preparedness' is important and relates directly to the issues of contingency planning. For the purposes of this analysis, AWC defines 'adequate preparedness' as government having invested sufficiently in the necessary physical resource associated and the necessary infrastructure and personnel (which could be contracted), to ensure that approved culling methods can be delivered without delay. This latter point is important because adequate safeguarding of animal welfare during emergency culling requires both provision of an appropriate culling method *and* prompt use of that method. Delay consequent upon inadequate logistical and contractual planning that results in unnecessary suffering is therefore ethically unacceptable.

Ethical considerations relating to any emergency culling of poultry

71. Were a situation to arise where there was such rapid and wide spread of infection that, despite adequate preparedness, the resource available to enable the use of Annex I methods was insufficient to protect the national flock, or a significant

proportion of it, against severe disease then the suffering associated with VSD for a relatively small number of birds would be necessary to protect a very large number of birds from disease and untimely death (the number of poultry on the ground at the time of the June Census 2021 was more than 190 million) and the resulting impact on the entire poultry chain.

72. Poultry flocks should be accommodated so that their exposure to the risk of disease infection is reduced to a level consistent with other welfare requirements, such as the freedom to express normal behaviour within indoor and potentially outdoor settings. Considerations should include operating to the highest standards of biosecurity, locating poultry farms away from areas where migrating or other wild birds are known to gather, maintaining sheds to prevent wild animals from entering them and minimising disease impacts on wildlife.

Conclusions

VSD

73. VSD is associated with profoundly negative welfare outcomes, primarily because the hyperthermic death process is prolonged and associated with significant suffering (paragraphs 38-45). The only times that this level of harm could be countenanced is:

(i) in the case of a zoonotic disease which causes serious human disease where,

(a) VSD could be used to protect humans from such disease and no existing Annex I method could do so, or where

(b) despite adequate preparedness, the resource available to enable the use of Annex I methods was insufficient to protect humans against severe disease; or

(ii) during a disease outbreak where, despite adequate preparedness, the rate of spread of infection was significantly outpacing the contingency arrangements for depopulation placing the national flock at risk.

74. VSD could conceivably be used in a case of force majeure so extreme that preparedness to deploy Annex I methods is overwhelmed such that birds may starve, dehydrate or otherwise suffer very significant pain or distress for a significant period of time, which is assessed as being likely to exceed that suffered during VSD.

75. VSD+ with supplementary heat causes distress and suffering to poultry, but the period of suffering is shorter than with VSD alone and this approach could conceivably be used in preference to VSD alone in the critical situations described above.

76. VSD+ with CO_2 results in significantly more distress and suffering than CO_2 alone and if CO_2 is available, then WHG should be deployed.

77. VSD should not be permitted for depopulation of young birds where heat output and low stocking density would mean that achieving an increase in ambient temperature to achieve a body temperature high enough to cause death would not be feasible.

Anaesthetic agents

78. The use of an oral anaesthetic which is palatable and non-aversive to poultry could be an acceptable method for culling poultry if proven to be effective. Birds that ingest alpha chloralose are subject to a variable level of sedation. However, not all birds, particularly those infected, will ingest a lethal dose and therefore this method will not achieve a 100% kill and a secondary method would have to be deployed rapidly.

79. For all culling methods, the use of a suitable sedative, including alpha-chloralose, will reduce the level of stress in some birds, particularly healthy birds that are eating and drinking normally. However, in the case of VSD, alpha-chloralose would not be appropriate as it would cause a reduction in body temperature (hypothermia), which is counterproductive for a killing method that involves hyperthermia.

Recommendations

80. AWC recommends that VSD should not be used for the culling of any poultry in disease control procedures due to the unacceptable impact on bird welfare.

81. AWC recommends that VSD + with additional heat alone, or in combination with carbon dioxide gas, should not be used for the culling of poultry in disease control procedures.

82. AWC recommends that VSD with the addition of carbon dioxide gas should not be used for the culling of poultry in disease control procedures. If carbon dioxide gas is available, it should be used for WHG.

83. However, AWC accepts that VSD and VSD+ (heat) could conceivably be used in the following very exceptional circumstances as a culling method for poultry, subject to derogation:

- *The culling of poultry in force majeure situations such as flood, fire or major infrastructure failure where the birds have lost access to food and/or water and will starve or die of dehydration and it is impossible to bring in the equipment and or personnel needed to cull the birds by approved Annex I methods. In such cases, VSD should only be used in adult breeders or laying hens, or broilers [and meat turkeys] close to maximum slaughter age and stocking density. Wherever possible, VSD should be used with added heat.*
- *A major outbreak of a highly pathogenic zoonotic disease where the number of cases overwhelmed the Government's contingency plans and culling capacity and where, if birds were not culled rapidly, there was a significant risk to humans. Also, an outbreak of a highly pathogenic zoonotic disease, if VSD offered greater safety to people carrying out the cull (and therefore in close proximity to the birds) than any of the Annex I methods.*
- *A highly pathogenic exotic poultry disease where the disease was rapidly spreading, the number of birds needing to be killed significantly exceeded government contingency capacity and failure to kill those birds quickly would increase the environmental viral load putting the national flock at risk.*

84. Anaesthetic agents currently available should not be used as an in-feed or in-water killing method for the depopulation of poultry.

85. Research should be undertaken to identify products that could be used as an in-feed or in-water sedative/anaesthetic/culling method and would achieve a 100% kill success rate. Specific research should be carried out on the use of alpha-chloralose for the effective killing of farmed poultry (current scientific evidence is based on the killing of rodents and wild birds).

Appendix 1: AWC membership

Prof Madeleine Campbell—Chair
Dr Gareth Arnott
Emily Craven
*▫Dr Jane Downes
*Dr Troy Gibson
Prof Simon Girling
*^Dr David Grumett
*^Richard Jennison
*^Peter Jinman (Chair to December 2022)
Dr Julian Kupfer
*Stephen Lister
*Dr Dorothy McKeegan
Dr Romain Pizzi
*Dr Pen Rashbass
Prof Sarah Wolfensohn
Dr Julia Wrathall
Dr James Yeates

*Members of the AWC Welfare at Killing sub-committee which worked on this Opinion

▫Chair of the AWC Welfare at Killing sub-committee

^ = AWC member until December 2022 and co-opted to the Working Group for the remainder of the project

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References in footnotes are not an exhaustive list of the evidence considered in the preparation of this report.

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