The reduction of the risks of spreading of infections during mass outbreak

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Possible option for causing the transmission

- *Contact between migratory birds and poultry*
- *Wind-borne spreading between farm, via dust and feathers*
- *Absence of bio security protection at farm level*
- *Contact between humans and infected birds*

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Wageningen University is leading in research on spreading of avian Influenza transmission:

- *"Estimating the Per-Contact Probability of Infection by Highly Pathogenic Avian Influenza (H7N7) Virus during the 2003 Epidemic in The Netherlands" (2012)*
- *"Avian influenza transmission risks: Analysis of biosecurity measures and contact structure in Dutch poultry farming" (September 2012)*
- *"Modelling the Wind-Borne Spread of Highly Pathogenic Avian Influenza Virus between Farms" (February 2012)*
- *"Genetic Data Provide Evidence for Wind-Mediated Transmission of Highly Pathogenic Avian Influenza" (March 2013)*

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FLI Research shows new insights on responders as carrier of the virus

- *Research based on data collected during the H7N7 outbreak in Holland, Belgium and Germany, 2003*
- *The intensity of the contact between humans and infected carcasses is similar for all large-scale culling methods*
  - *By electrocution and container gassing, the culling process is labour intensive; the disposal process is labour extensive*
  - *By stable gassing, the culling process is labour extensive, the carcass disposal process is labour intensive*
- *Regardless the labour intensity of the culling and disposal processes, all operations demand the same numbers of responders*

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FLI Research based on large-scale H7N7 outbreak in 2003

- *Why became so many poultry farms infected so quickly?*
- *Why did it take 10 weeks to stop the outbreak?*
- *Why were only a very small number backyard farms infected?*
- *What is the role of poultry workers in the distribution of the virus?*
- *What lessons can be learnt?*

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What we do know is that large-scale culling contributed to the spreading

All current culling techniques were developed during the outbreak in Holland without prior testing:

- *Stable gassing with CO2 en CO*
- *Container gassing*
- *Electrocution (waterbath method)*

Because of its labor intensity, large-scale culling most likely contributed to the intensity of the outbreak

***Responders became spreaders** of the virus: **50%** of all responders showed antibodies and most likely became carrier of the virus*

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Each farm type needs specific culling method

Labour intensive farms were culled using container gassing and electrocution

- *Layers*
- *biological farms*
- *(grand)parent stock*
- *breeders*
- *ducks*

Labour extensive farms were culled by stable gassing

- *Turkeys*
- *Broilers*
- *Pullets*

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All culling methods are extremely labour intensive

- *Poultry was caught or taken out of the cage by hand and carried out to the culling equipment outside the house*
- *Large packages of gas bottles, containers, power generators, frond loaders etc, needed to be in place before the culling procedure could start*
- *In case of stable gassing, large numbers of responders needed to enter the infected house and take out the carcasses and bring these to the disposal containers*

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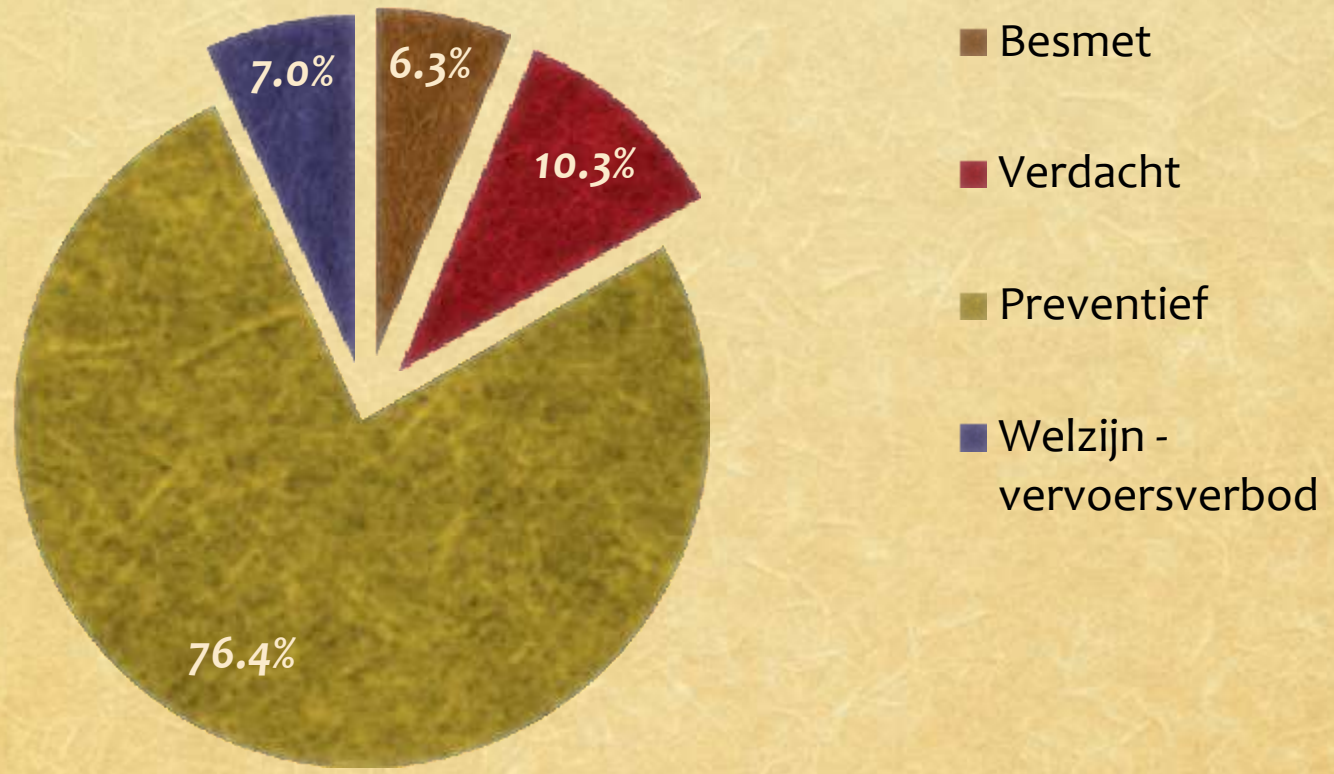
Dividing culling operations on 1.134 farms (based on locations)



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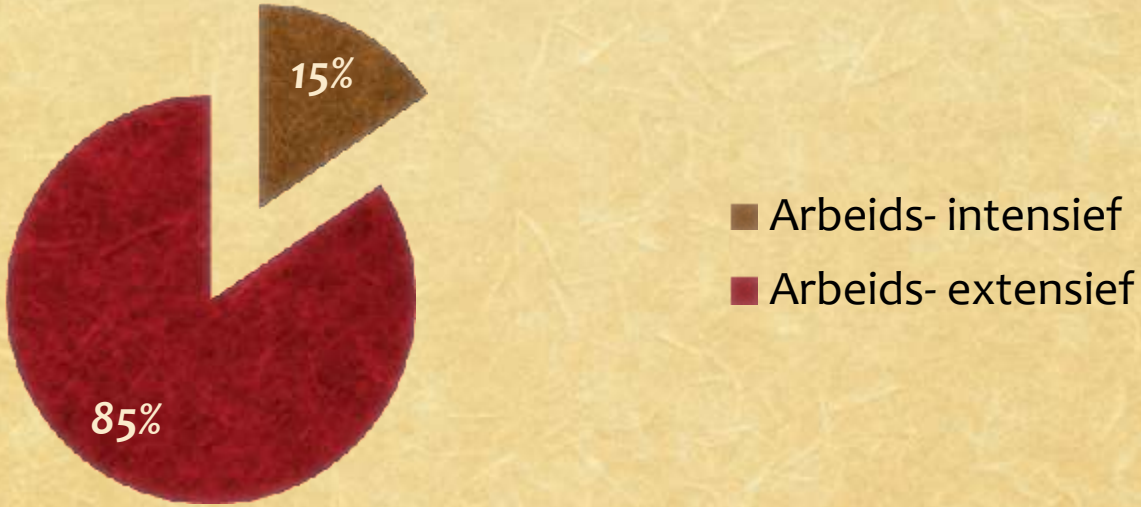
Dividing Infected and suspected numbers of animals
culling on labour intensive farms versus stable gassing



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Dividing Infected and suspected numbers of farm locations
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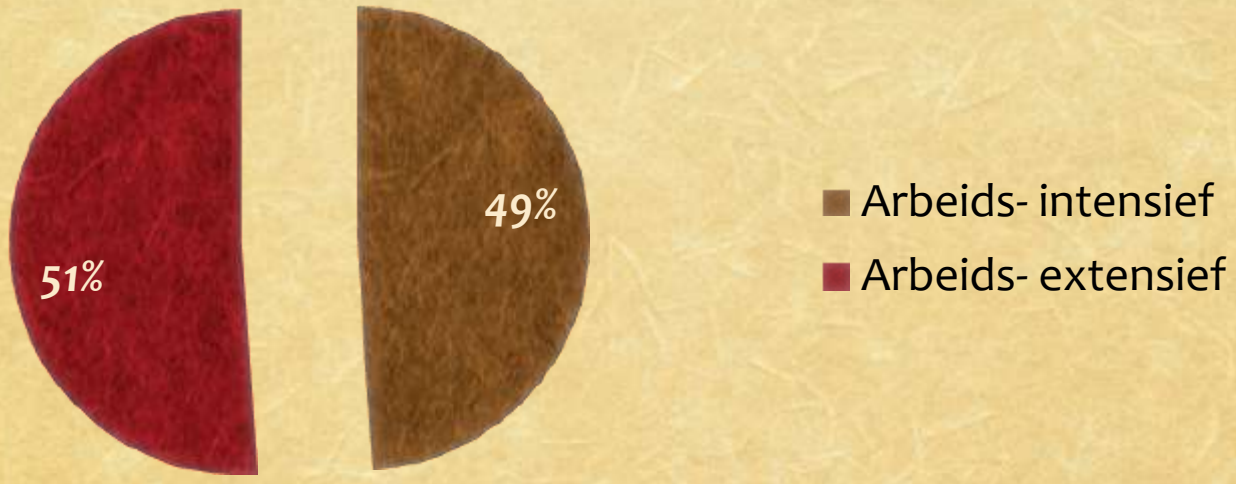

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Dividing farms according to labour intensity of the farm
Full grown birds - versus young birds – versus turkeys

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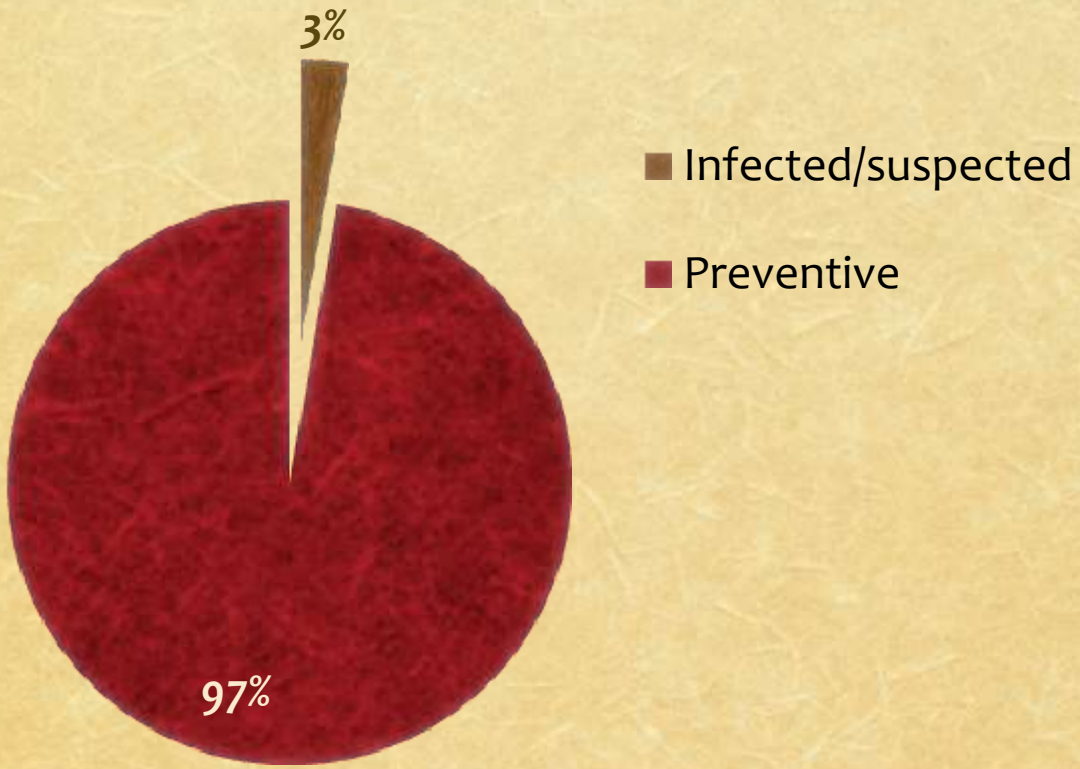
Infections under small farming (free range) and hobby farming



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The contact between humans and animals is the key transmitter of the infection

Labour intensive farms are extremely vulnerable of getting infected

- *4 727 124 of in total 29 370 427 birds were infected/suspected*
- *More than **79%** of **all farms** with the notification Infected/suspected **were labour intensive farms**, indicating that poultry workers were most likely responsible for the infection of the flocks, due to the lack of following strict bio security protocols*
- *Only **12%** of labour-extensive farms with young birds got infected, indicating that farms with a high-level of bio security and limited contact between humans and poultry are better protected against infections*
- *Only **3%** of the small Free range and hobby farms got infected, indicating that direct contact between migratory birds and poultry plays only a marginal role*

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Focus on Isolation

Instead of mass culling, the focus should be on:

- *Isolation of the complete farm, including all farm workers*
- *Preventing contact between humans and birds*
- *Disinfection of the carcasses before handling*
- *All culling techniques need to be replaced by labour extensive alternatives that exclude contact between responders and infected birds, like the anoxia method*

Question:

- *Could the Anoxia method contribute to reduction of the risks of spreading?*

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How could the Anoxia method contribute to reduction of the risks of spreading?

Research programs in process at the Friedrich Loeffler Institute FLI (Germany), together with

- *University Wageningen (Holland)*
- *University of Uppsala (Sweden)*

- *Applying the Anoxia technique on*
  - *poultry*
  - *pigs*
- *Focusing on*
  - *culling for disease control*
  - *stunning for slaughter purposes*
- *Resulting in:*
  - *Proof of Principle (animal reaction and behavior)*
  - *Proof of Practice (applying the technique)*
  - *Ground truthing (EFSA Approval process for stunning equipment)*

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Anoxia: *Never heard about it?*

- *In a plane you are instructed what to do in case the cabin pressure drops ..*
- *When climbing Mount Everest, you need additional oxygen, unless you are a Sherpa ..*
- *In case you are diving, you are instructed what to do when you dive below 30 meters ..*

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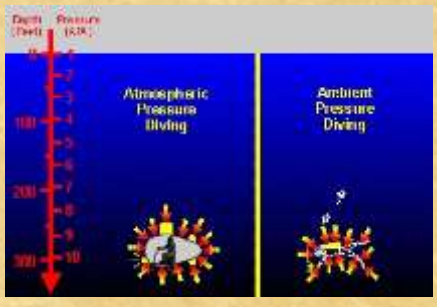
The metabolic process

- *As the altitude increases (from > 2,400 meter) atmospheric pressure decreases, oxygen levels drop*
- *At 30 meters below sea level atmospheric pressure is 4 times the normal atmosphere, leading to higher CO_2 and lower Oxygen levels.*
- *A decrease in blood oxygen level leads to relative increase of the nitrogen concentration inhaled, resulting in Hypoxic Anoxia or Nitrogen Asphyxiation*



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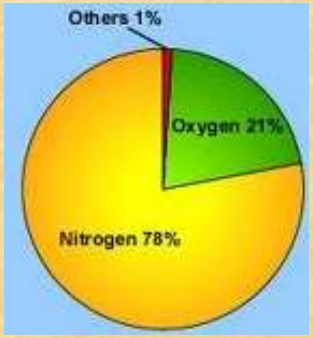
Anoxia caused by exposure to >98% Nitrogen

- ***No physical responses,*** *the air we breath consists of 78% Nitrogen, so high quantities of remain undetected ..*
- ***No stress or pain sensations,*** *on contrary; mountain climbers and divers describe Anoxia as reaching a state of positive anxiety ..*
- ***No reaction by animals*** *when they are exposed to Anoxia until the moment that they turn unconscious ..*



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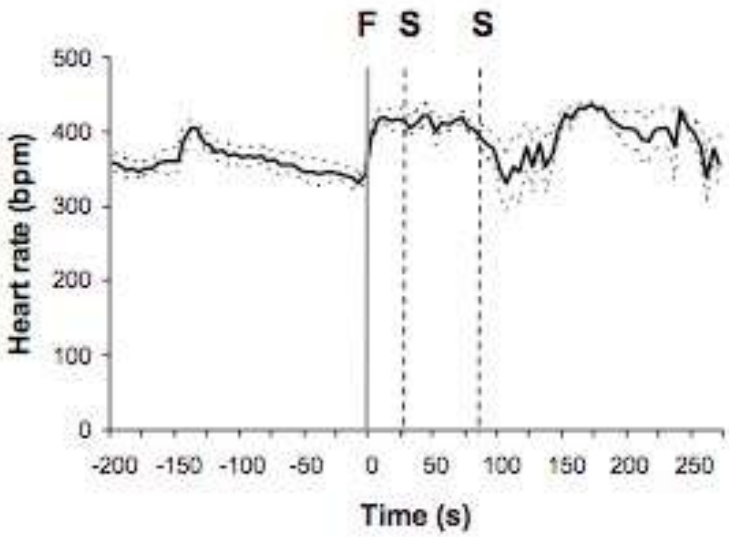
Anoxia method
Approved for culling method within the EU

- ***Proof of Principle published on May*** *2013 in Poultry Science 92:1145–1154*
  - *Reviewed/downloaded 23.150 times on N2GF.com*
- ***Main researchers***
  - *Dorothy McKeegan - College of Medical, Veterinary & Life Sciences, University of Glasgow*
  - *Marien Gerritzen - Wageningen UR, Livestock Research*
- ***Main conclusion***
  - *"These trials provide proof-of- principle that submersion in gas-filled, high expansion foam provides a rapid and highly effective method of euthanasia, which may have potential to provide humane emergency killing or routine depopulation. "*

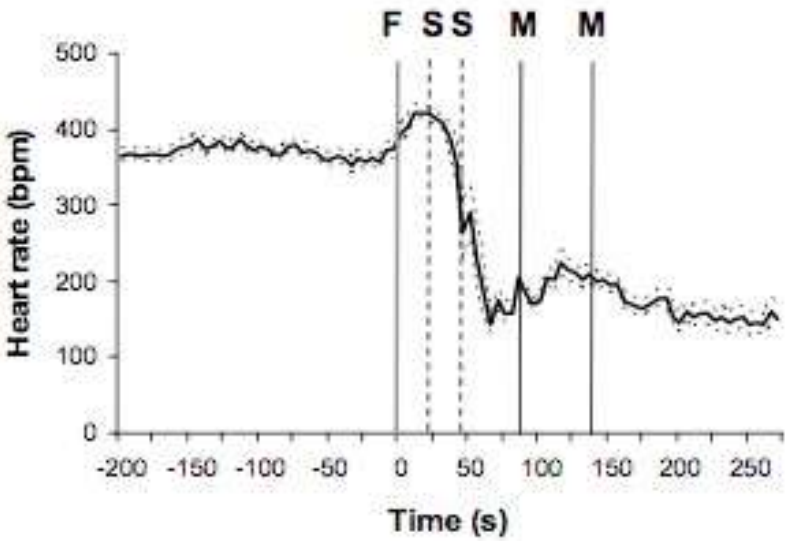
Heart rate responses

Results - heart rate responses to foam in hens

Air filled foam (control)



Nitrogen filled foam



F – Foam start **S - Submerged** **M - Motionless**

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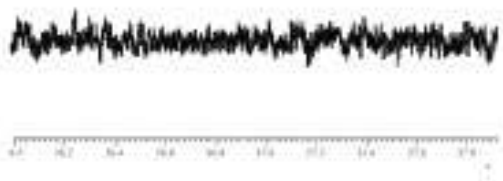
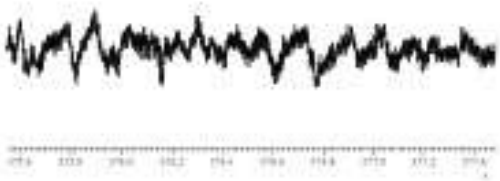
EEG responses

EEG responses to nitrogen filled foam (UK)

Baseline



Transitional



	Transitional	Suppressed	Isoelectric
Hens Mean(± SD)	9.8 ± 2.8	30.1 ± 6.8	65.7 ± 11.5
Broilers Mean(± SD)	8.3 ± 4.4	17.6 ± 3.5	46.9 ± 8.3

Time taken (s) to reach EEG phases in relation to submersion

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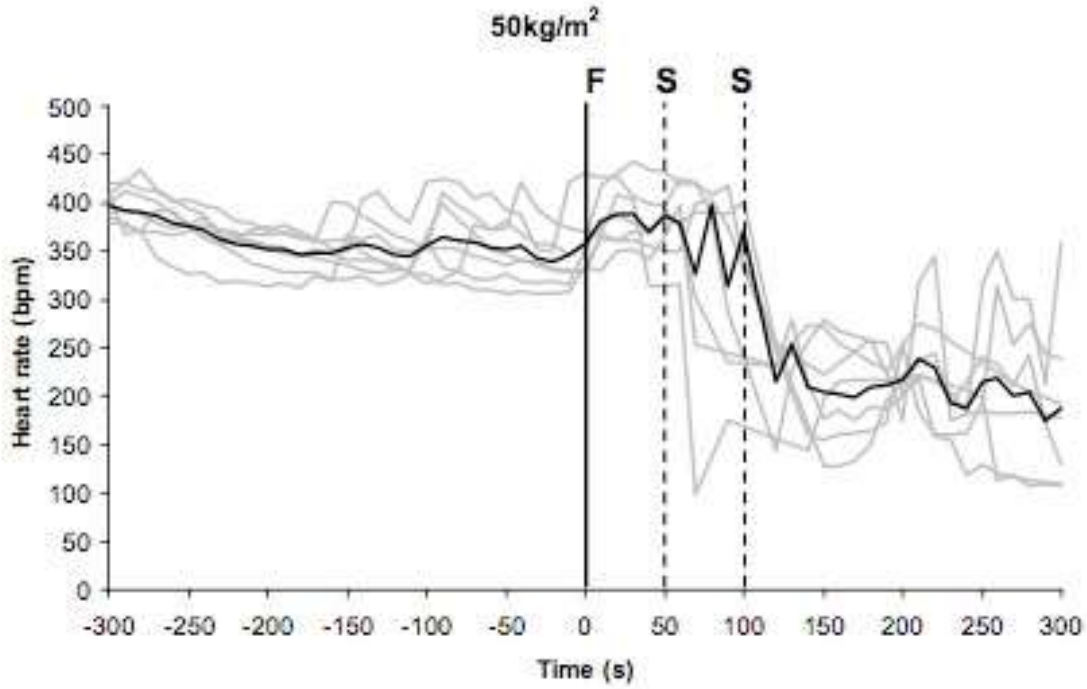
ECG responses

Group trials – ECG responses



F – Foam start

S - First and last submersion

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Behavioral responses

Behavioural responses to nitrogen foam

		Headshakes	*Ataxia/loss of posture (s)*	*Flapping onset (s)*	*Flapping bouts*	*Flapping duration (s)*	*Time to motionless (s)*
Hens	Mean ± SD	**2.0** ± 1.8	**15.5** ± 3.9	**17.8** ± 3.9	**3.9** ± 1.4	**13.7** ± 4.2	**65.2** ± 10.9
	Range	0 – 6	10 - 23	13 – 24	2 – 6	5 – 21	43 – 81
Broilers	Mean ± SD	**2.4** ± 2.1	**9.2** ± 4.0	**15.3** ± 4.7	**3.6** ± 1.0	**13.7** ± 5.5	**51.4** ± 7.6
	Range	0 – 7	0 – 14	10 – 23	2 – 5	6 – 20	40 – 64
	T test	NS	**P = 0.001**	NS	NS	NS	**P = 0.004**

Timings in relation to submersion

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Anoxia applied to culling poultry

- *High expansion foam with >98% N_2 gas*
- *Animals inhale N_2 gas without noticing*
- *No O_2 to the brain => unconscious within 15-30 seconds*
- *When taken out of the foam, slaughter within 2,5 minutes*
- *When left in the foam, dead in 3 minutes without stress or pain*

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Advantages

- *Minimal contact between animals and humans*
  - *Reducing humans becoming carrier of the infection*
  - *Reducing humans becoming infected*
- *Combination of processes handling infected poultry*
  - *Culling*
  - *Disinfection*
  - *Disposal*
- *Low-cost, scalable solutions*
- *Safeguarding Animal welfare during the entire culling operation*

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Advantages for authorities

- *Standardized solution*
- *Easy to enforce*
- *Integrated and decentralized response structure*
- *Low investment, low operational cost*
- *No external staff*
- *Low operational health and safety risks*

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Applying the Anoxia method

Small- scale euthanasia

- *Euthanasia on sick and cripple farm animals*
- *Applying large zip-lock bags*
- *Using bottled Nitrogen*

Small scale culling

- *Culling small numbers for disease control*
- *Applying disposable containers*
- *Using packages of bottled nitrogen or nitrogen generators*

Large-scale culling

- *Culling large number of floor reared poultry or caged birds*
- *Applying scissor lift technology and belt containers*
- *Using nitrogen generators*

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Small culling operations using disposable containers

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Small culling operations using disposable containers

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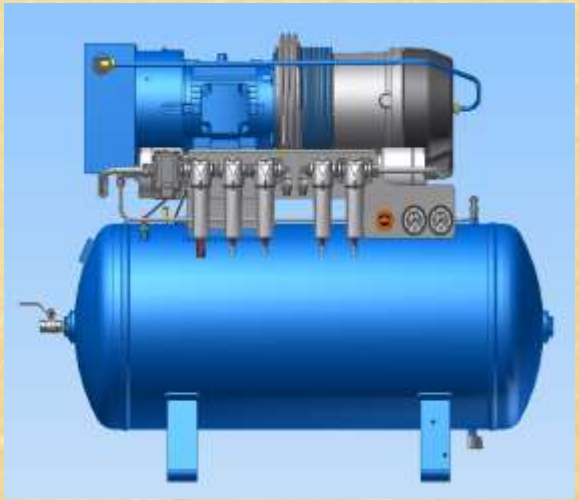
Large-scale culling equipment



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Anoxia for culling caged layers

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To conclude:

The current HPAI virus is for poultry similar to what's EBOLA is for humans

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The outbreak response focus should be on isolation instead of large-scale culling

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Culling the least numbers of birds is serving animal welfare and the economy equally

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