

<b>Institution: Royal Veterinary College (RVC)</b>		
<b>Unit of Assessment: A 6 Agriculture, Veterinary and Food Science</b>		
<b>Title of case study: Protecting public health by cost-effective modernisation of meat inspection systems throughout Europe by applying risk-based surveillance approaches</b>		
<b>Period when the underpinning research was undertaken: 2011 - 2018</b>		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Katharina Stärk	Professor of Veterinary Public Health	02/01/07 – 31/12/17
Silvia Alonso	Lecturer in Veterinary Public Health	01/02/08 – 28/02/13
Javier Guitian	Senior Lecturer in population medicine -> Professor of Veterinary Public Health	01/07/02 – present
Ana Mateus	Lecturer in Veterinary Public Health -> Senior lecturer in Veterinary Public Health	01/04/14 – present
<b>Period when the claimed impact occurred: 2014 - 2020</b>		
<b>Is this case study continued from a case study submitted in 2014? N</b>		
<b>1. Summary of the impact</b> (indicative maximum 100 words)		
<p>RVC research has led to changes in European Union legislation allowing a transformation in meat inspection (MI) systems and changes in industry practice providing human health and economic benefits. Through successfully applying risk-based surveillance approaches pioneered at the RVC to food safety, and close relationships including staff exchange with industry and regulatory bodies, the RVC has helped drive modernisation of MI systems across a range of production animal species, now being implemented through the amended regulations across the UK and EU.</p>		
<b>2. Underpinning research</b> (indicative maximum 500 words)		
<p>Traditionally, meat inspection (MI) has involved mandatory palpation and cutting into carcasses and organs as part of inspection. Although this approach is effective in detection of gross lesions indicative of some notifiable diseases and welfare conditions, it has less value in identification and has been shown to increase cross-contamination of bacterial infections (exemplified by enterobacteriaceae). Salmonella and Campylobacter are now principal public health hazards of concern in the EU and are undetectable by traditional MI. As a result, the European Commission (EC) mandated the European Food Safety Authority (EFSA) to prepare scientific opinions related to MI in different species and evaluate MI carried out under Regulation (EC) No 854/2004, to determine the most appropriate way to assess fitness of meat for human consumption and monitor for food-borne zoonotic infections in the European Union. A consortium (COMISURV) comprising Professor Katharina Stärk and Dr Silvia Alonso of the RVC for the United Kingdom and SAFOSO Inc. Switzerland, the National Veterinary Institute (SVA) Sweden, ANSES (Agency for Food, Environmental and Occupational Health &amp; Safety) France and BfR (Federal Institute for Risk Assessment) Germany, were contracted by EFSA in 2010 to support EFSA's Panel on Animal Health and Welfare (AHAW) in critically assessing animal and public health implications of any changes in current MI methods.</p> <p>Risk-based surveillance, that was originally pioneered at the RVC by Professor Dirk Pfeiffer, has been successfully applied to food safety by Stärk and Guitian. Stärk and her collaborators conducted quantitative stochastic modelling with scenario tree modelling of a number of diseases/ welfare conditions (pre-selected by EFSA) in a range of species in order to estimate the detection probability of public health hazards, together with animal welfare considerations under different MI systems. Due to lack of published data on the incidence rates of the selected diseases both at individual animal, herd-, flock- and abattoir-level, this work was based on expert</p>		

opinion and biologic features of the listed diseases and conditions. The research identified that risk-based visual only inspection was comparable to traditional methods for inspection of pigs from a variety of housing systems [1]. Other species were then studied including cattle [2], poultry [2], sheep and goats [3], farmed game [4]. This research formed the basis of a series of EFSA reports [1-4] and subsequent academic publications [5, 6]. The researchers concluded that a move to visual-only post-mortem inspection has – for the diseases and conditions considered – negligible negative impact on general case detection in countries that are free of tuberculosis and for all countries where traditional MI information is not systematically used to inform disease control efforts. They went on to conclude that with availability of additional information from the farm of origin, so called food chain information (FCI), could be used much more systematically to provide the basis of a risk-based approach to the type of post-mortem inspection applied in the abattoir.

One of the diseases detected by incising the carcass is cysticercosis. Another international research team led by Javier Guitian and funded by EFSA demonstrated subsequently that alternative inspection strategies (multiple incisions in the heart, rather than masseter muscle) could enhance public health protection and save both time and resources required for the detection of the larval stage of *Taenia saginata* (*Cysticercus bovis*) in beef [7].

### 3. References to the research (indicative maximum of six references)

1. Ellerbroek L, Mateus A, **Stärk K, Alonso S**, Lindberg A. External scientific report submitted to EFSA on the Contribution of meat inspection to animal health surveillance in Swine (2011). 80 pgs. <https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2011.EN-191>
2. Huneau A, Le Bouquin-Leneveu S, Dia M, Mateus A, **Stärk K, Alonso S**, Ellerbroek L, Lindberg A. External scientific report submitted to EFSA on the Contribution of meat inspection to animal health surveillance in Poultry (2012). 131 pgs. <https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2012.EN-287>
3. **Hardstaff J**, Nigsch A, **Dadios N, Alonso S**, Lindberg. External scientific report submitted to EFSA on the Contribution of meat inspection to animal health surveillance in Sheep and Goats (2012). 142 pgs. <https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2012.EN-320>
4. **Dadios N, Hardstaff J, Alonso S, Stärk K**, Lindberg A. External scientific report submitted to EFSA on the Contribution of meat inspection to animal health surveillance in Farmed Game (2012). 218 pgs. <https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/sp.efsa.2012.EN-323>
5. **Stärk KDC, Alonso S, Dadios N**, Dupuy C, Ellerbroek L, **Georgiev M, Hardstaff J**, Huneau-Salaün A, Laugier C, Mateus A, **Nigsch A**, Afonso A, Lindberg A. (2014) Strengths and weaknesses of meat inspection as a contribution to animal health and welfare surveillance. *Food Control*. 39:154–162. <https://doi.org/10.1016/j.foodcont.2013.11.009>
6. Huneau-Salaün A, **Stärk KD, Mateus A**, Lupo C, Lindberg A, LE Bouquin-Leneveu S. (2015) Contribution of Meat Inspection to the surveillance of poultry health and welfare in the European Union. *Epidemiology & Infection*. 143(11):2459-72. <https://doi.org/10.1017/S0950268814003379>
7. **Chengat B**, Marshall L, **Crotta M, Gilbert W, Johnson JC**, Alban L, **Guitian J**. (2018) Risk-based inspection as a cost-effective strategy to reduce human exposure to *Cysticercus bovis* in low-prevalence settings. *Parasites & Vectors*. 11(1):257. <https://doi.org/10.1186/s13071-018-2839-z>

### Other Quality Indicators

Katharina Stärk had an international role as President of the European College for Veterinary Public Health until 2009 and was Director at SAFOSO, Bern, Switzerland 2010-2019, which provides internationally-active consultancy in the fields of food safety and public health. Her growing reputation for research informing policy on risk surveillance led to her being invited to lead the UK's contribution (from her position at RVC) to the European consortium responding to EFSA's call for academic assessment of the risks of modernising meat inspection. Further endorsement of Professor Stärk's ability to undertake research to inform risk-based surveillance systems was evident at the time from award of contracts for her to lead research commissioned by DEFRA to develop of a generic approach to evaluate animal health surveillance systems in Great Britain (SE4302; GBP267,000; 2010-12).

The quality of RVC's risk analysis and surveillance expertise in general is evident from its leadership of the EU Government funded consortium RISKSUR (310806 FP7-KBBE-2012-6; EUR3,000,000; 2012-2015 - Pfeiffer & Guitian were investigators) and, more recently the award of an OIE collaborating centre in Risk Analysis and Modelling (2019-2024), joint with APHA.

Ana Mateus, a protégé of Stärk, was employed during her post-doctoral period at SAFOSO and then recruited to a lectureship at the RVC continuing her development under Stark's mentorship. She has progressed to senior lecturer and the value of her expertise in informing public health policy is evident by repeat consultancy contracts funding her to work with Public Health England.

The quality of RVC's policy-oriented food safety research is highlighted by the recruitment of Milen Georgiev, immediately after completion of a 3-year training period July 2012 – April 2015 at the RVC as Veterinary Public Health Resident, by the Food Standards Agency (FSA) where he is Team Leader in Meat Hygiene Policy.

Professor Guitian was the only academic member of a delegation to China in 2016, led by the UK's Chief Veterinary Officer, to discuss potential future exports of UK meat.

Reference 5, published in the internationally prestigious journal *Food Control*, was in the top 10% for its field based on the field weighted citation indices.

#### 4. Details of the impact (indicative maximum 750 words)

It is widely recognised that traditional MI is outdated and expensive to undertake for animals reared in many countries under conditions where diseases it was designed to detect are either of extremely low prevalence or absent [a, b]. Furthermore, systematically incising into carcasses on a slaughter line significantly increases the risk of cross-contamination of important food-borne pathogens (e.g. *Campylobacter* and *Salmonella*) of public health importance which are not detectable by traditional methods and which may not be associated with disease in the animals [a, b]. Traditional MI also results in injury to the inspectors from incising the carcass; minimising the number of incisions made could only reduce the incidence of such injuries to personnel working in abattoirs [b]. For these reasons, public health researchers throughout Europe, including Stärk and colleagues from the RVC, had advocated with EFSA for a more modern risk-based surveillance approach to MI. This resulted in the commissioned work described above. In parallel work commissioned by FSA, the theoretical benefits of visual only MI, proposed by Stärk and others were validated by experimental study undertaken by Scotland's Rural College between 2011 and 2012 ([Tongue et al., 2013](#)) [a].

Systematic evaluation of MI systems, carried out by RVC researchers and their collaborators, has underpinned a transition from conventional systems (which involve mandatory palpation and incision of specific organs and parts of the carcass) to a risk-based approach whereby a solely visual inspection is used for high health status animals. In October 2011, the EFSA adopted a Scientific Opinion on the public health hazards to be covered by inspection of meat (swine) ([ESFA, 2011](#)), which concluded that the required palpations and incisions in post mortem inspection involve a risk of cross contamination with bacterial hazards. In this document, the BIOHAZ Panel acknowledged members of the Working Group on the public health hazards to be covered by inspection of meat from swine, including Katharina Stärk, for the preparatory work on this scientific opinion. Stärk and colleagues' research subsequently helped stimulate changes to legislation, which have allowed risk-based visual inspection of all pigs since June 2014 (Commission Regulation (EU) No 218/2014 and 219/2014 [c]), and increased flexibility for risk-based visual meat inspection of other species since December 2019 (Official Controls Regulation (EU) 2017/625 and Commission Implementing Regulation (EU) 2019/627 [d]) [a, b].

Although visual inspection of fattening pigs housed under controlled conditions in integrated production systems since weaning has been permitted since 2004, in countries that use a variety of indoor and outdoor production systems (such as the UK, Spain and Italy), uptake of this option was reported to be low [a, b, e] almost certainly because pigs from different production systems were processed within the same abattoir and not differentiated, hence traditional MI methods generally continued for all pigs.

The European Commission report that, as a result of the introduction of Commission Regulation (EU) No 219/2014, a substantial number of Member States and slaughterhouses placing their meat on the EU market have now replaced traditional inspection with visual only, including local smaller slaughterhouses [a]. The EU is the world's second biggest producer of pork next to China. European Parliamentary Research Service (EPRS) reported that in 2016, 260,000,000 pigs were slaughtered in the EU (EPRS, 2020). Preliminary data from the Risk-based meat inspection and integrated meat safety assurance (RIBMINS) COST Action Network, which is collecting information about the impact of Regulation 218/2014, showed that 19 of 26 respondent representatives of European Member States stated that visual inspection has been implemented in swine, either partially or fully, in their country [f]. The impact of the changes varies with country due to variability in husbandry systems used and the proportion of abattoirs exporting to countries requiring traditional inspection. Data have been gathered from UK, Denmark, Spain and Italy to provide examples of the impact on the pig meat industry of the 2014 legislative change, and are detailed in Table 1 and below. These 4 countries account for 38.9% of pigs in the EU-28 pig herd in 2018 (EPRS, 2020).

Table 1. The total number of pigs estimated be inspected by visual only MI per annum by corroborating sources in the UK, Spain, Denmark and Italy in 2020 [a, b, e, f, g]

Country	Total number of pigs slaughtered	Estimated % inspected visually	Number of pigs estimated to be inspected visually
UK* [a, b, e]	9,000,000	10-25%	900,000–2,250,000
Denmark [f]	16,000,000–18,000,000	“the vast majority”	16,000,000
Spain** [e]	>50,000,000	varies between region	>20,000,000
Italy*** [g]	12,000,000	75%	9,000,000

\* Conservative estimates suggest 10-15% of pigs slaughtered in the UK are now visually inspected, and this proportion is slowly increasing [e]; other estimates suggest 20-25% of UK pig inspection is now visual only [b]

\*\*Estimated from data collected from Catalunya, Aragon and Murcia by AVESA council members and assuming the experience from the 3 regions surveyed is similar in other large pork-producing Spanish regions, and that traditionally raised Iberian pigs still undergo traditional MI [e].

\*\*\*100% visually inspected in Northern Italy; pigs in Southern Italy are traditionally inspected [g].

The implementation of full visual-only inspection in Denmark has enabled the number of meat inspectors to be reduced by 1 person, on each line and each shift, which is estimated to have resulted in a saving of approximately EUR3,000,000 [11-2020] per year [f]. The numbers have been further reduced by 1 extra person if the abattoir has modified the slaughter line enabling concurrent inspection of the red offal (lungs, heart) above the green offal (intestines) [f]. Moreover, the research led to a change in paradigm from gross pathology to microbiology when assessing lesions in carcasses, estimated to save an additional EUR3,000,000 [11-2020] annually by reducing food waste and associated climate impact [f].

As a direct result of RVC's research, the Italian Ministry of Health financed a project to test and compare risk-based visual inspection and traditional MI in Northern Italy [g]. Findings showed the risk-based visual protocol had the same, or better, performance as traditional inspection, and was not deemed to be a particular risk to public health or animal health and welfare. As a result, in 2016, the Ministry of Health adopted visual only inspection in the industrial slaughterhouses in Northern Italy [g].

COMISURV's initial work undertaken in other production animal species was also instrumental in more recent regulatory changes [d] that enable flexibility for risk-based visual inspection of all other species slaughtered for human consumption since December 2019. As FCI and inspection results are increasingly available, this will promote a further shift towards visual only inspection in other species in future [b]. Other RVC research regarding inspection of cattle for *C.bovis*, (a zoonotic tapeworm) also contributed to this change. In 2018, upon request of the FSA, Professor Guitian presented the findings of the studies on bovine cysticercosis (*T. saginata*) to the European Union Committee for official control regulations. Previous legislation required 2

incisions in the masseter muscles of any bovine >6 weeks of age. RVC's evidence of low prevalence of *C. bovis* in young animals has raised the age at which incisions are required to 8 months, and 20 months if raised in indoors in a country free of bovine TB [a, d]. Many bull calves are slaughtered for meat <20 months of age and this change is likely to impact on the value of the carcass. For example, in Denmark in 2016, 70% of the 315,000 bull calves were slaughtered before they reached 12 months of age and a further 27% were slaughtered between 12 and 24 months of age [f].

**5. Sources to corroborate the impact** (indicative maximum of 10 references)

*All corroborating evidence has been submitted with this impact case study.*

a. Letter from European Commission corroborating the role of Stärk and colleagues' research in stimulating changes to EU legislation allowing increased risk-based visual meat inspection.

b. Letter from Food Standards Agency corroborating the role of Stärk and colleagues' research in stimulating changes to EU legislation allowing increased risk-based visual meat inspection and impact of these in the UK.

c. Commission Regulation (EU) No 218/2014 and Commission Regulation (EU) No 219/2014 corroborating changes to risk-based visual inspection of all pigs since June 2014

<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1569332907453&uri=CELEX:32014R0218>

<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1569332862338&uri=CELEX:32014R0219>

d. Regulation (EU) 2017/625 and Commission Implementing Regulation (EU) 2019/627 corroborating increased flexibility for risk-based visual meat inspection of other species since December 2019.

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02017R0625-20191214>

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R0627-20210101>

e. Letters from Eville and Jones corroborating impact of the 2014 legislative changes on pigs slaughtered in the UK and Spain.

f. Letter from Danish Agriculture and Food Council corroborating impact of the 2014 legislative changes on pigs slaughtered in Denmark and data from the RIBMINS project.

<https://ribmins.com/wp-content/uploads/2020/10/RIBMINS-Conference-2020-Book-of-Abstracts.pdf>

g. Letter from University of Parma corroborating impact of the 2014 legislative changes on pigs slaughtered in Italy.