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RIBMINS

Risk-based meat inspection and integrated meat safety assurance

Salmonella in the pork production chain in the EU

Silvia Bonardi | 4-Feb-21 | Virtual Training School

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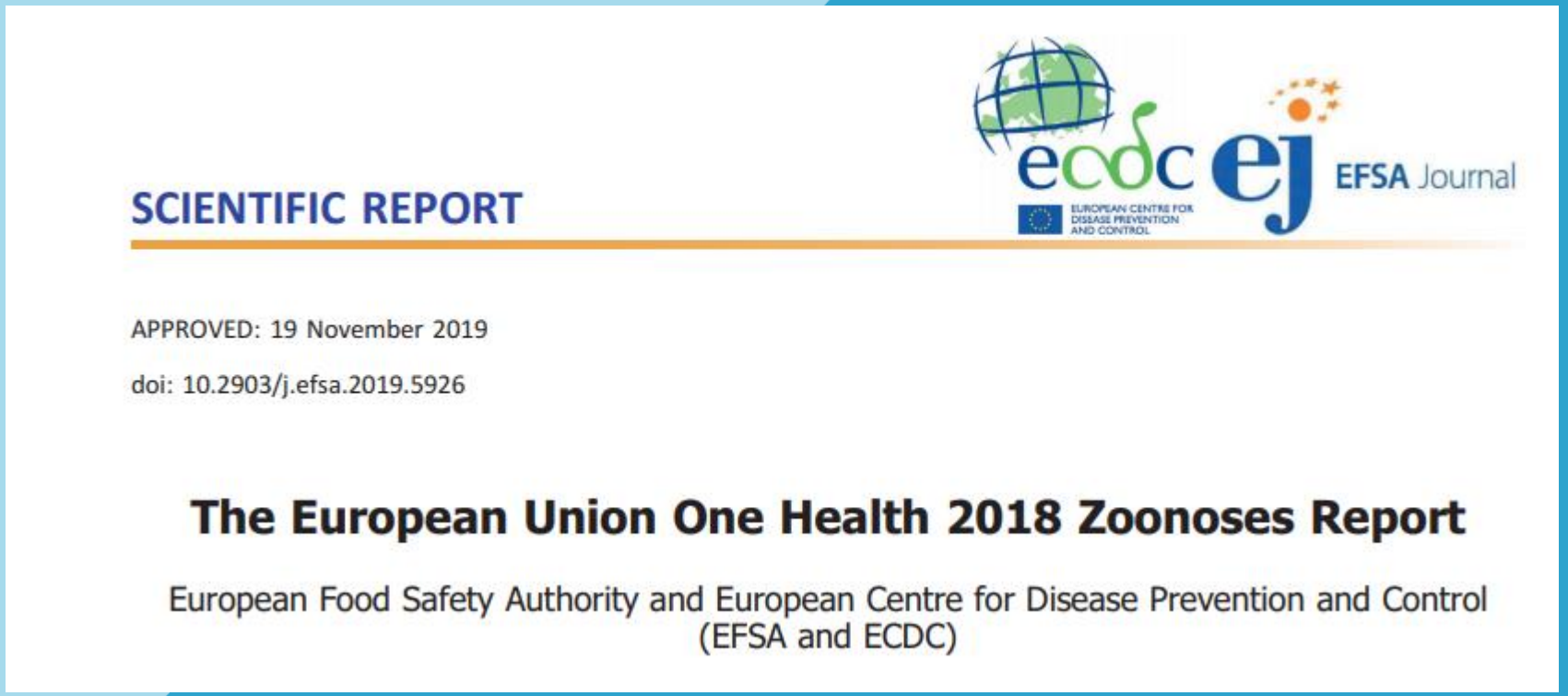
Salmonellosis in the EU



SCIENTIFIC REPORT

ecdc EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL

ej EFSA Journal

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The European Union One Health 2018 Zoonoses Report

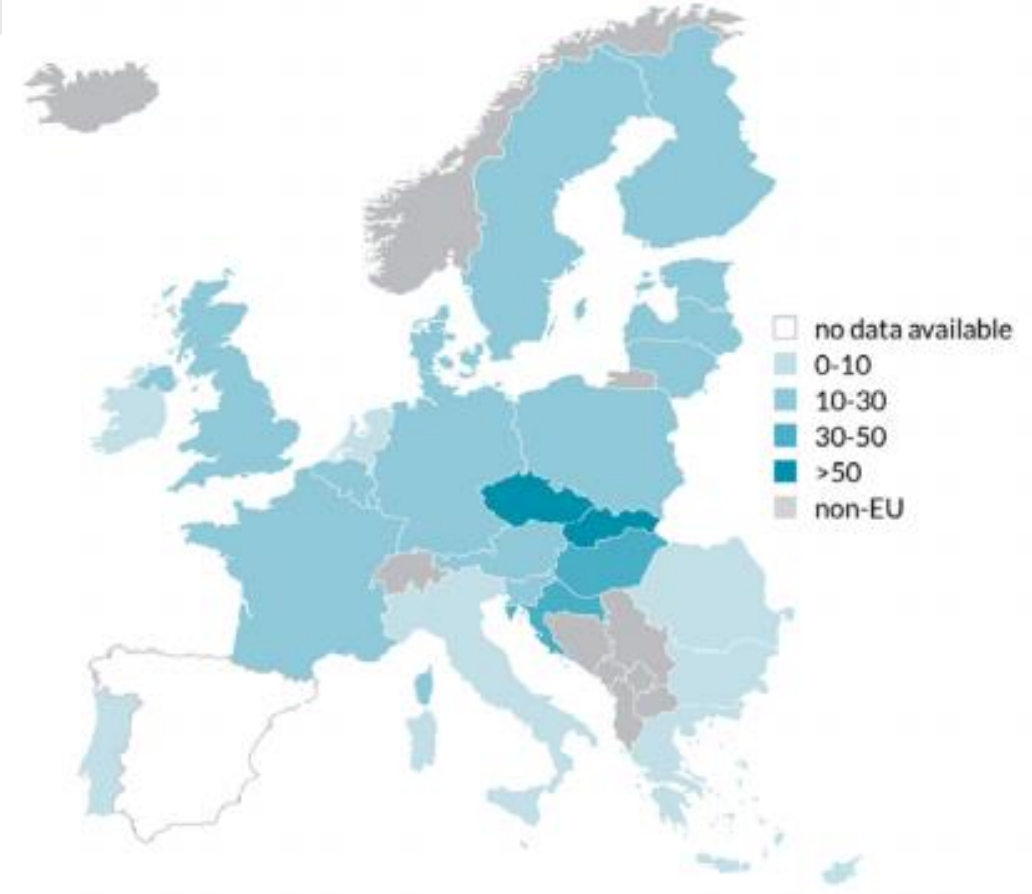
European Food Safety Authority and European Centre for Disease Prevention and Control (EFSA and ECDC)

Human cases of salmonellosis

Salmonella is the second most common food-borne pathogen in humans in the EU

Notification rate:

20.1 cases/100,000 in 2018



Top-5 *Salmonella* serovars in humans

Serovar	2018			2017			2016		
	Cases	MSs	%	Cases	MSs	%	Cases	MSs	%
Enteritidis	32,727	24	60.9	32,262	25	61.2	26,781	23	57.1
Typhimurium	7,410	25	13.8	6,806	25	12.9	6,725	23	14.3
Monophasic Typhimurium 1.4.[5].12:i:-	2,553	23	4.7	2,096	22	4.0	2,688	21	5.7
Infantis	1,221	23	2.3	1,163	22	2.2	1,099	21	2.3
Derby	414	19	0.8	295	18	0.6	372	17	0.8
Newport	411	18	0.8	383	19	0.7	316	16	0.7
Other	9,047	–	16.8	9,724	–	18.4	8,938	–	19.0
Total	**53,783**		**100.0**	**52,729**	**26**	**100.0**	**46,919**	**24**	**100.0**

Source(s): Twenty-five MS; Austria, Belgium, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

EFSA Journal 2019;17(12):5926

Salmonellosis in pigs

- The role of pigs as carriers of *Salmonella* has been intensively studied both on farm and at slaughter

- host-restricted serovars : *S.* Typhisuis (typhoid-like disease)
- host-adapted serovars: *S.* Choleraesuis (systemic disease)
- ubiquitous serovars: *S.* Typhimurium and many others

Swine paratyphoid

- *S.* Typhisuis and *S.* Choleraesuis
- severe systemic disease, often fatal

- *S.* Choleraesuis variant Kunzendorf
- Isolated worldwide during the 1950s and 1960s
- Reappeared in Danish herds from 2012 to 2013
- high mortality (20–30%) among 7–50 kg pigs

Infections by ubiquitous serovars

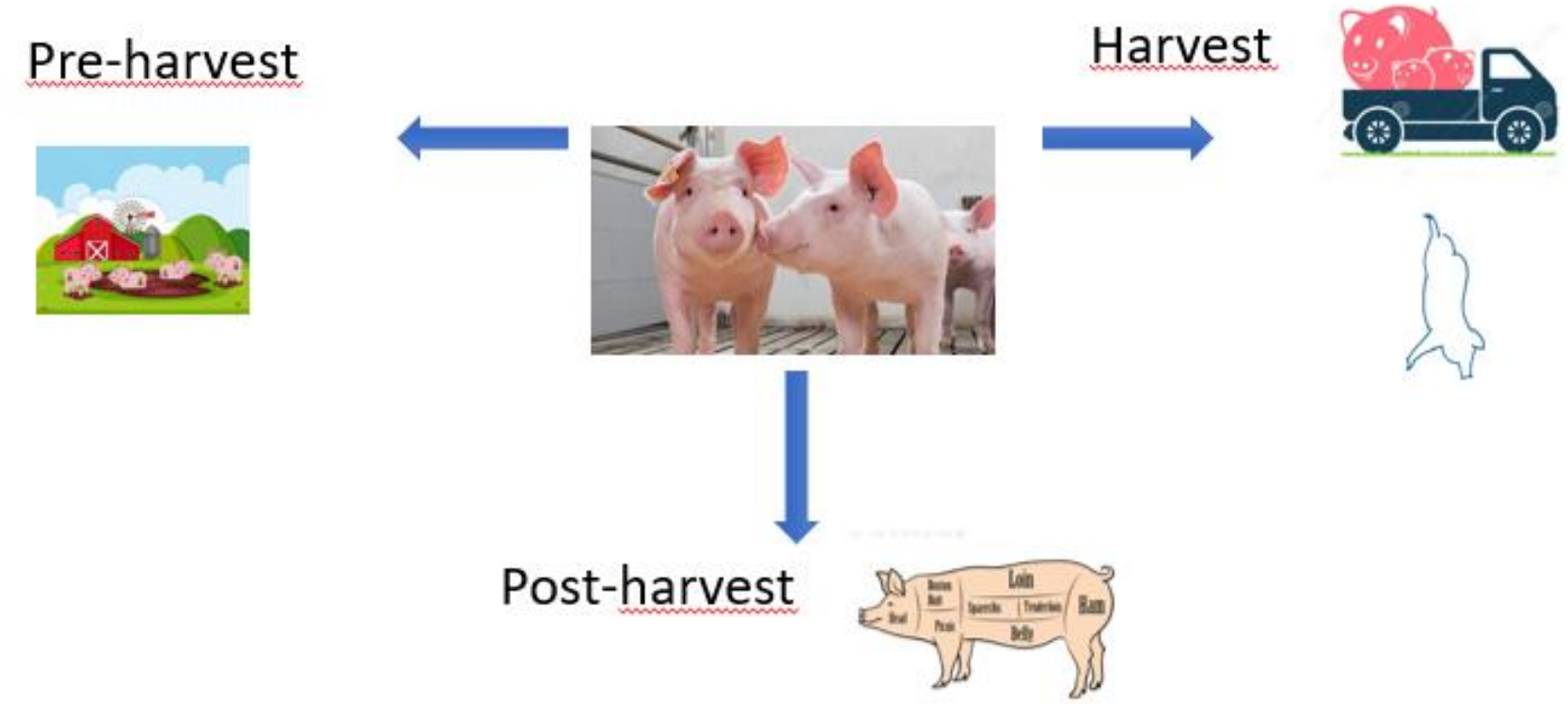
- Commonly seen in pigs 3 weeks-3 months of age
- Rare in suckling pigs
- Incubation period: generally 1-5 days

- Acute disease (death)
- Chronic disease (diarrhoea)
- Asymptomatic infections

Infections by ubiquitous serovars

- Most infected pigs remain healthy carriers (tonsils, gut, gut-associated lymphoid tissue)
- Pigs infected at the end of the fattening period could pose a threat to human health

The stages of the pork chain



The pre-harvest stage

- The holding period of pigs on the farm until their departure to the slaughterhouse
- Fattening pigs (65 kg and over) are generally asymptomatic carries of ubiquitous serovars
- *Salmonella*: faeces or lymph nodes

Most common serovars on pig farms in the EU

- *S.* Typhimurium
- *S.* Derby
- *S.* Typhimurium monophasic variant

In addition

S. Typhimurium var. Copenhagen, *S.* London, *S.* Infantis, *S.* Muenchen,

S. Rissen, *S.* Livingstone

EFSA Journal 2015;13(12):4329, 190

Control factors on farm

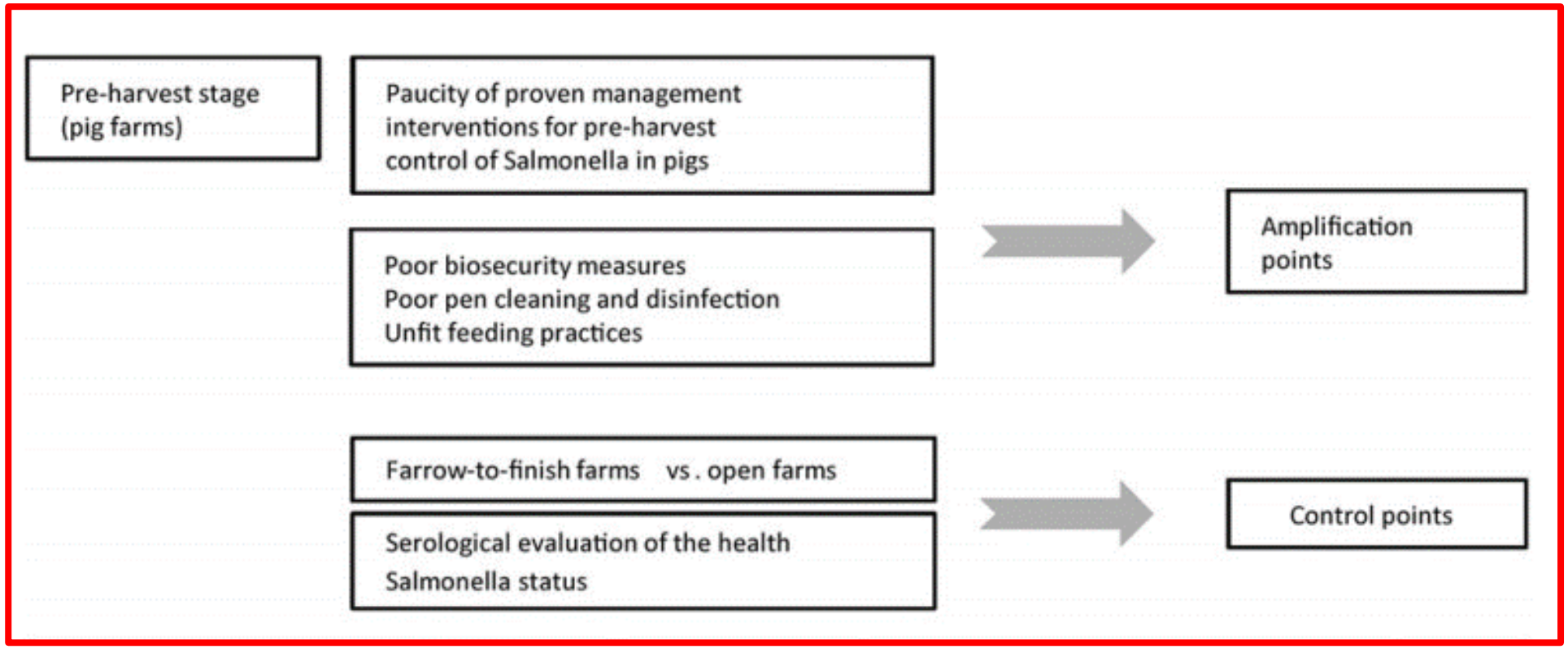
- Feeding practices
- Management procedures
- Types of herds
- Size of the herd
- Level of hygiene
- General health status of the pigs

The importance of feed

- *Salmonella*-free feed to guarantee a safer pork chain

- Wet feed *vs.* pelleted feed reduces the risk of *Salmonella* infection (fermentation step and growth of lactic acid bacteria and yeasts)

Amplification and control points at farm



Bonardi S. Epidemiol. Infect. 2017; 145: 1513-27

The harvest stage

- Transportation of the pigs from the farm
- Lairage period
- Slaughtering process
- Cooling of carcasses

EFSA Journal 2006; 341: 1–131

Salmonella during transportation and holding

Stress factors linked to

- group housing
- transportation
- holding at the slaughterhouse

might trigger *Salmonella* shedding by asymptomatic pigs

Tranportation of pigs

Stress factors:

- rough handling of pigs during loading and unloading

Tranportation of pigs

Stress factors:

- High stocking density

Tranportation of pigs

Stress factors:

- Water withdrawal

Tranportation of pigs

Stress factors:

- Poor driver skills

Holding of pigs

Prolonged stress:

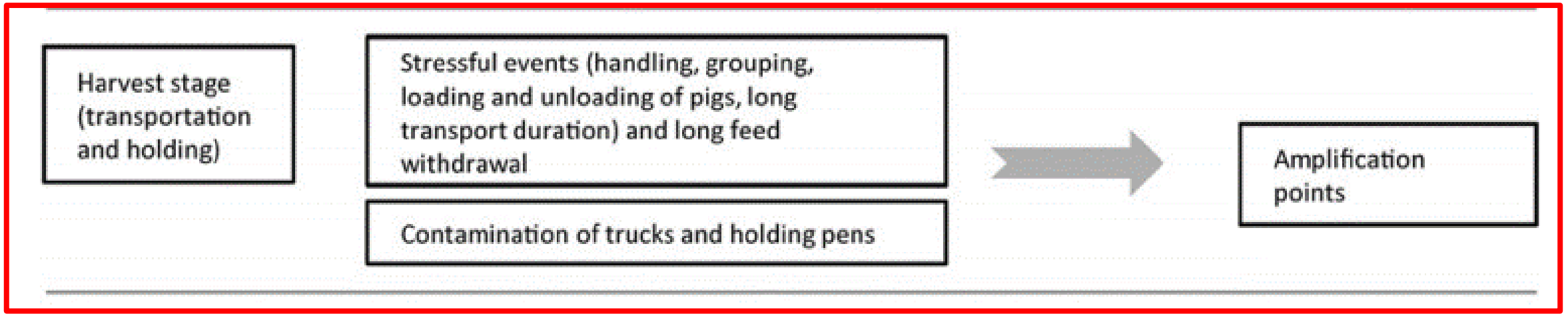
- Lairage duration influences *Salmonella* infection

For all these reasons…

Prevalence of *Salmonella*-positive pigs on farms

is commonly lower

than prevalence of positive pigs at lairage



Bonardi S. Epidemiol. Infect. 2017; 145: 1513-27

Salmonella at slaughter

- *Salmonella* is frequently isolated from mesenteric lymph nodes (MLN) and faecal samples of pigs

- *Salmonella* in MLN: the 'gold standard' for definition of the carrier state at slaughter

EFSA Journal 2006; 341: 1–131

Routes of contamination of pig carcasses

1. Related to the pig :

✓ faeces

✓ skin

2. Related to the environment:

✓ equipment (belly openers, carcass splitters)

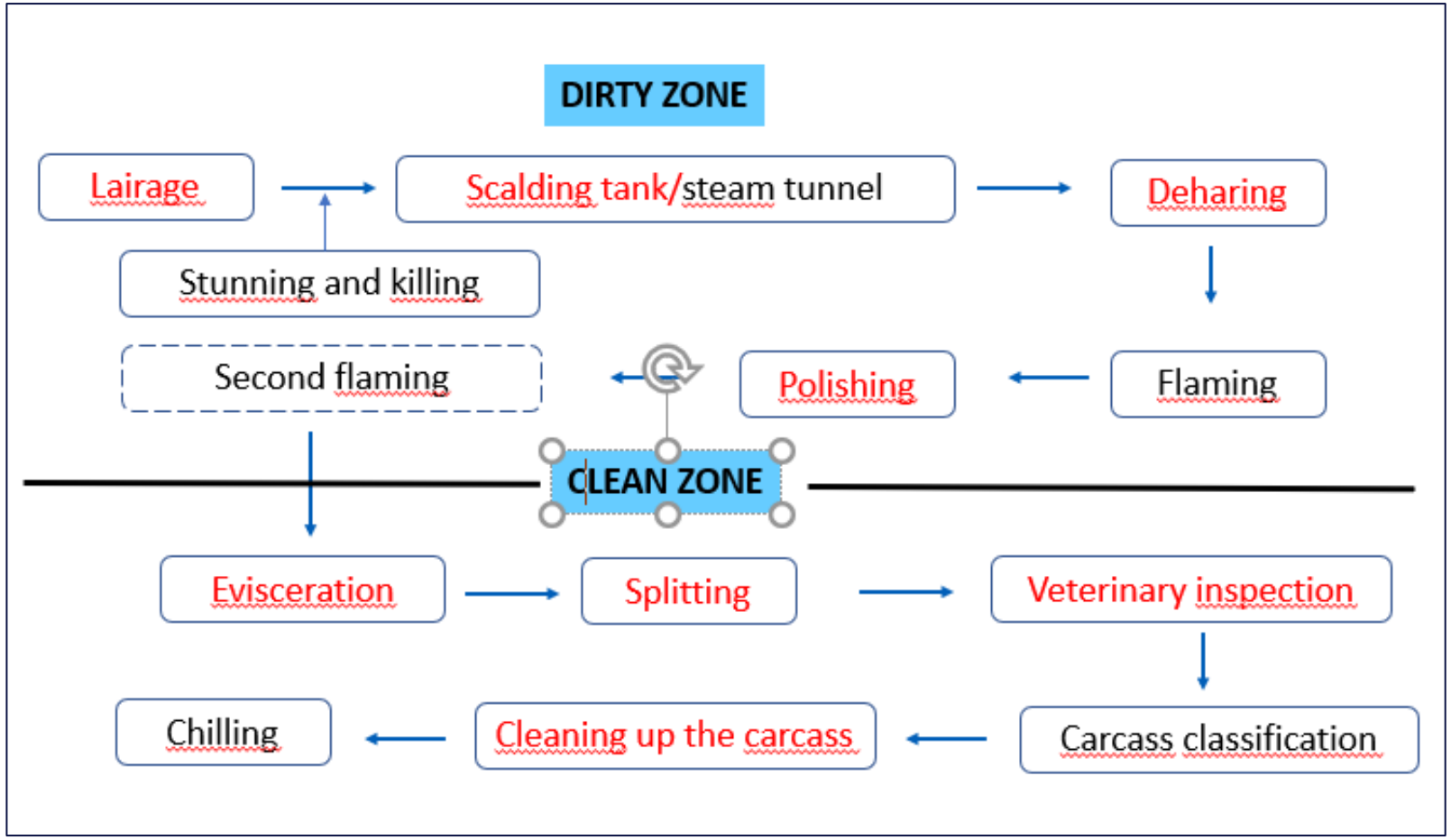
✓ workers

Prevalence of *Salmonella* in MLN, faeces and carcasses

Prevalence (%)			Country	Reference
MLN	Faeces	Carcasses		
26.0		16.0	Portugal	Gomes-Neves et al., 2012
22.0	22.0	15.0	UK	Marier et al., 2014
7.4		3.2	Denmark	Argüello et al., 2013
	23.0	5.3	UK	Davies et al., 2004
	21.5	10.9	Italy	Bonardi et al., 2013

Carrier pigs

Critical steps for *Salmonella* contamination



De Busser et al. Vet. J. 196 (2013) 20–27

Differences in carcass contamination among abbattoirs

1. N° of carrier pigs introduced to the slaughter line
2. Effective decontamination steps (dehairing and flaming; hot water)
3. Good hygienic standards
4. Cross-contamination (carcasses – equipment; carcasses)
5. Resident slaughterhouse microflora
6. Workers; veterinarians

Influence of deharing

- Failures in carcass dehairing can cause significantly higher prevalence of carcass contamination than in normal conditions

pagepress

Influence of pigskin on *Salmonella* contamination of pig carcasses and cutting lines in an Italian slaughterhouse

Silvia Bonardi,[1] Ilaria Bruini,[1]
Irene Alpigiani,[1] Alice Vismarra,[1]
Elena Barilli,[1] Franco Brindani,[1]
Marina Morganti,[2] Paola Bellotti,[2]
Luca Bolzoni,[2] Stefano Pongolini[2]

Italian Journal of Food Safety 2016; volume 5:5654

Cross-contamination between carcasses

Workers & Veterinarians

Hot water decontamination

Regulation (EC) 2015/1474

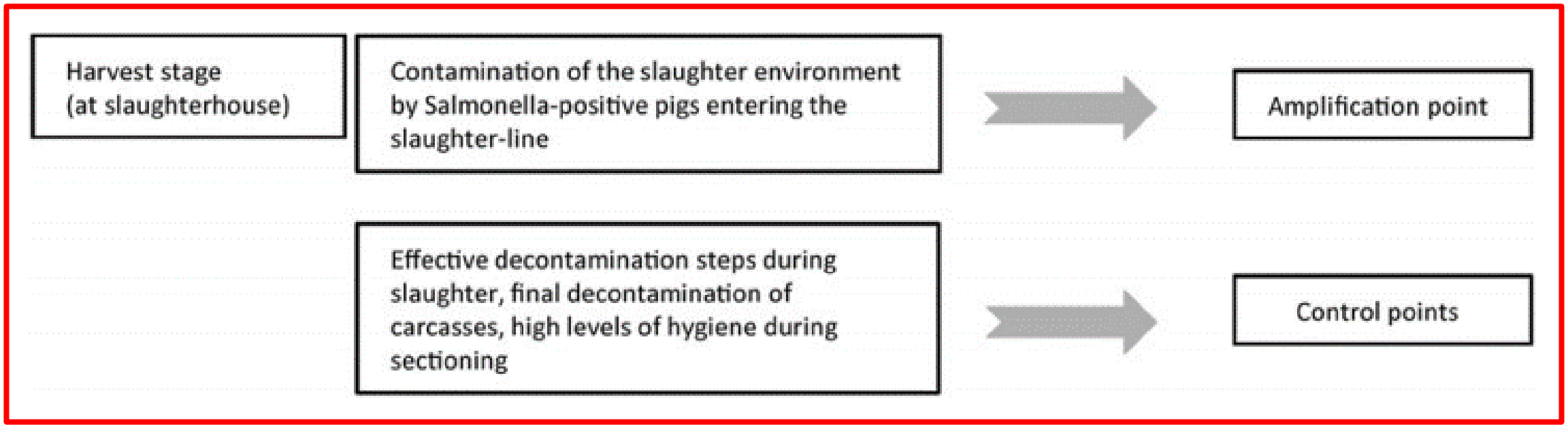
Use of hot-water to remove microbiological surface contamination from carcasses

Water at 80°C for 14-16 s

al University of Denmark

Sanco workshop february 2009

Amplification and control points at slaughter



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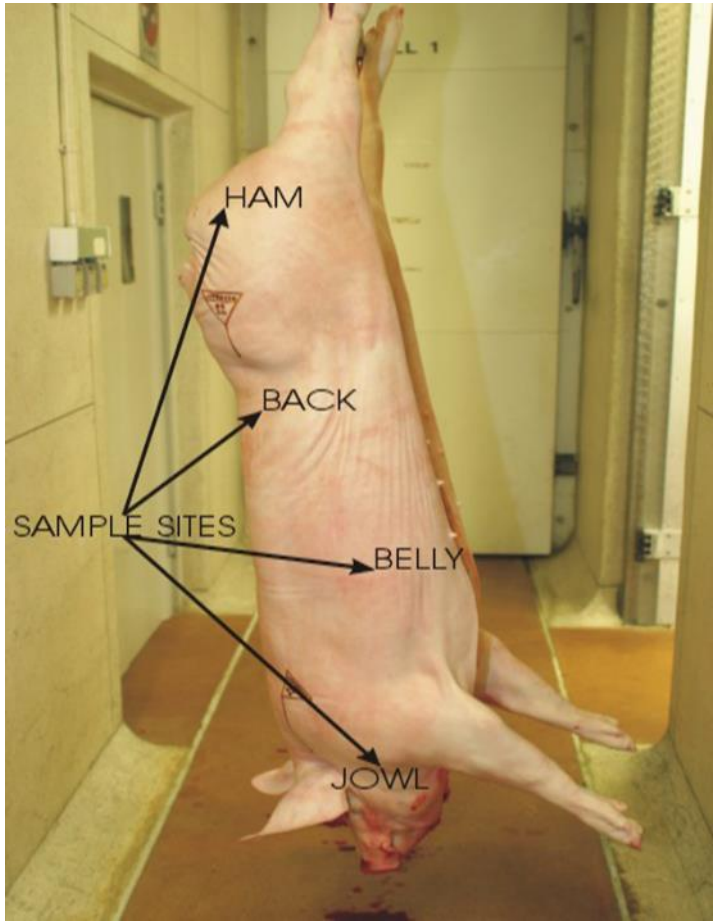
The post-harvest stage

- **Regulation (EC) No 2073/2005**

- Amended by **Regulation (EC) No 217/2014**:

  acceptable N° of *Salmonella*-positive pig carcasses: 3/50 (6%)



The post-harvest stage

- **Regulation (EC) No 2073/2005** - amended by Regulation No. 2019/229

Food category	Microorganism	Sampling plan		Limits	Reference method	Stage where the criterion applies
		N	C			
Minced meat/meat preparations to be eaten raw	***Salmonella***	5	0	Not detected in 25 g	EN/ISO 6579-1	Products placed on the market during their shelf-life
Minced meat/meat preparations to be cooked						
Mechanically separated meat						
Meat products to be eaten raw, excluding products whose manufacturing process or composition will eliminate the Salmonella risk						

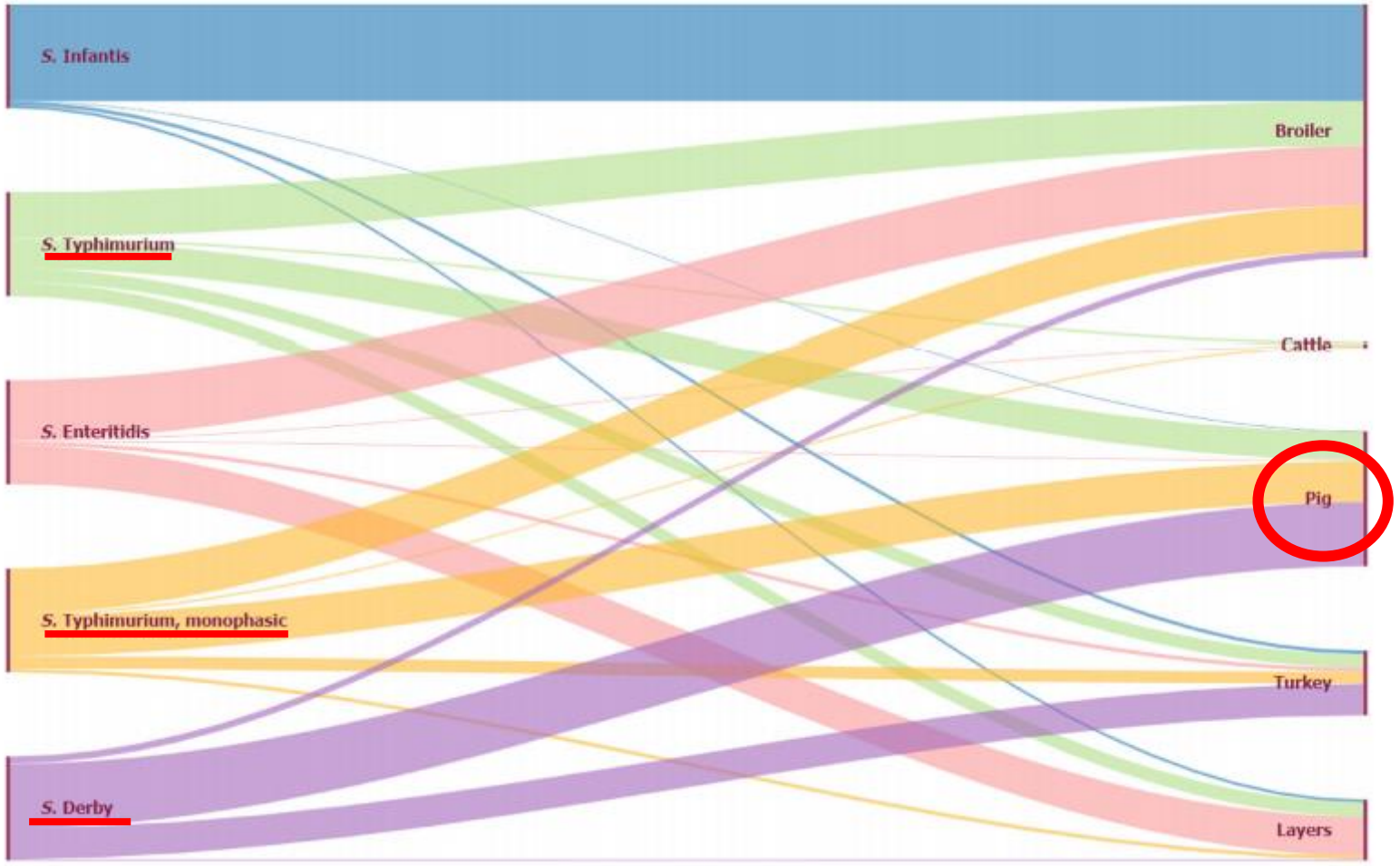
Pay attention!

As *Salmonella* is not only introduced to the slaughter line by the pigs, but can:

- persist in the slaughterhouse environment
- be acquired during transportation and holding

the serovars isolated on farm can vary widely from those isolated after slaughter

The Sankey diagram



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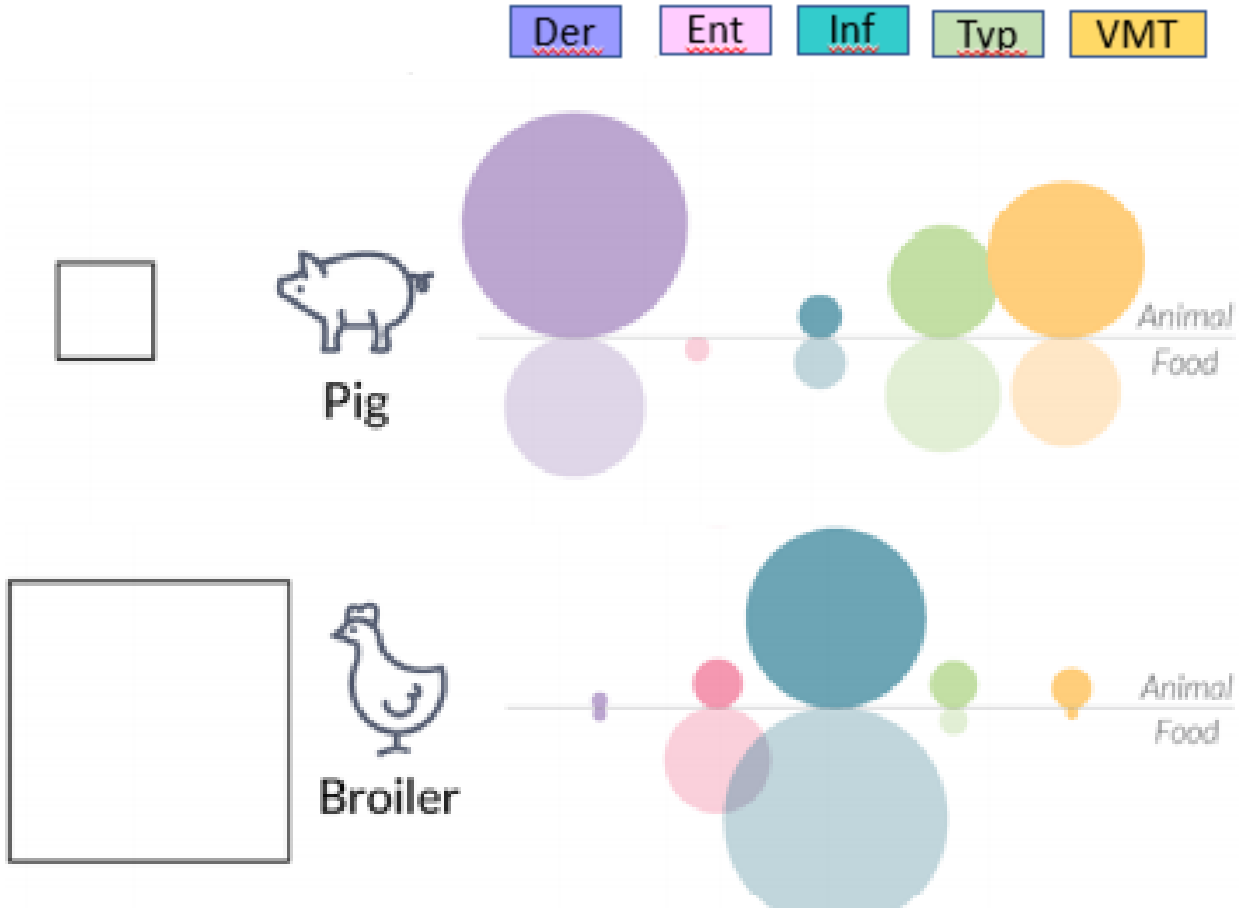
Distribution of human top-5 *Salmonella* serovars - 2018



Der — *S.* Derby

Ent — *S.* Enteritidis

Inf — *S.* Infantis

Typ — *S.* Typhimurium

VMT — *S.* Typhimurium monophasic variant

EFSA Journal 2019;17(12):5926

Conclusions

- Salmonellosis is the 2nd most frequently reported zoonosis in EU

- Among food animals, pigs are the 2nd largest contributor to human cases of salmonellosis, after laying hens

- Epidemiology of the infection in herds, distribution of *Salmonella* serovars among pigs and contamination routes at slaughter should be investigated and controlled to reduce their impact on human health.

THANK YOU!

silvia.bonardi@unipr.it

www.unipr.it

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