Danish approach to control of salmonella in cattle

Liza Rosenbaum Nielsen

Professor of Veterinary Preventive Medicine

Section for Animal Welfare and Disease Control Department of Veterinary and Animal Science Faculty of Health and Medical Sciences

6 April 2017 Uppsala

UNIVERSITY OF COPENHAGEN





Denmark



5.5 million people, 1.2 million in Copenhagen

- ~12.3 million pigs
- ~1.5 million cattle, ~540.000 slaughtered cattle, ~3000 dairy farms



Source attribution salmonella Denmark 2015

Figure 1.2. Estimated sources of 925 cases of human salmonellosis in Denmark, 2015. (See also Appendix Table A1)



Source: Danish Zoonosis Centre, National Food Institute.

ANNUAL REPORT ON ZOONOSES IN DENMARK 2015

No human cases attributed to domestic eggs and poultry in 2015 Estimated burden of salmonella disease: 348-401 DALYs – disability adjusted life years

Serotype distributions in human cases Denmark 2014-2015

Table 1.1. Top 10 Salmonella serotypes in humans and information about travel aboad, 2014-2015

2015	Number of patients (%)	% of patien Abroad ^b	ts ^a infected Domestically	2014	Number of patients (%)	% of pati Abroad ^b	ents ^a infected Domestically
Enteritidis	258 (27.9)	78.2	21.8	Enteritidis	268 (23.9)	77.2	22.8
1,4,[5],12:i:-	117 (12.6)	34.3	65.7	1,4,[5],12:i:-	230 (20.5)	12.7	87.3
Typhimurium	116 (12.5)	32.7	67.3	Typhimurium	197 (17.6)	31.2	68.8
Newport	32 (3.5)	50.0	50.0	Infantis	38 (3.4)	26.1	73.9
Oranienburg	24 (2.6)	25.0	75.0	Dublin	21 (1.9)	0	100
Infantis	21 (2.3)	53.3	46.7	Stanley	21 (1.9)	81.3	18.8
Stanley	21 (2.3)	80.0	20.0	Newport	19 (1.7)	50.0	50.0
Dublin	19 (2.1)	30.0	70.0	Virchow	18 (1.6)	77.8	22.2
0:4,5,12; H:b:-	17 (1.8)	54.5	45.5	Agona	16 (1.4)	28.6	71.4
Java	16 (1.7)	71.4	28.6	Kentucky	16 (1.4)	58.3	41.7
Other serotypes	284 (30.7)	57.8	42.2	Other serotypes	278 (24.8)	59.0	41.0
Total	925 (100)	56.6	43.4	Total	1,122 (100)	46.4	53.6

a) Patients with unknown travel information (17.3 of all patients in 2014 and 28.8 of all patients in 2014) were excluded from the percent calculations.

b) Infected abroad is defined as travel abroad in a seven-day period prior to disease onset.

Source: Statens Serum Institut.

Salmonella Dublin in humans in Denmark





Source: Steen Ethelberg, SSI – includes all cases from 1990 and up to 2015 Yellow = all cases Gray = dead within 30 days Case fatality risk close to that of listeriosis

Fresh meat surveillance at slaughter

Figure A4. Salmonella in beef, monitored at slaughterhouses^a, 2009-2015



a) For more information about the surveillance programme, see Table A36. Source: Danish Veterinary and Food Administration.

Intensified bacteriological surveillance of persistently antibody positive cattle herds 2014-2017

	Serotypes						
Herd type	Dublin	Typhimurium	Other	S_4,12:i / S_4,5,12:i:-	Negative	Total	
Beef cattle	3				12	15	
Heifer raising	2			1	7	10	
Dairy herd	76	3	3	4	263	349	
Organic dairy	8				24	32	
Fattening calves	15		1		33	49	
Total	104	3	4	5	220		
(SEGES)	(90%)	(3%)	(3%)	(4%)	339	455	

Not random sample, but not 'only passive surveillance'- see later

Bacteriological culture results from passive surveillance (clinical suspicion) 2014-2017

Serotype	Number of isolates			
Dublin	5			
Negative	12			
S_4,5,12:i:-	3			
Typhimurium	1			
Total	21			



How much 'serogroup-B' in the Danish dairy cattle?

Bulk tank milk samples tested with 2 tests at DTU-Vet in master thesis project 2015 (Acknowledgements: Elisabeth Toft)



Test results for all samples

Group D ELISA results (ODC%)

Conclusions from Elisabeth Toft's project

- Salmonella serogroup B causes to some 'misclassification' of Dublin-test-positive dairy herds
- Estimated to be 6.2-13% of the serogroup-D test-positive
- Corresponds to the bacteriological culture results from intensified surveillance
- Not possible to differentiate between serotypes based on serogroup D alone
- Not always clear distinction with two tests (B and D) either

Future – consider including more serotypes in the testing?? Currently not the plan – very few are missed.

Salmonella Dublin in cattle

- Bloody diarrhoea
- > Loss of appetite
- Depression
- Fever + dehydration
- Septic shock
- Necrotic skin and bone
- > Arthritis
- Pneumonia
- > Abortions



- Many cattle infected
 - without clinical signs





Bulk tank milk ELISA after introduction of *Salmonella* Dublin-infection in dairy herds



Milk losses related to introduction of *Salmonella* Dublin

kg ECM per day in 3 parity groups in 28 newly infected dairy herds



(Nielsen T.D. et al. JDS, 2012)

Economic consequences in S. Dublin infected dairy herds

Salmonella Dublin Simherd model estimations



Year

Economic consequences in S. Dublin infected dairy herds

Salmonella Dublin Simherd estimations based on project data





Not unusual that the gross margin drops with 100-200 Euro per cow-stall the first 2-3 years after the infection is introduced.

Large herd

- proportionally larger losses

Up to €35,000 lost annually (per 200 cow-stalls)



Surveillance programme for S. Dublin since 2002



Level 3 Salmonellosis / bacteria detected

Level 2 Test-positive BTM>25 ODC% in last 4 samples, +no jump of 20 from 3-BTM average *Or:* 8 blood samples, none above 50 ODC%

Level 1 Test-negative

- Dairy herds: 3-4 bulk tank milk antibody tests

06/04/2017

19

- Non-dairy herds: 8-10 antibody tests on blood samples
- Movements of animals
- > Locking system (3 weeks)
- Classification information <u>www.glr-chr.dk</u>







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Eradication programme since 2007

Goal:

The Danish cattle population free from *Salmonella* Dublin in 2016

Three phases

1.2007-2009 Voluntary intervention and evaluation. Projects.

2. 2010-2012

Restrictions to improve motivation

3. 2013-2016

Veterinary Authorities handle infected herds through law enforcement (regionalisation)



Target:

Eradication from the cattle population by end of 2016



Follow the development at <u>www.kvaegvet.dk</u>

Regionalisation since 2013

Regionalisation since 2015



No movement of cattle from HP to LP (except calves for fattening + slaughter) High prev-region Level 1 herds must pre-test before participating in shows

Phase 3 – intensified control

- Level 2+3 in low-prevalence region put under official veterinary supervision
 restrictions similar to Sweden
- All Level 2+3:
 - Must have a **herd-specific control action plan** Usually developed with local veterinarian/advisor **Strict movement restrictions** out of these herds No participation in animal shows
- Level 1 farms in high-prevalence regions cannot more cattle to low-prevalance region (few exceptions)
- Level 2+3 can have free second opinion and advice from SEGES

06/04/2017 25

Free, voluntary second opinion from SEGES on salmonella control in test-positive farms





Nu tror jeg på vi bliver fri for Salmonella Dublin

Poul Henrik Søgaard fik for alvor øjnene op for, hvor han og medarbejderne skal lægge indsatsen efter besøg af SEGES' salmonellaekspert.

I 2015 fik Poul Henrik Søgaard konstateret Salmonella Dublin i sin besætning, som består af 425 Dansk Holstein-årskøer. Årsagen var indkøb af en tyr, som viste sig at være smittet.

"Jeg fik med det samme lagt en handlingsplan sammen med min dyrlæge. Men jeg tog det nok ikke tilstrækkeligt alvorligt og havde ikke nok fokus på det," forklarer Poul Henrik Søgaard. Så da handlingsplanen ikke havde den ønskede effekt, foreslog hans dyrlæge, at de bestilte et gratis besøg af SEGES' salmonellakyndige dyrlæge, Betina Tvistholm.

"Betina gennemgik besætningen sammen med min dyrlæge og jeg. Og her gik det virkelig op for mig, at det er gødning, der er den helt store synder i det her spil," forklarer han.

"Og det var nok også først ved hendes besøg, at det gik op for mig, hvor alvorligt det her er – dels hvor meget det koster og dels, at vi hurtigt risikerer at hele besætningen er smittet," forklarer han.

Nye og faste rutiner



"Tag imod SEGES' tilbud om besøg," lyder opfordringen fra Poul Henrik Søgaard. "Det er gratis – der er simpelthen ingen grund til at lade være." Foto: Poul Henrik Søgaard.

På Betina Tvistholms anbefalinger har han og de seks medarbejdere nu ændret en del arbejdsrutiner og sat dem i system. Blandt andet er de 100 pct. konsekvente med kun at flytte dyr i hold. Og de har helt faste rutiner omkring rengøring og desinfektion af især kalvebokse og hos opstarterhold.

Phase 3 – intensified testing

After 1 year in Level 2 (test-positive in surveillance)

- Effect of control actions must be documented
- 8 samples from the youngest calves >3 months old every 3 months
- If test-positive calves -> bacteriological culture Calves, high-risk animals + slurry
- If culture positive -> Level 3 (economic consequences due to movement and slaughter restrictions)

.....

Regional development of test-positive dairy herds (Level 2+3)



Non-dairy herds - surveillance based on the last 8 blood samples (ELISA – cut-off 50 ODC%)



National prevalence is declining

25% -> 7-8% test-positive dairy herds from 2003 to 2016 42% -> 17% test-positive large slaughter calf herds 2007-2016



Dairy bull calf Slaughter calf herd

Abattoir

Bull calves from Level 2 much cheaper Today very difficult to sell in DK

Source herds of calves to large fattening herd in 2015



New tool for fattening herd owners

List of source herds with salmonella and calf mortality Need permission from dairy herds to extract calf mortality and BTM results

	Lev.					Seneste udtagnings-	Seneste antistof-				Lev.
Nr.	De	esnr	Antal dyr indkøbt	Salmonella niveau dagsdato	Dato for niveau skifte	dato	værdi	Gennemsnit af seneste 4 prøver	Kalvedød 1-30 dage	Kalvedød 1-180 dage	Opnørt
		23	93	1	29-10-2004	· .	·	· · · ·	·	·	
2	<u> </u>	46	78	1	08-06-2006		<u> </u>	·		·	
3	2	57	651	1	18-04-2007		<u> </u>		·	·	
4	2	75	120	1	05-10-2002		<u>.</u>				
5	2	20	126	1	15-03-2016						
6	2	64	372	1	05-10-2002	•					
7	2	69	210	1	06-03-2007			· · · · ·			
8	2	95	252	1	08-06-2011						
9	2	19	678	1	09-07-2016						
10	2	92	189	1	05-10-2002						
11	2	41	15	1	05-10-2002						
12	4	24	462	1	03-03-2006						
13	4	61	219	1	20-03-2008						
14	4	27	153	1	05-10-2002						
15	4	67	333	1	05-10-2002						
16	4	15	195	1	23-05-2006	•		•			
17	4	50	240	1	05-10-2002		· .				
18	4	68	45	1	20-01-2009						
19	4	06	36	1	31-10-2003						
20	4	27	24	1	09-04-2011						
21	4	00	6	1	29-03-2011						
22	2	52	33	1	05-10-2002						
23	4	06	21	2	28-06-2016						
24	4	22	12	1	08-09-2012						
25	4	11	12	1	18-05-2016			· ·			
26	4	12	6	1	30-03-2016						
27	-	37	6	1	05-10-2002		· .				
28		46	15	1	02-04-2016						
29	-	56	9	1	12-09-2012						
30	5	62	27	2	26-07-2016						
31	-	76	9	1	04-11-2009						
32	-	65	12	1	16-11-2004						
33	-	89	279	1	05-10-2002						
34	-	31	102	1	16-09-2005						

Challenges Structural development over 20 years



Important risk factor for infectious disease spread: Herd size !

Biosecurity

- not an overly popular conversation topic







Future changes to the programme?



??? Not decided yet Negotiations ongoing

- Mandatory control effort in test-positive herds
- Mandatory follow-up on calves
 8 blood samples every 3 months
- Continued testing 1-2 years after becoming Level 1?

Control campaign vet authorities Mandatory secondary advisory, if no effect of control efforts

From end of 2019: All test-positive herds under official veterinary supervision (closed herds, special hygienic slaughter)



FACULTY OF HEALTH AND MEDICAL SCIENCES UNIVERSITY OF COPENHAGEN

Genetic clusters and circulation of *Salmonella* Dublin in Jutland

Leonardo V. de Knegt¹, Egle Kudirkiene¹, Gitte Sørensen², Liza R. Nielsen¹, John E. Olsen¹ ¹ Department of Veterinary and Animal Sciences, University of Copenhagen, Denmark, <u>leonardo@sund ku dk</u> ² National Food Institute, Technical University of Denmark / Statens Serum Institut, Denmark

12 0

OBJECTIVE

METHODS

To use whole genome sequencing (WGS) to improve

the understanding of strain circulation between herds

S. Dublin: 197 isolates from 58 herds 1996 to 2016

Assembly/Annotation: SPADEs 3.9.1./Prokka 1.0

Population structure analysis: CSI Phylogeny

· Movement of cattle between herds since 1980:

Genome content analysis: Roary/Scoary

· Sequencing: MiSeq 250 bp pair-end

BACKGROUND

2002: Danish S. Dublin surveillance program 2007: National eradication programme initiated 2010: Enforced trade restrictions in legislation 2013: Mandatory control and strict trade restrictions

CHALLENGE

Continued circulation of S. Dublin, but cattle movements too intricate to detect clear circulation patterns based on existing data. Many herds interconnected by 1st or 2nd or higher degree contacts







Thank you for your attention

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