

Chapter 2

REPORTS OF *SALMONELLA* IN LIVESTOCK AND HUMANS

This chapter provides information on *Salmonella* isolated from livestock from samples taken on all premises, including farms, hatcheries, veterinary surgeries, zoos, slaughterhouses and human food premises. An overview of the number of incidents and isolations of *Salmonella* reported in farm animal species is given at Tables 8 & 9 and Figures 1 to 8. Poultry refer to reports from chickens, turkeys, ducks, geese and game birds.

For comparison purposes, data have been reproduced here on the number of laboratory reports of human isolations of *Salmonella* reported in England and Wales to the Health Protection Agency (HPA) Centre for Infections (Cfi) and in Scotland to Health Protection Scotland (HPS) (Tables 5 - 7). Clinical microbiology laboratories voluntarily report data and there are a number of factors that influence these reports. These are discussed in the Zoonoses Report UK 2008 (Defra 2009, in press).

Table 5 ranks the most common *Salmonella* serovars isolated from livestock in Great Britain in 2008 against the most common serovars isolated from human cases of salmonellosis in Great Britain. Tables 6 and 7 provide a similar comparison for phage types of *S. Typhimurium* and *S. Enteritidis* in livestock and humans. Apart from *Salmonella Typhimurium* and *Salmonella Enteritidis* the other serovars associated with human cases are reported relatively rarely from British livestock. The total number of isolation reports to the HPA from human cases of salmonellosis decreased by 16.8% in 2008 compared with 2007.

For several years tables have been produced comparing the relative frequency of *Salmonella* serovars in each animal species over the last five years. These data should be considered alongside absolute numbers of reports, as the relative proportions may remain similar despite a change in number of reports, in which case we conclude that the change in number of reports is likely to be constant across serovars. Similarly, if there is a change in serovar relativity, it is only by examining changes in absolute numbers that we can ascertain the size of any increase or decrease. For example, in 2008 the total number of *Salmonella* incident reports decreased by 9.2% compared with 2007 and decreased by 32.2% compared with 2006. However, this was not consistent across serovars. Compared with 2007, reports of *S. Typhimurium* decreased by 11.2%, and reports of *S. Kottbus*, *S. Binza*, *S. Livingstone* and *S. Anatum* decreased by 68.8%, 49.1%, 48.4% and 40.0% respectively. There were also falls in the number of incidents of *S. Agama* (32.3%), *S. Derby* (30.4%), *S. Indiana* (35.1%),

S. Senftenberg (32.4%) and *Salmonella* 61:k:1,5,(7) (20.9%) compared with 2007. There were increases in the number of reports of *S. Orion* (48.6%), *S. Enteritidis* (48.2%) and *S. Montevideo* (31.4%) there was therefore a change in the distribution of reports between these serovars.

S. Dublin was in 2008, for the tenth successive year, the serovar most commonly isolated from livestock and was responsible for 25.9% of reports, a similar level to 2007 (23.5%). *S. Typhimurium* was once again the second most common serovar (13.7%), *S. enterica diarizonae* subspecies the third (6.8%), *S. Indiana* the fourth (6.6%) and *S. Enteritidis* the fifth (5.5%). The increase in the number of incidents of *S. Enteritidis* in 2008 was due to an increase in reports from chickens (78 reports in 2008, compared with 37 in 2007).

Some serovars of *Salmonella* can infect a wide variety of host groups, for example, *S. Typhimurium*. Others tend to be associated with a particular animal group, for example *S. Enteritidis* and poultry, *S. Dublin* and cattle and *S. enterica diarizonae* subspecies and sheep. Thus the serovar distribution reflects the group distribution of reports. In 2008, 34.4% of reports were from poultry, 34.2% from cattle, 8.2% from sheep and 10.0% from pigs (see Table 1). There were 35 reports of *Salmonella* from horses in 2008 (compared with 62 in 2007) and no reports from deer, goats or rabbits.

Changes in the number of incidents have to be treated with caution in view of the inherent biases associated with the data collection.

Tables 8 & 9 and Figure 1 show that in 2008 the total number of incidents of *Salmonella* reported fell by 154 (9.2%) compared with 2007 and by 718 (32.2%) compared with 2006.

The relative frequency of reports of *S. Enteritidis* in 2008 was 5.5%, compared with 3.4% in 2007 (Table 9). There were 78 reports of *S. Enteritidis* in chickens, three in pigs, and single reports in cattle, ducks and horses and five in non-statutory species (two from mixed species and single reports from dogs, environment and hedgehogs).

The relative frequency of reports of *S. Typhimurium* (STM) fell to 13.7% of all reports in 2008 compared with 14.0% in 2007 (Table 9) and there was a decrease in all species except in game birds (35.5% in 2008 compared with 19.2% in 2007).

The number of incidents of *S. Dublin* reported in cattle rose slightly in 2008 compared with 2007 (377 reports and 375 reports respectively) and there were increases in the number of reports from both adult cattle (5.0%) and calves (7.8%). The proportion of incidents of *S. Dublin* in

cattle also increased slightly (to 63.4% of total reports in cattle) in 2008 compared with 2007 (60.6% of total reports in cattle) and this serovar was again the most common reported in cattle.

Reports of *S. enterica* subspecies *diarizonae* (almost entirely from sheep) decreased by 20.9% compared with 2007 (Table 8) and for the ninth year running *S. enterica* subspecies *diarizonae* 61:k:1,5,(7) and variants were most common serovars isolated from sheep (69.2%).

The three most common serovars reported from humans in 2008 were *S. Enteritidis* (42.1% of all reports), *S. Typhimurium* (18.6% of all reports) and *S. Virchow* (2.7% of all reports). By contrast the most common serovars reported from livestock during this period were *S. Dublin* (25.9% of all reports), *S. Typhimurium* (13.7% of reports) and *S. Enterica Diarizonae* subspecies (6.8% of reports). There were very few reports of *S. Virchow* from livestock, which accounted for 0.3% of all reports in 2008.

The most frequently reported definitive types of *S. Typhimurium* in humans during 2008 were DT104, DT193 and DT120 (13.6%, 12.6% and 10.0% of all *S. Typhimurium* reports respectively) and the most common phage types of *S. Enteritidis* reported from humans were PT4 and PT1 (21.7% and 14.5% of all *S. Enteritidis* reports respectively). *S. Typhimurium* DT193 is a relatively common group of strains associated mainly with pigs and to a lesser extent cattle and other livestock. In livestock, DT104 was the most common phage type of *S. Typhimurium* in both cattle (36.5%) and sheep (66.7%), U288 was the most common phage type in pigs (47.2%) and in poultry DT8 and U302 were the most common phage types (both 16.7%). *S. Enteritidis* PT4 and PT6 were the most common *S. Enteritidis* phage types in poultry and in 2008 comprised 44.3% and 13.9% of total *S. Enteritidis* incidents in chickens respectively.

These trends and others are highlighted further in the relevant species sections.

During 2008 there was only one serotype reported in livestock for the first time; this was *Salmonella* Ordonez and was reported from a chicken laying flock. *S. Ordonez* has previously been reported from compound pig feed in 1996, unspecified compound feed in 1993 and palm kernel in 1991. Two other unusual serotypes reported in cattle during 2008; these were *Salmonella* Alachua which was reported for the first time since 1997 and *S. Nagoya* has only been reported five times in the last ten years.

Perhaps the most important factor which may bias the number of *Salmonella* reports is the submission rate. This report presents numerator data but the denominator, in most cases, is unknown and may change over time. Most *Salmonella* incident reports from cattle, sheep and pigs result from the investigation of clinically diseased animals. Economic factors may exert a strong influence on diagnostic practices, such as whether a veterinary surgeon is consulted and whether samples are submitted for laboratory examination, and 2008 once again saw an economically depressed livestock industry.

Although diagnostic submissions to the Veterinary Laboratories Agency (VLA) and the Scottish Agricultural College (SAC) have declined in recent years, during 2008 the total number of diagnostic submissions received increased by 10.1% compared with 2007. Additionally as most of the data from species other than poultry relate to clinical investigations, the prevalence of subclinical infection in these species of livestock is not usually known.

Changes in the denominator population for *Salmonella* reports from poultry, particularly chickens, turkeys and ducks, are difficult to assess and most sample submissions are associated with statutory or voluntary surveillance activities. Statutory monitoring of chicken breeding flocks for *Salmonella* detailed in the PBFHO 2007 has been supplemented by additional voluntary testing of many flocks in recent years and in 2008 this Order was replaced for chickens by the Control of Salmonella in Poultry Order 2007. Turkey and duck breeding flocks undertake voluntary monitoring for *Salmonella* following protocols based on those defined in the PBFHO 2007 and there is also a substantial amount of voluntary monitoring in production flocks. Therefore, it is likely that there has been an increase in surveillance of poultry flocks for *Salmonella* over the five-year period. The assessment of submission rates in poultry is further complicated by the large proportion of *Salmonella* testing undertaken by private laboratories. More details on the changes in the intensity and the methods for *Salmonella* monitoring in the poultry sector are included in the Poultry Chapter of this publication.

Although trends in *Salmonella* reports can be compared with diagnostic submission rates to VLA/SAC it should be remembered that not all submissions will have been examined for *Salmonella*. Private laboratories also report the isolation of *Salmonella* and the total number of submissions to these laboratories is unknown.

Fig 1: Number of incident reports of *Salmonella* in livestock (2004 - 2008)

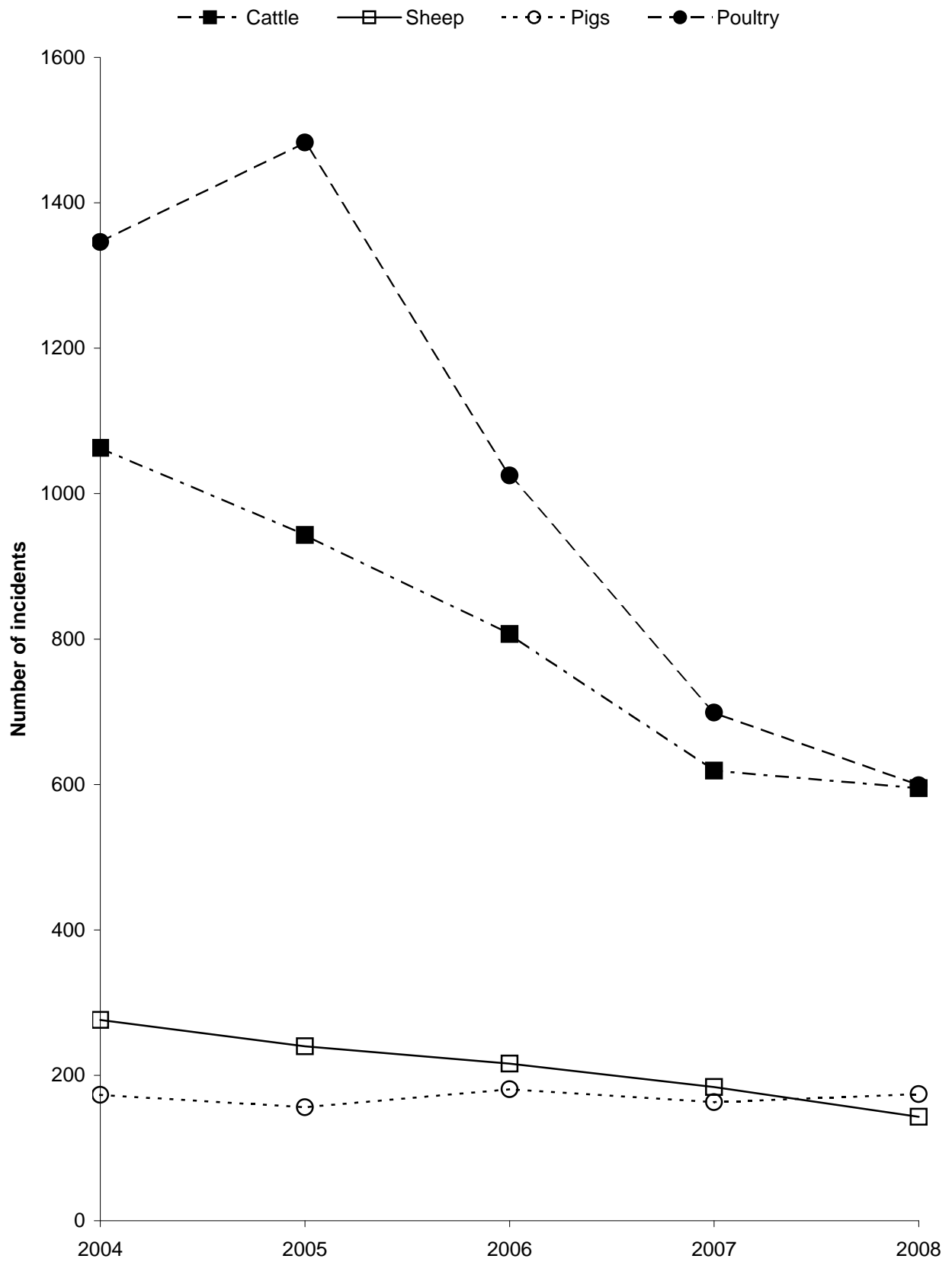


Table 5: Reports of the most common *Salmonella* serotypes in 2008 in livestock and humans in Great Britain

Human cases			Cattle			Sheep			Pigs			Poultry		
Serotype	No. isolations	%	Serotype	No. incidents	%	Serotype	No. incidents	%	Serotype	No. incidents	%	Serotype	No. incidents	%
Enteritidis	4571	42.1	Dublin	377	63.4	<i>Enterica diarizonae</i> subsp	99	69.2	Typhimurium	106	60.9	Indiana	98	16.4
Typhimurium	2022	18.6	Typhimurium	74	12.4	Montevideo	23	16.1	Derby	13	7.5	Enteritidis	79	13.2
Virchow	294	2.7	Mbandaka	29	4.9	Dublin	9	6.3	London	10	5.7	Kedougou	59	9.8
Agona	266	2.4	Anatum	19	3.2	Derby	3	2.1	Reading	9	5.2	Orion	51	8.5
Newport	205	1.9	Montevideo	19	3.2	Typhimurium	3	2.1	Bovismorbificans	5	2.9	Mbandaka	49	8.2
Stanley	144	1.3	Newport	17	2.9	Indiana	2	1.4	Kedougou	5	2.9	Hadar	35	5.8
Kentucky	142	1.3	Agama	16	2.7				Enteritidis	3	1.7	Binza	27	4.5
			Durham	3	0.5							Senftenberg	25	4.2
			Ohio	3	0.5							Typhimurium	24	4.0
			<i>Enterica diarizonae</i> subsp	3	0.5							Derby	22	3.7
												Ohio	20	3.3
Other serotypes	3219	29.6	Other serotypes	35	5.9	Other serotypes	4	2.8	Other serotypes	23	13.2	Other serotypes	110	18.4
Total	10863		Total	595		Total	143		Total	174		Total	599	

* Reports to the Health Protection Agency and Health Protection Scotland, provisional data

Table 6: Reports of the most common *Salmonella* Typhimurium definitive types in 2008 in livestock and humans in Great Britain

Human cases			Cattle			Sheep			Pigs			Poultry		
DT	No. isolations	%	DT	No. incidents	%	DT	No. incidents	%	DT	No. incidents	%	DT	No. incidents	%
DT 104	276	13.6	DT 104	27	36.5	DT 104	2	66.7	U288	50	47.2	DT 8	4	16.7
DT 193	255	12.6	DT 193	17	23.0	DT 8	1	33.3	DT 193	37	34.9	U302	4	16.7
DT 120	202	10.0	U302	9	12.2				DT 104	7	6.6	DT2	2	8.3
U320	195	9.6	UNTY	9	12.2				UNTY	4	3.8	DT 30	2	8.3
RDNC	158	7.8	U302	4	5.4				DT 104b	2	1.9	DT 35	2	8.3
DT 104b	73	3.6	DT 191a	2	2.7				DT 208	2	1.9	DT 41	2	8.3
DT191a	69	3.4	DT 41	2	2.7				U302	2	1.9	DT 193	2	8.3
DT8	60	3.0										U310	2	8.3
U311	49	2.4												
Other DTs	685	33.9	Other DTs	4	5.4	Other DTs	0		Other DTs	2	1.9	Other DTs	4	16.7
Total	2022		Total	74		Total	3		Total	106		Total	24	

* Reports to Health Protection Agency and Health Protection Scotland, provisional data

Table 7: Reports of the most common *Salmonella* Enteritidis phage types in 2008 in livestock and humans in Great Britain

Human cases*			Cattle			Sheep			Pigs			Poultry		
PT	No. isolations	%	PT	No. incidents	%	PT	No. incidents	%	PT	No. incidents	%	PT	No. incidents	%
PT 4	992	21.7	PT 8	1	100.0				PT6	2	66.7	PT 4	35	44.3
PT 1	661	14.5							PT4	1	33.3	PT 6	11	13.9
PT 21	452	9.9										PT 7	7	8.9
PT 14b	438	9.6										PT 8	7	8.9
PT 8	409	8.9										PT 6a	5	6.3
PT 12	356	7.8										PT 1	3	3.8
PT 6	348	7.6										UNTY	3	3.8
PT 6a	109	2.4										PT 14b	2	2.5
PT 53	67	1.5										PT 35	2	2.5
PT 15	65	1.4												
Other PTs	674	14.7	Other PTs	0		Other PTs	0		Other PTs	0	0.0	Other PTs	4	5.1
Total	4571		Total	1		Total	0		Total	3		Total	79	

* Reports to Health Protection Agency and Health Protection Scotland, provisional data

Table 8: *Salmonella* in cattle, sheep, pigs and poultry on all premises

<i>Salmonella</i> Incidents (Isolations)	2004		2005		2006		2007		2008	
ENTERICA ENTERICA										
Adelaide	-	(-)	-	(-)	-	(-)	1	(2)	-	(-)
Agama	25	(25)	24	(26)	30	(37)	31	(36)	21	(21)
Agona	26	(27)	25	(25)	20	(25)	7	(10)	8	(8)
Ajiobo	6	(6)	1	(1)	1	(1)	3	(3)	1	(1)
Alachua	-	(-)	-	(-)	-	(-)	-	(-)	1	(1)
Anatum	35	(38)	39	(40)	33	(40)	40	(45)	24	(36)
Berta	-	(1)	-	(-)	1	(2)	1	(1)	-	(-)
Binza	92	(95)	56	(60)	64	(80)	53	(60)	27	(32)
Bovismorbificans	1	(1)	3	(4)	5	(8)	5	(5)	5	(6)
Bradford	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
Braenderup	1	(1)	-	(-)	1	(1)	-	(-)	-	(-)
Brandenburg	20	(23)	-	(-)	-	(-)	-	(-)	-	(-)
Bredeney	3	(3)	1	(1)	5	(5)	-	(-)	1	(1)
Butantan	-	(-)	-	(-)	4	(7)	5	(7)	1	(1)
Carno	-	(-)	1	(1)	-	(-)	1	(1)	1	(2)
Cerro	-	(-)	-	(-)	3	(6)	-	(-)	1	(1)
Choleraesuis	1	(1)	1	(1)	-	(-)	-	(-)	-	(-)
Coeln	-	(-)	1	(1)	2	(3)	-	(-)	-	(-)
Concord	-	(-)	-	(-)	1	(1)	-	(-)	-	(-)
Corvallis	5	(5)	1	(1)	-	(-)	-	(-)	-	(-)
Cubana	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Derby	61	(64)	88	(93)	67	(94)	56	(69)	39	(46)
Dublin	794	(815)	665	(693)	495	(561)	392	(449)	391	(469)
Duesseldorf	-	(-)	1	(1)	-	(-)	1	(1)	1	(1)
Durham	1	(1)	1	(1)	2	(2)	7	(8)	4	(4)
Eboko	-	(-)	-	(-)	1	(1)	1	(1)	-	(-)
Enteritidis	23	(27)	93	(103)	34	(61)	56	(115)	83	(246)
Fischerkietz	2	(2)	-	(-)	-	(-)	-	(-)	-	(-)
Gallinarum	-	(-)	5	(9)	5	(13)	6	(18)	-	(-)
Give	47	(47)	24	(25)	16	(17)	19	(22)	11	(12)
Gloucester	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Goldcoast	9	(11)	11	(11)	9	(9)	2	(4)	2	(3)
Hadar	60	(66)	26	(27)	28	(31)	30	(30)	35	(39)
Havana	10	(10)	10	(10)	15	(17)	8	(9)	6	(6)
Heidelberg	-	(-)	-	(-)	-	(-)	2	(2)	-	(-)
Idikan	3	(3)	11	(11)	2	(2)	-	(-)	-	(-)
Indiana	163	(166)	212	(224)	159	(224)	154	(194)	100	(122)
Infantis	21	(21)	6	(6)	6	(8)	1	(1)	4	(5)
Jangwani	-	(-)	3	(4)	-	(-)	-	(-)	-	(-)

Table 8: *Salmonella* in cattle, sheep, pigs and poultry on all premises

<i>Salmonella</i> Incidents (Isolations)	2004	2005	2006	2007	2008
ENTERICA ENTERICA					
Kedougou	89 (90)	85 (87)	104 (148)	48 (75)	64 (100)
Kentucky	6 (6)	2 (2)	4 (4)	6 (10)	1 (1)
Kiambu	1 (1)	- (-)	- (-)	- (-)	- (-)
Kimuenza	1 (1)	- (-)	2 (2)	3 (4)	2 (3)
Kokomlemle	- (-)	1 (1)	- (-)	- (-)	- (-)
Kottbus	37 (38)	93 (96)	51 (73)	32 (45)	10 (10)
Larochelle	1 (1)	1 (1)	- (-)	- (-)	- (-)
Lexington	10 (10)	3 (3)	- (-)	- (-)	- (-)
Liverpool	39 (48)	15 (16)	2 (3)	- (-)	- (-)
Livingstone	214 (224)	159 (167)	63 (79)	31 (43)	16 (17)
London	8 (10)	5 (5)	6 (7)	9 (10)	10 (10)
Mbandaka	23 (26)	24 (28)	34 (44)	70 (88)	79 (91)
Meleagridis	1 (1)	3 (3)	- (-)	- (-)	- (-)
Menston	- (-)	2 (2)	- (-)	- (-)	- (1)
Mons	- (-)	- (-)	- (-)	1 (1)	- (-)
Montevideo	62 (70)	62 (67)	47 (62)	35 (41)	46 (58)
Nagoya	- (-)	- (-)	1 (1)	- (-)	1 (2)
Newington	- (-)	- (-)	- (-)	1 (1)	- (-)
Newport	52 (55)	52 (52)	31 (38)	23 (26)	21 (26)
Nottingham	- (-)	- (-)	- (-)	- (-)	3 (4)
Ohio	31 (31)	27 (27)	43 (45)	14 (14)	23 (24)
Ordonez	- (-)	- (-)	- (-)	- (-)	1 (1)
Orion	43 (44)	46 (47)	39 (52)	35 (41)	52 (57)
Oskarshamn	- (-)	- (-)	1 (1)	- (-)	- (-)
Oslo	1 (1)	1 (1)	- (-)	- (-)	1 (1)
Panama	- (-)	- (-)	- (1)	- (-)	1 (1)
Paratyphi B var Java	- (-)	1 (1)	- (-)	- (-)	- (-)
Poona	2 (2)	1 (1)	- (-)	4 (4)	1 (1)
Pullorum	3 (4)	- (1)	1 (3)	- (1)	- (1)
Reading	8 (8)	12 (13)	10 (10)	3 (4)	9 (9)
Regent	- (-)	- (-)	1 (1)	- (-)	- (-)
Riggil	- (-)	- (-)	1 (1)	- (-)	- (-)
Rissen	1 (1)	4 (4)	1 (1)	1 (1)	1 (1)
Saintpaul	5 (5)	27 (27)	12 (14)	1 (2)	1 (1)
Schwarzengrund	6 (6)	1 (1)	1 (1)	2 (2)	- (-)
Senftenberg	61 (66)	128 (133)	49 (85)	37 (71)	25 (34)
Sinstorf	- (-)	- (-)	- (-)	1 (1)	- (-)
Stanley	2 (2)	- (-)	1 (1)	- (-)	- (-)
Stourbridge	2 (2)	3 (3)	6 (6)	2 (2)	- (-)
Sundsvall	- (-)	1 (1)	- (-)	- (-)	- (-)
Taksony	- (-)	- (-)	3 (3)	- (-)	- (-)
Tennessee	2 (2)	1 (1)	- (-)	- (-)	2 (2)

Table 8: *Salmonella* in cattle, sheep, pigs and poultry on all premises

<i>Salmonella</i> Incidents (Isolations)	2004		2005		2006		2007		2008	
ENTERICA ENTERICA										
Thomasville	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Thompson	39	(39)	33	(34)	15	(16)	2	(3)	9	(10)
Typhimurium	341	(372)	404	(446)	429	(587)	233	(277)	207	(254)
Uganda	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Vejele	8	(8)	-	(-)	-	(-)	-	(-)	-	(-)
Virchow	37	(38)	19	(19)	15	(20)	3	(8)	5	(9)
Worthington	-	(-)	-	(-)	1	(1)	-	(-)	-	(-)
Yoruba	1	(1)	2	(2)	1	(1)	2	(2)	-	(-)
ENTERICA DIARIZONAE										
61:k:1,5	1	(1)	1	(1)	2	(2)	1	(1)	4	(6)
61:k:1,5,7	135	(138)	105	(105)	86	(88)	80	(81)	60	(62)
61:k:1,7	-	(-)	4	(4)	-	(-)	-	(-)	-	(-)
61:-:1,5	-	(-)	-	(-)	5	(5)	1	(1)	5	(5)
61:-:1,5,7	49	(49)	48	(48)	57	(59)	47	(49)	32	(32)
61:-:1,7	-	(-)	-	(-)	4	(4)	-	(-)	-	(-)
unspecified arizonae	-	(-)	-	(-)	-	(-)	-	(-)	1	(1)
UNSPECIFIED										
untypeable	-	(-)	-	(-)	1	(1)	-	(-)	-	(-)
structure only	118	(163)	113	(181)	73	(132)	43	(61)	37	(43)
rough strain	8	(9)	21	(22)	16	(18)	11	(11)	14	(17)
untyped	-	(-)	-	(-)	1	(1)	-	(-)	-	(-)
TOTAL	2858	(3033)	2822	(3033)	2229	(2878)	1665	(2075)	1511	(1957)

Fig 2: Incidents of *Salmonella* serovars in cattle, sheep, pigs & poultry in 2008

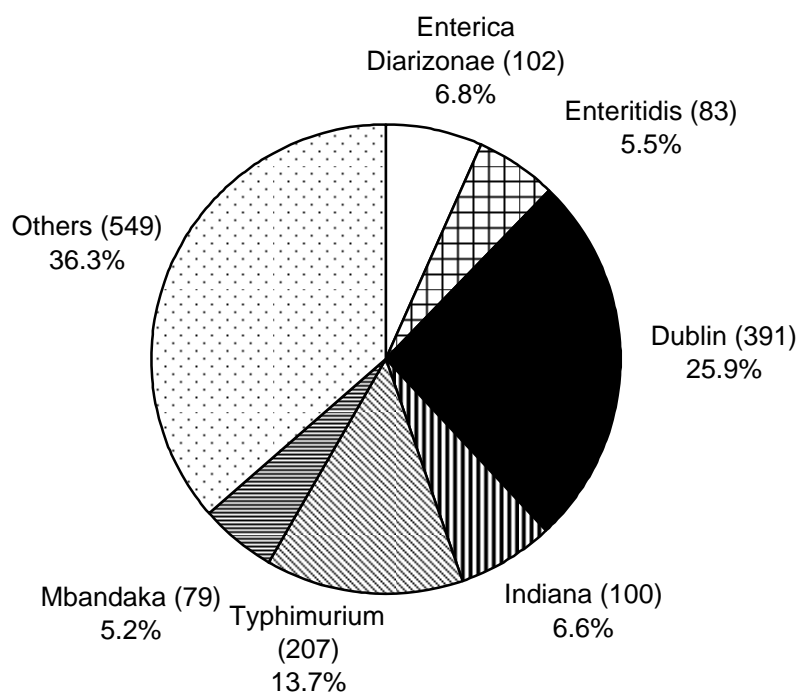


Table 9: Incidents of the top 5 *Salmonella* serovars in cattle, sheep, pigs and poultry in 2008 as a % of all incidents compared to previous years

Serotype	2004	2005	2006	2007	2008
S. Dublin %	27.8	23.6	22.2	23.5	25.9
S. Typhimurium %	11.9	14.3	19.2	14.0	13.7
S. <i>Enterica Diarizonae</i> subspecies %	6.5	5.6	6.9	7.7	6.8
S. Indiana %	5.7	7.5	7.1	9.2	6.6
S. Enteritidis %	0.8	3.3	1.5	3.4	5.5
Total no. incidents	2858	2822	2229	1665	1511

Fig 3: Incidents of *Salmonella* serovars in cattle, sheep, pigs & poultry (2004 - 2008)

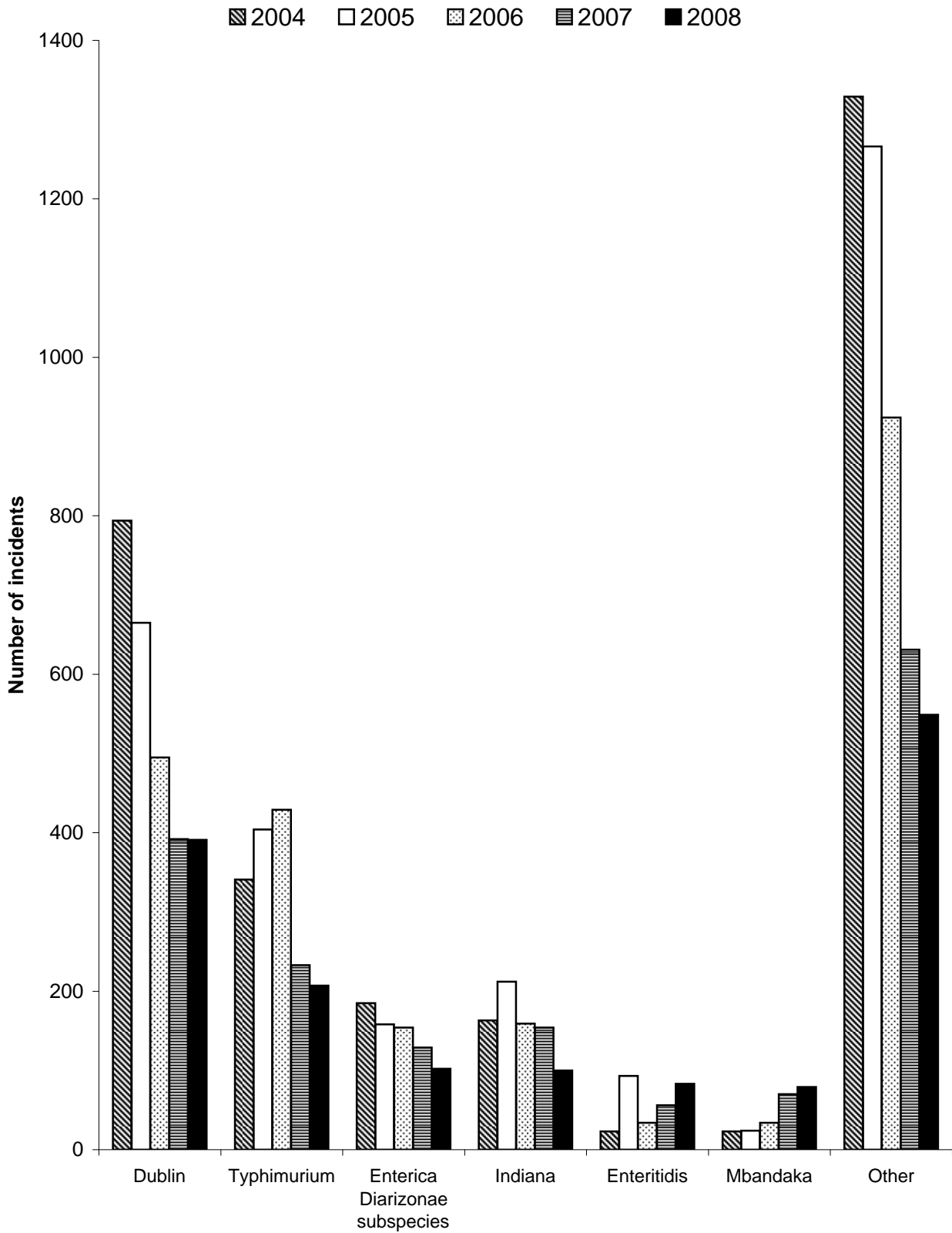


Fig 4: Number of incident reports of *Salmonella* Typhimurium in livestock (2004 - 2008)

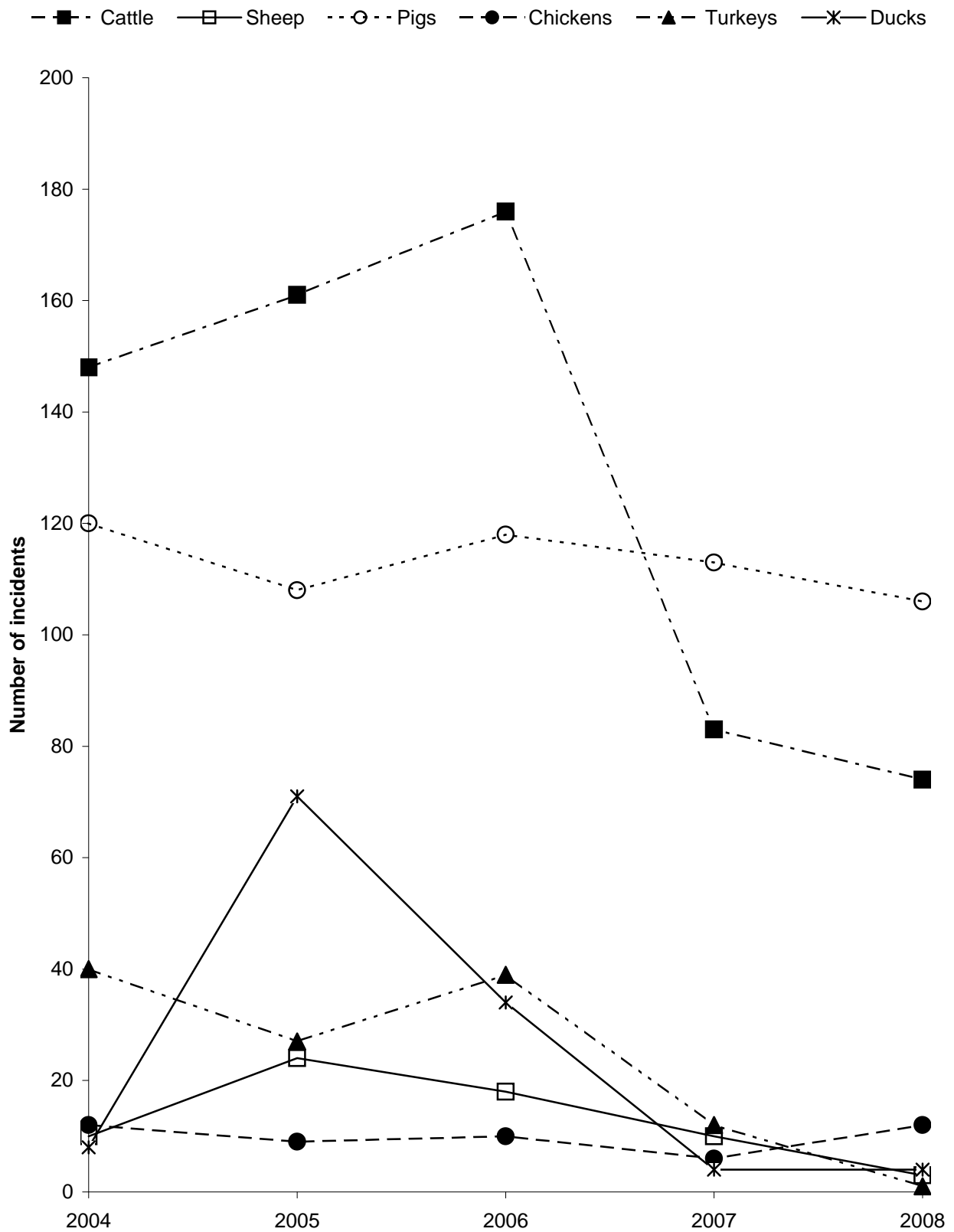


Fig 5: Number of incident reports of *Salmonella* Enteritidis in livestock (2004 - 2008)

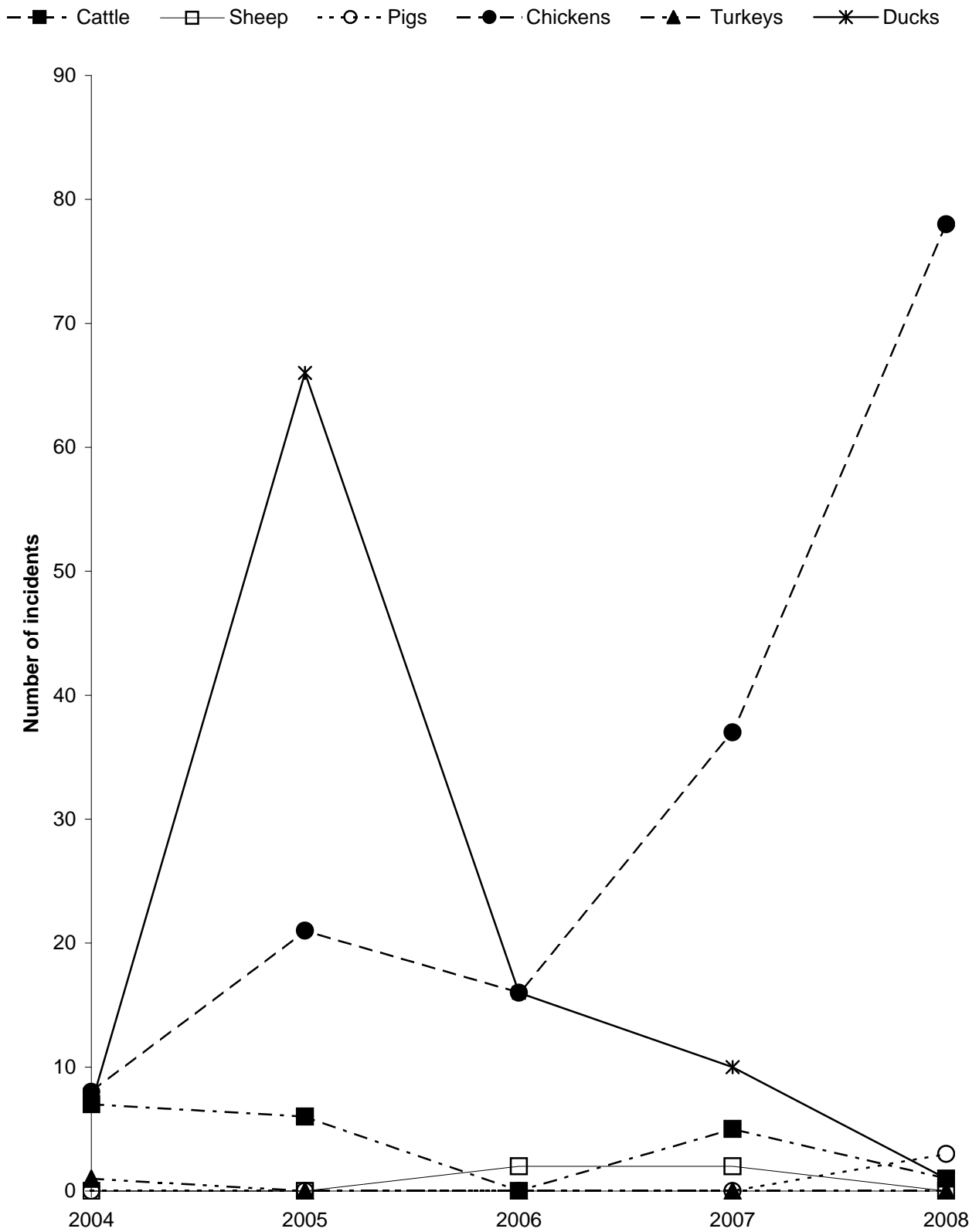


Fig 6: Number of incident reports of *Salmonella* Hadar in livestock (2004 - 2008)

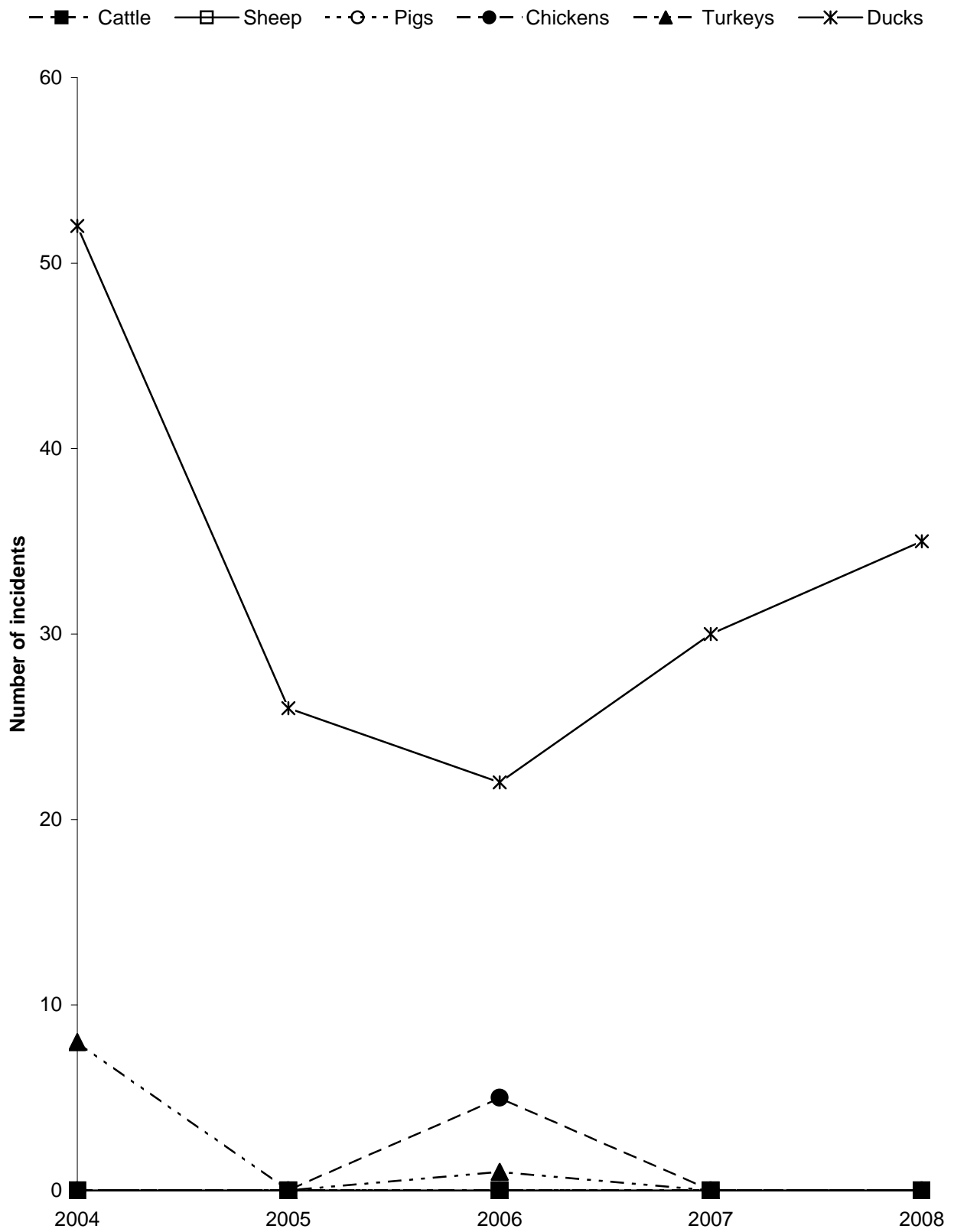


Fig 7: Number of incident reports of *Salmonella* Infantis in livestock (2004 - 2008)

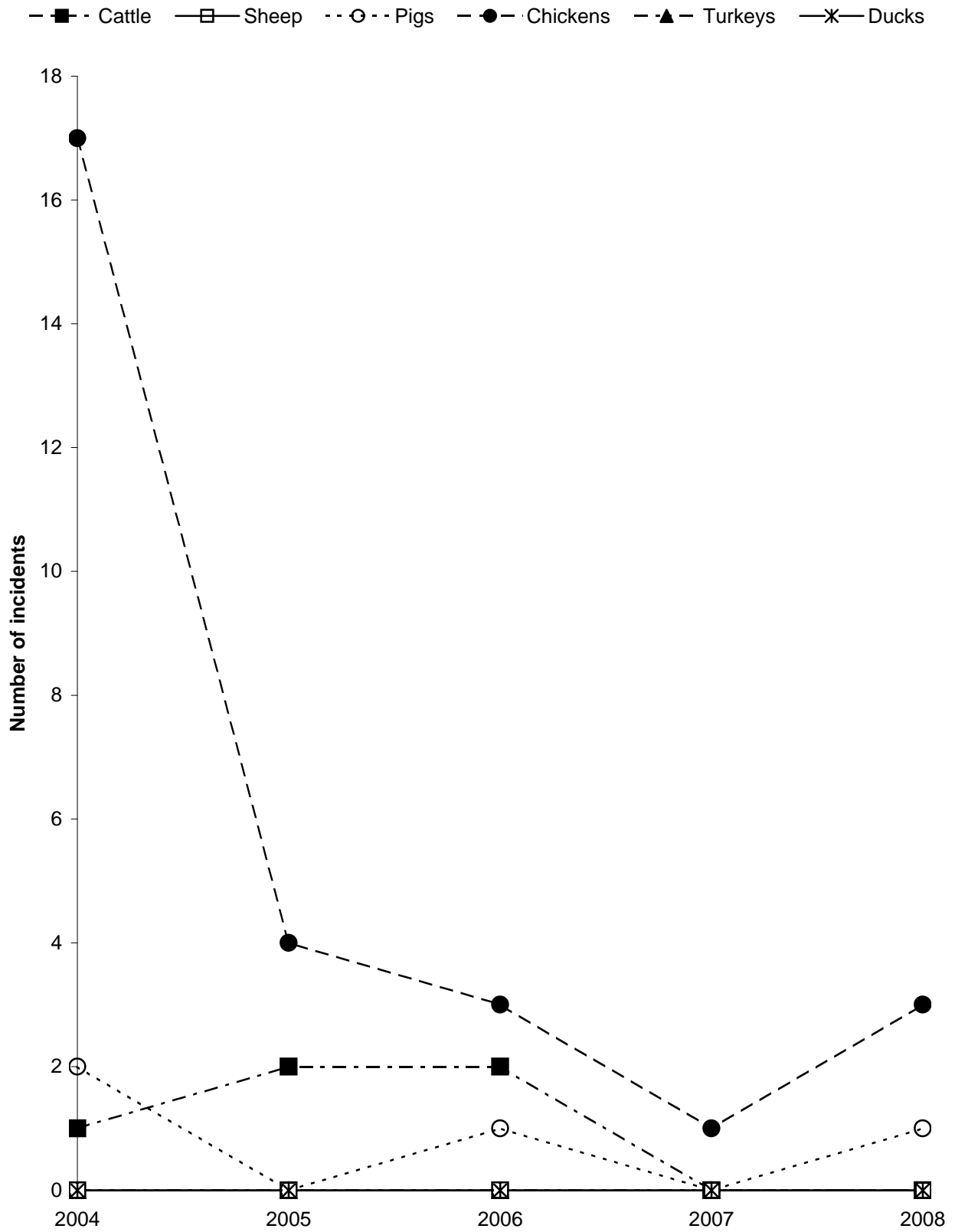


Fig 8: Number of incident reports of *Salmonella* Virchow in livestock (2004 - 2008)

