

TECHNICAL REPORT

Multi-country outbreak of *Salmonella* Enteritidis infections associated with consumption of eggs from Germany¹

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ABSTRACT

Sporadic or outbreak cases of *Salmonella* Enteritidis reported by Austria, France, Germany and the United Kingdom, in addition to one case reported in Luxembourg in a patient residing in France, appear to be linked by time of symptom onset and microbiological characteristics of isolates. Cases in Austria, France and Germany share an epidemiological link to the same egg packaging centre in southern Germany. Isolates from contaminated eggs identified in France originating from the implicated German egg packaging centre share similar molecular characteristics to the human cases. Isolates from a sample of a *Salmonella*-contaminated strawberry cake, identified in Germany through an investigation unrelated to this outbreak, also share similar molecular characteristics to the human cases. Additional microbiological and environmental investigations could further strengthen evidence to support or discard the hypothesis of all cases being part of the same outbreak, and being infected after consumption of the same food (i.e. contaminated eggs produced in southern Germany). This is particularly unclear with regard to the outbreak cases in the United Kingdom. Investigations and actions taken by the food sector have supposedly stopped the distribution of the suspected contaminated food to the market. However, due to the delay in case reporting, it is still possible that more cases will be notified. ECDC will continue to closely monitor the occurrence of human cases through EPIS-FWD and Member States could consider enhancing their surveillance activities for this *Salmonella* serovar and specifically for the phage type 14b. It is noticeable that *Salmonella* Enteritidis-contaminated eggs have been able to reach the market, in spite of the strict regulations applying to table eggs for human consumption, and the success in reducing human and animal infections in recent years within the EU. EPIS-FWD and RASFF have been confirmed to be excellent tools for sharing information, identifying potential cross-border threats and linking independent investigations simultaneously occurring in different Member States.

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KEY WORDS

Salmonella Enteritidis, eggs, food-borne outbreak

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Erratum: On 28 August 2014, the phrase on p.6: 'Since 1996, 1 067 outbreaks have been investigated in Germany: 21 (2%) were associated with PT14b. From 2011 to 2014, of 64 outbreaks investigated, three were caused by PT14b' was clarified to read: 'Since 1996, 1 067 outbreaks have been laboratory-investigated by the National Reference Centre in Germany: 21 (2%) were associated with PT14b. From 2011 to 2014, of 64 laboratory-investigated outbreaks by the National Reference Centre, three were caused by PT14b.'

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JOINT ECDC–EFSA RAPID OUTBREAK ASSESSMENT

Multi-country outbreak of *Salmonella* Enteritidis infections associated with consumption of eggs from Germany

25 August 2014

Conclusions

Sporadic or outbreak cases of *Salmonella* Enteritidis reported by Austria, France, Germany and the United Kingdom, in addition to one case reported in Luxembourg in a patient residing in France, appear to be linked by time of symptom onset and microbiological characteristics of isolates.

Cases in Austria, France and Germany share an epidemiological link to the same egg packaging centre in southern Germany.

Isolates from contaminated eggs identified in France originating from the implicated German egg packaging centre share similar molecular characteristics to the human cases. Isolates from a sample of a *Salmonella*-contaminated strawberry cake, identified in Germany through an investigation unrelated to this outbreak, also share similar molecular characteristics to the human cases.

Additional microbiological and environmental investigations could further strengthen evidence to support or discard the hypothesis of all cases being part of the same outbreak, and being infected after consumption of the same food (i.e. contaminated eggs produced in southern Germany). This is particularly unclear with regard to the outbreak cases in the United Kingdom.

Investigations and actions taken by the food sector have supposedly stopped the distribution of the suspected contaminated food to the market. However, due to the delay in case reporting, it is still possible that more cases will be notified. ECDC will continue to closely monitor the occurrence of human cases through EPIS-FWD and Member States could consider enhancing their surveillance activities for this *Salmonella* serovar and specifically for the phage type 14b.

It is noticeable that *Salmonella* Enteritidis-contaminated eggs have been able to reach the market, in spite of the strict regulations applying to table eggs for human consumption, and the success in reducing human and animal infections in recent years within the EU.

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Source and date of request

Following an urgent inquiry in the Epidemic Intelligence Information System for Food- and Waterborne Diseases and Zoonoses (EPIS-FWD) related to the outbreak of *Salmonella* enterica serovar Enteritidis (*S.* Enteritidis) launched by France on 1 August 2014, and a message posted on the Early Warning and Response System (EWRS) on 14 August, ECDC and EFSA agreed to prepare a rapid outbreak assessment to assess the public health risk at the European Union level.

Public health issue

This is a multi-country outbreak of *S.* Enteritidis cases reported in Austria, France and Luxembourg associated with eggs from Germany and caused by isolates indistinguishable by molecular typing methods. Potential links with this multi-country outbreak are also being investigated in Germany and in the United Kingdom, where additional cases have been reported caused by isolates that are highly similar or indistinguishable by molecular typing methods.

Consulted experts

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EFSA experts

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External experts

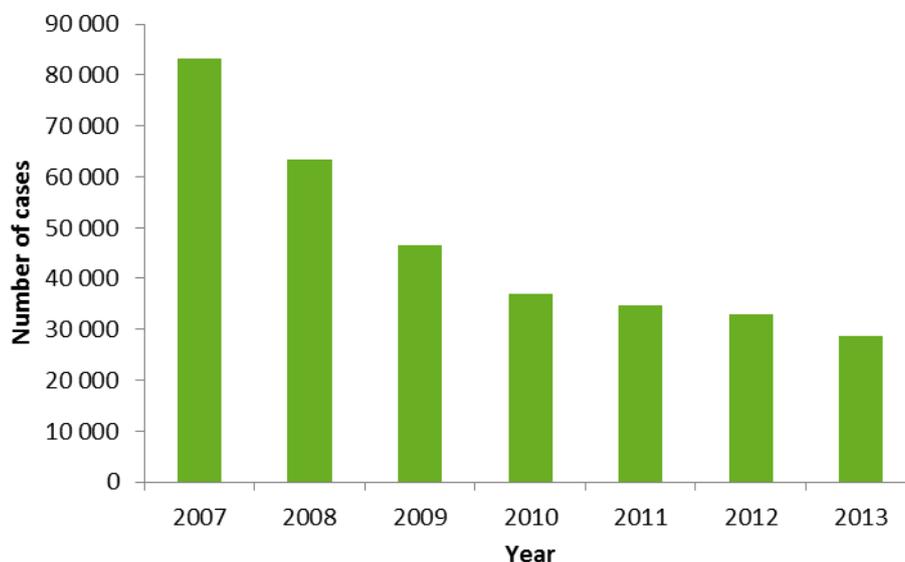
Daniela Schmid and Elisabeth Kanitz, Austria
Henriette de Valk, Nelly Fournet, Simon Le Hello, France
Helen Bernard, Christina Frank, Wolfgang Rabsch, Germany
Joël Mossong, Luxembourg
Ian Fisher, United Kingdom.

Disease background information

S. Enteritidis isolations in humans

S. Enteritidis is the most commonly detected serovar in human salmonellosis in Europe. It has declined substantially in recent years (Figure 1), most likely as a result of the successful control measures implemented for laying hens and egg production.

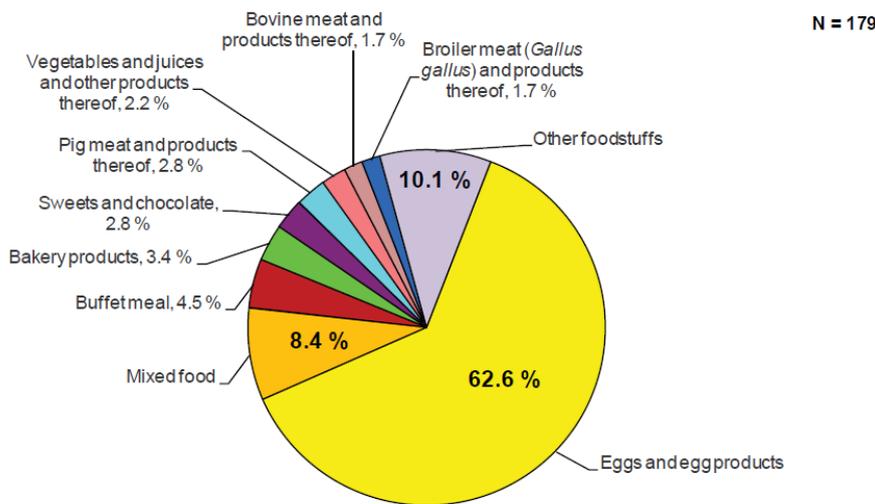
Figure 1. Distribution of confirmed cases of *Salmonella* Enteritidis by year in EU/EEA, The European Surveillance System (TESSy) data, 2007–2013



From 2007 to 2013, 328 537 *S. Enteritidis* cases were reported to the European Surveillance System (TESSy) (mean number per year 46 934, range 29 350 to 83 376) by 27 countries, with Germany and the Czech Republic together reporting 52% of all cases. Of all cases with available information, 43% (n=139 090) were under 15 years, 51% (n=168 725) were female and 90% (n=245 479) were acquired within the reporting country. Symptom onset of cases was distributed across the year, with a peak from July to September. In the first quarter of 2014, 2 076 cases were reported to TESSy.

Enteritidis is the predominant serovar associated with the *Salmonella* outbreaks [1]. In 2012, *S. Enteritidis* accounted for 179 outbreaks and 2 177 human cases (37.6% of all cases in *Salmonella* outbreaks). Most of these *S. Enteritidis* outbreaks were attributed to eggs and egg products (Figure 2). In the same year, egg and egg products were implicated in 168 outbreaks (22%) out of 763 outbreaks reported at EU level, of which 93.5 % were caused by *Salmonella* spp. [1]. The majority of these outbreaks were associated with *S. Enteritidis* (66.7%), as in previous years (Figure 3).

Figure 2. Distribution of food vehicles in strong-evidence outbreaks caused by *S. Enteritidis* in the EU, 2012

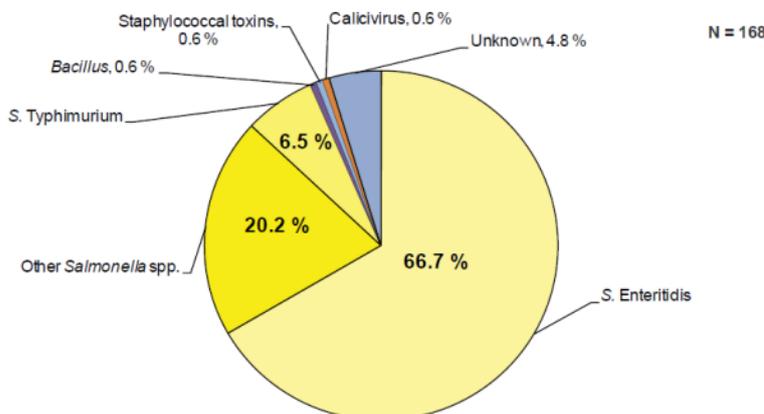


Source: EFSA (European Food Safety Authority) and ECDC (European Centre for Disease Prevention and Control), 2014 [1].

Note: data on 179 outbreaks included from Austria (1), Belgium (2), Estonia (1), France (22), Germany (16), Hungary (5), Lithuania (5), Poland (67), Slovakia (4), Slovenia (2), Spain (50) and United Kingdom (4).

Other foodstuffs (n=18) include: cheese (1), dairy products (other than cheeses) (2), fish and fish products (1), herbs and spices (1), meat and products thereof, unspecified (2), other, mixed or unspecified poultry meat (2), other or mixed red meat and products thereof (1) and other foods (8).

Figure 3. Distribution of outbreaks with strong evidence, implicating eggs and egg products, by causative agent in the EU, 2012



Source: EFSA (European Food Safety Authority) and ECDC (European Centre for Disease Prevention and Control), 2014 [1].

Note: data on 168 outbreaks are included from France (33), Germany (3), Netherlands (1), Poland (51), Slovakia (3), Spain (74) and United Kingdom (3).

Outbreaks of *Salmonella* Enteritidis PT14b have previously been associated with the consumption of eggs in the EU. For instance in 2009 in England and in 2010 in Austria, Germany and Luxembourg [2-4]

S. Enteritidis isolations from food, animals and feed

EU/EEA Member States have frequently reported *S. Enteritidis* from food and animals (national zoonoses monitoring in accordance with Directive 2003/99/EC).

From 2004 to 2012, the EU/EEA Member States reported a total of 25 143 isolations of *S. Enteritidis* from the following animals: chickens (*Gallus gallus*) (21 936 isolates), turkeys (294), ducks (331), geese (379), ostriches (12), pigeons (21), pheasants (17), quails (9), other poultry (110), cattle (873), sheep (13), goats (12), pigs (302), wild boar (36), domestic solipeds (36), cats (31), dogs (49), hedgehogs (68), foxes (23), reptiles (19), parrots (11), wild birds (45) and other or unspecified animals (516).

In the same period, *S. Enteritidis* isolations were reported from the following foods: eggs (937), egg products (115), broiler meat (1 855), turkey meat (56), pork (253), meat from bovine animals (143), meat from ducks (14), meat from geese (7), meat from other poultry (651), dairy products, including cheeses (28), bakery products (49) and other food (738).

S. Enteritidis was also detected in 224 samples of different feed categories: feed material of different types (98), compound feeding stuffs for poultry (67), compound feeding stuffs for other animals (24), pet food (22) and other feeding stuffs (13).

The EU-wide *Salmonella* baseline survey on the prevalence of *Salmonella* in holdings of laying hen flocks *Gallus gallus* (2004-2005) [5] showed that Enteritidis was by far the most common serovar in laying hen flocks in the survey. It was found in samples from 18 Member States in 890 *Salmonella*-positive holdings.

The majority of the 2012 *S. Enteritidis* isolations in animals (1 942) were obtained from the following animal populations/ species: broiler flocks of *Gallus gallus* (831), laying hens flocks (695) and breeding flocks of *Gallus gallus* (70). Other isolations were reported from cattle (61), geese (60), ducks (39), turkeys (16) and pigs (16).

In 2012, 509 isolations were reported from food, mainly from broiler meat (*Gallus gallus*) (283), eggs and egg products (109), meat from turkeys (14), meat from other poultry species (29) and meat from pigs (22).

Fourteen *S. Enteritidis* isolations in feed were reported in 2012, nine in feed material, three in compound feeding stuffs for different animal species and two from pet food.

In 2012, *S. Enteritidis* isolations from eggs (102) and egg products (7) were reported by 10 Member States: Bulgaria (one isolate from table eggs), the Czech Republic (one isolate from raw liquid egg), Germany (five isolates from table eggs), Hungary (one isolate from dried egg products), Italy (one isolate from table eggs), the Netherlands (one isolate from table eggs), Poland (one isolate from table eggs), Romania (70 isolates from table eggs, including quail eggs, in the context of hazard analysis and critical control points (HACCP) and own checks), Slovakia (eight isolates from table eggs) and Spain (14 isolates from table eggs, five from ready-to-eat egg products and one from unspecified egg products).

Table 1. Reported isolations of *S. Enteritidis* from food, animals and feed, in EU Member States and other reporting countries, 2004–2012

Source	No. of isolations (2004–2012)
Animals	
<i>Gallus gallus</i> (fowl)	21 936
Turkeys	294
Ducks	331
Geese	379
Ostriches	12
Pigeons	21
Pheasants	17
Quails	9
Other poultry	110
Cattle	873
Sheep	13
Goats	12
Pigs	302
Wild boar	36
Domestic solipeds	36
Cats	31
Dogs	49
Hedgehogs	68
Foxes	23
Reptiles	19
Parrots	11
Wild birds	45
Other animals	516
Total	25 143
Food	
Eggs	937
Egg products	115
Meat from broilers	1 855
Meat from turkeys	56
Meat from pigs	253
Meat from bovine animals	143
Meat from ducks	14
Meat from geese	7
Meat from other poultry	651
Dairy products, including cheeses	28
Bakery products	49
Other food	738
Total	4 846
Feed	
Feed materials	98
Compound feeding stuffs for poultry	67
Compound feeding stuffs for other animals	24
Pet food	22
Other feeding stuffs	13
Total	224

Note: Based on Directive 2003/99/EC of the European Parliament and of the Council of 17 November 2003 on the monitoring of zoonoses and zoonotic agents, amending Council Decision 90/424/EEC and repealing Council Directive 92/117/EEC

S. Enteritidis isolations reported to the Rapid Alert System for Food and Feed (RASFF)

In 2014 so far, twenty-six notifications of *S. Enteritidis* have been reported to RASFF, mostly associated with poultry meat (n=19), but also with eggs, all related to the events described in this assessment (n=3), meat products other than poultry (n=1), pet food (n=1), nuts and seeds (n=1) and spices (n=1).

Event background information

Epidemiological investigations

On 1 August 2014, the French Institute for Public Health Surveillance (INVS) reported through EPIS-FWD six outbreaks of *S. Enteritidis* involving 45 cases (16 confirmed) in eastern France, between 23 June and 21 July 2014. Cases were associated with consumption of raw eggs bought in shops from the same supermarket chain and used to prepare home-made food such as ice-cream, tiramisu, mayonnaise and chocolate mousse. Trace-back investigations identified the same egg packaging centre (also egg producer) in Bavaria, associated with the six outbreaks and with two different egg producers (three outbreaks linked to one producer and three others linked to a second producer).

Following the launch of the urgent inquiry in EPIS FWD, the Federal Ministry of Health in Austria reported a cluster of *S. Enteritidis* phage type (PT) 14b occurring since 14 June 2014 in the Austrian province of Tyrol involving 61 cases (27 confirmed). Fifty-one of the 61 Tyrolean cases had a common epidemiological link: they had consumed meals from one kitchen either as residents of nursing homes or addressees of a home-delivery service. This kitchen used eggs originating from the same egg packaging centre implicated in the French outbreaks. Since 16 June, 25 additional cases have been notified in six other Austrian provinces. On 31 July, Austria notified the food safety authorities through RASFF (notification ref. 2014.1063).

The National Reference Centre at the Robert Koch Institute (RKI) in Germany has reported 24 human isolates of *S. Enteritidis* PT14b since June 2014, 17 of which have come from the state of Bavaria. One of the isolates belongs to an asymptomatic carrier with an epidemiological connection to the implicated egg producer (staff) who was identified during the investigation. A second asymptomatic carrier was identified during a routine investigation in a bakery by local food safety authorities without connection to any notified cases. In Germany, phage typing is carried out only on *S. Enteritidis* strains reaching the National Reference Centre; since the implicated egg producer is based in Bavaria, more *S. Enteritidis* isolates were sent to the National Reference Centre from this federal state. Since the beginning of August, all local health authorities in Bavaria have been asked to arrange phage typing for all notified *S. Enteritidis* cases; for the other German federal states this was requested in mid-August.

The Public health Institute in Luxembourg (LNS) reported one case of *S. Enteritidis* infected with the outbreak strain in early June 2014 in a patient residing in France close to the Luxembourgish border who consulted a hospital in Luxembourg. The patient consumed eggs possibly bought in a shop of the same supermarket chain associated with the other French cases.

In June and July 2014, Public Health England (PHE) reported local and regional outbreaks of *S. Enteritidis* PT14b, primarily linked to restaurants and take-aways at different locations in England, with 247 notified cases. Investigations are underway; a definitive vehicle of infection has not been identified as yet.

Microbiological investigations

The German National Reference Centre for *Salmonella* has presented background information on the phage type of the outbreak strain. Of over 90 phage types included in the Ward scheme [6], the most frequent in Germany in recent years have been PT4, PT8 and PT21. PT14b was observed only in some rare outbreaks. Since 1996, 1 067 outbreaks have been laboratory-investigated by the National Reference Centre in Germany: 21 (2%) were associated with PT14b. From 2011 to 2014, of 64 outbreaks laboratory-investigated by the National Reference Centre, three were caused by PT14b. Therefore this phage type could be considered a rare phage type in Germany.

Pulsed-Field Gel Electrophoresis (PFGE) has been shown to have a low discriminatory power for *S. Enteritidis* [7] and PFGE typing is therefore not particularly informative for this serovar. Instead, ECDC promotes the use of Multi-Locus Variable number tandem repeat analysis (MLVA) according to the Hopkins MLVA protocol [8] to subtype *S. Enteritidis*. There is currently no comprehensive collection of comparable background MLVA typing data for *S. Enteritidis* available at the EU level.

All MLVA typing performed in connection with this outbreak has followed the Hopkins MLVA protocol [8] and all countries with identified human cases have found the same MLVA type in all or part of the isolates examined, as well as in some food isolates (Table 2). By country, the results were as follows:

- France: the MLVA type of the epidemic strain is 2-12-7-3-2 (from 15 human strains and two strains isolated from eggs). This strain is fully susceptible to tested antibiotics.
- Austria: the same MLVA type, 2-12-7-3-2, as in France has been identified (in 24 of 27 laboratory-confirmed cases from Tyrol and in 20 of 25 laboratory-confirmed cases from the other six provinces). The same type also occurred previously in an outbreak in Tyrol in October 2013.
- Germany: isolates from seven cases were sent to the Austrian Reference Centre in Graz for MLVA typing. The typing identified the same MLVA type as in the other countries, 2-12-7-3-2.
- Luxembourg: The only reported case also had MLVA type 2-12-7-3-2.
- United Kingdom: 78 isolates from the first outbreak had the MLVA type of 2-11-7-3-2; 162 isolates from more recent outbreaks had the profile 2-12-7-3-2. Seven additional isolates were single-locus variants from these two main MLVA types.
- Netherlands: the MLVA type 2-12-7-3-2 has been detected five times in recent years; this background information was reported in EPIS-FWD.

Strains from France and Austria have been sent to PHE Microbiology Services in the UK for comparison by whole genome sequencing to clarify whether the UK outbreaks may be caused by the same strain as in continental Europe.

Food investigations

Three RASFF notifications have been made related to these outbreaks: two from France (2014.0938; 2014.1072) on 9 July and 1 August 2014, and one from Austria (2014.1063) on 31 July 2014. In all notifications it was reported that the 'best before' date was not available, the product was most probably no longer on the market and that all samples from flocks and eggs tested negative.

In France, eggs associated with *S. Enteritidis* cases tested positive for *Salmonella*. The strain from the eggs had MLVA type 2-12-7-3-2, identical to the outbreak strain.

In Germany, a strawberry cake tested positive for *S. Enteritidis* 14b during a routine investigation by the local food safety authority. The strain from the cake also had MLVA type 2-12-7-3-2 identical to the outbreak strain. To date it is unclear whether eggs from the implicated Bavarian packaging centre were used for the preparation; investigations are still ongoing.

On 15 August 2014, Germany published on EPIS-FWD the list of countries to which the eggs from the implicated packaging centre had been distributed: Austria, Czech Republic, Germany, France, United Kingdom, Croatia, Slovenia and Hungary. Further distribution details were communicated to affected EU Member States by the Bavarian food safety authorities through the RASFF or bilaterally.

Table 2. Microbiological finding, multi-country *Salmonella* Enteritidis outbreak, 2014

Member State	MLVA Type	Human isolate(s)	Food isolate(s)
Austria	2-12-7-3-2	44	0
France	2-12-7-3-2	15	2 (eggs)
Germany	2-12-7-3-2	7	1 (cake)
Luxembourg	2-12-7-3-2	1	0
United Kingdom	2-12-7-3-2	162	0
	2-11-7-3-2	78	0

Threat assessment for the EU

S. Enteritidis is the most frequently reported *Salmonella* serovar in the EU and it is frequently associated with consumption of raw/under-cooked eggs or egg products.

Five Member States have recently identified several local sporadic or outbreaks human cases sharing indistinguishable MLVA type of *S. Enteritidis*. Further typing of isolates from France and Austria by PHE as described above will contribute to the understanding of how closely related these isolates are and whether these are part of the same outbreak.

National epidemiological investigations as well as positive food isolates in France and Austria point towards a common vehicle of infection (eggs from Bavaria) in these two countries. The epidemiological investigation in Luxembourg also appears to be consistent with this hypothesis. Further investigations are on-going in Germany and the UK to clarify whether all cases are part of the same multi-state outbreak and eggs from the same producer have been the common vehicle of infection.

Three RASFF messages have been sent from two of the countries with human cases and the responsible food authorities have initiated control actions. The list of countries where potentially contaminated eggs have been distributed is available.

The eggs found to be contaminated are supposedly no longer on the market and their shelf life has probably expired. However, due to notification delays, it is possible that more cases linked to this event will be reported.

Member States could consider enhancing their surveillance for *S. Enteritidis* to ensure that potential new increases in the number of cases reported, especially of *S. Enteritidis* PT14b, will be promptly detected.

Several EU regulations exist to prevent *Salmonella* contaminated eggs from being placed on the market (e.g. Commission Regulations (EC) No. 2160/2003, (EC) 1237/2007, (EC) 589/2008 and (EC) 517/2011). EFSA has recently published a scientific opinion on the public health risks of table eggs due to deterioration and development of pathogens, including an assessment of the risk to consumers of *S. Enteritidis* posed by extending the shelf-life of eggs. This was done by applying a quantitative model, and comparing the current situation regarding egg storage in the EU with different possible scenarios that consider the prolongation of the best-before and the sell-by date [9]. An effective way to minimise any increase in risk during extended storage is to keep the eggs refrigerated both in retail outlets and in households. Higher temperatures during the summer months could favour the growth of *Salmonella* bacteria in meals prepared with contaminated eggs if appropriate control measures are not in place.

Conclusions

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