TECHNICAL REPORT

Third external quality assurance scheme for *Salmonella* typing

European Food- and Waterborne Diseases and Zoonoses Network

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This report was commissioned by the European Centre for Disease Prevention and Control (ECDC), coordinated by Taina Niskanen, and produced by the Dutch National Institute for Public Health and the Environment (RIVM)/Laboratory for Zoonoses and Environmental Microbiology, 3720 BA Bilthoven, Netherlands, on behalf of the European Food- and Waterborne Diseases and Zoonoses , August 2011.

Authors
I. E. Pol-Hofstad (RIVM), W. F. Jacobs-Reitsma (RIVM), H. Maas (RIVM), E. de Pinna (HPA), D. Mevius (CVI) and K. A. Mooijman (RIVM)

Errata
The following corrections were made on 2 May 2012 and 27 June 2012, respectively:
page 33, Figure 21: the figure was corrected; page 5, Table 3: column 15, row E2, now reads 'OL'.

Suggested citation: European Centre for Disease Prevention and Control. Third external quality assurance scheme for *Salmonella* typing. Stockholm: ECDC; 2012.

Stockholm, April 2012

ISBN 978-92-9193-342-6

doi 10.2900/34187

Contents

Abbreviations and symbols

Abbreviations

AMP	Ampicillin
AST	Antimicrobial susceptibility testing
ATCC	American Type Culture Collection
CAMHB	Cation-adjusted Mueller-Hinton broth
CHL	Chloramphenicol
CIP	Ciprofloxacin
CLSI	Clinical and Laboratory Standards Institute
CTX	Cefotaxime
CVI	Central Veterinary Institute
DSN	Dedicated surveillance network
DT	Definitive type
EEA	European Economic Area
ECDC	European Centre for Disease Prevention and Control
ESBL	Extended-spectrum beta-lactamase
EFSA	European Food Safety Authority
EQA	External quality assurance
EU	European Union
EUCAST	European Committee on Antimicrobial Susceptibility Testing
EURL-Salmonella	EU reference laboratory for *Salmonella*
EURL-AST	EU reference laboratory for antimicrobial resistance
FWD-Net	Food- and Waterborne Diseases and Zoonoses Network
GEN	Gentamicin
HPA	Health Protection Agency, UK
I	Intermediate
LGP	Laboratory of gastrointestinal pathogens
LZO	Laboratory for Zoonoses and Environmental Microbiology, Netherlands
MH agar	Mueller-Hinton agar
MIC	Minimal inhibition concentration
NAL	Nalidixic acid
NCCLS	National Committee for Clinical Laboratory Standards, USA
NRLs-Salmonella	National reference laboratories for *Salmonella*
NT	Not typable
PT	Phage type
QC	Quality control
R	Resistant
RIVM	National Institute for Public Health and the Environment, Netherlands
S	Susceptible
SE	*Salmonella* Enteritidis

STM	*Salmonella* Typhimurium
STR	Streptomycin
SUL	Sulfonamides
TET	Tetracycline
TMP	Trimethoprim
TSA	Trypticase soy agar
TSEs	Transmissible spongiform encephalopathies
UK	United Kingdom
WT	Wild type
XLD	Xylose lysine desoxycholate

Symbols

-	No reaction
±	5–20 plaques
+	21–40 plaques
++	41–80 plaques
+++	81–100 plaques
<<	Merging plaques towards semi-confluent lysis
CL	Confluent clear lysis
OL	Confluent opaque lysis
SCL	Semi-confluent lysis

Summary

Thirty-five laboratories of the Food- and Waterborne Diseases and Zoonoses Network (FWD-Net), 29 of which located in EU/EEA countries, participated in the third international external quality assurance (EQA) scheme for the typing of *Salmonella*. Six laboratories were located in non-EU/EEA countries.

Main findings

- All participating laboratories (including those in the EU/EEA) categorised 98% of the O antigens of the samples in agreement with the reference method and interpretive criteria. The participating EU/EEA laboratories categorised 91% of the H antigens of the samples in agreement with the reference method and interpretive criteria, compared with 92% for all participants. The EU/EEA laboratories were able to assign the correct serovar names for 90% of the samples (overall correct rate: 91%). In this third EQA scheme, fewer laboratories have deviating results compared with the second EQA. The results are comparable with those obtained in the first EQA scheme.
- The phage-typing results show that EU/EEA laboratories correctly phage-typed 80% of the *S.* Enteritidis strains (all laboratories: 82%). For S. Typhimurium, 79% of the strains were phage-typed correctly by the EU/EEA laboratories (overall correct rate 81%). Overall, the phage-typing results in the third EQA scheme were good, but when compared to the results of the second EQA scheme there were more deviations in the results for both S. Enteritidis and S. Typhimurium. Compared to the first EQA, results in this study were better.
- Antibiotic susceptibility testing (AST) results show a high level of performance: twenty of the 23 EU/EEA laboratories produced results that were more than 95% correct (all laboratories: 87%). Overall, 79% of all participating laboratories produced ≤ 5% deviations. If a threshold of 90% accuracy was applied, all but two participating laboratories would have been approved. Overall, in the third EQA scheme, 97% of 2448 evaluated tests were typed correctly, compared with 96% of 2443 evaluated tests in the second scheme, and 95% of a total of 2849 evaluated tests in the first EQA scheme.

The third international external quality assurance (EQA) scheme for the typing of *Salmonella* spp. was launched in November 2010. The study included the laboratories of the Food- and Waterborne Diseases and Zoonoses surveillance network and was organised by the Laboratory for Zoonoses and Environmental Microbiology (LZO) of the National Institute for Public Health and the Environment (RIVM, Bilthoven, Netherlands) in collaboration with the *Salmonella* Reference Unit of the Laboratory of Gastrointestinal Pathogens (LGP) of the Health Protection Agency (HPA) in London and the Department of Bacteriology and TSEs at the Central Veterinary Institute (CVI) of Wageningen University (Lelystad, Netherlands).

Three procedures for typing *Salmonella* spp. were evaluated in this EQA scheme: serotyping, phage typing and AST. The main objective of the EQA scheme was to assess whether typing of *Salmonella* strains by different laboratories within and outside the European Union was carried out uniformly and whether comparable results could be obtained.

Thirty-five laboratories took part in this study, of which two did not return their results. Twenty-nine EU/EEA and six non-EU/EEA laboratories participated.

Twenty strains of the species *Salmonella enterica* subspecies *enterica* were selected by RIVM for serotyping. Thirty-two participants performed serotyping of the strains, 26 of these were EU/EEA laboratories. Under the rules of the scheme, strains had to be typed with the method routinely used in each laboratory. The detected H and O antigens and serovar names (according to the White-Kauffmann-Le Minor scheme) had to be reported. Most problems were encountered in typing the H antigens. EU/EEA laboratories as well as all other participating laboratories typed O antigens correctly in 98% of the samples. The EU/EEA laboratories typed 91% of the samples correctly for H antigens (overall correct rate: 92%). 90% of the samples were identified with the correct serovar names by EU/EEA laboratories, compared with 91% for all laboratories. Fifteen of the 26 (58%) of the EU/EEA laboratories, and nineteen of the 32 (59%) participating laboratories correctly identified all 20 serovars. One serovar (*S.* Agona) was correctly typed by all participants.

The HPA selected 20 strains for phage typing. Ten strains belonged to the serovar *Salmonella* Enteritidis and ten strains to the serovar *Salmonella* Typhimurium. Nineteen participants performed phage typing of the *S.* Enteritidis strains, 15 of which were EU/EEA laboratories. Two laboratories did not carry out phage typing on *S.* Typhimurium strains, therefore only 17 participants provided results on phage typing of *S.* Typhimurium (13 EU/EEA countries). Overall, 80% of the *S.* Enteritidis strains were phage-typed correctly by the EU/EEA laboratories (overall correct rate: 82%). For *S.* Typhimurium, 79% of the strains were phage-typed correctly by the EU/EEA laboratories (overall correct rate: 81%).

Ten strains of various *Salmonella* serovars were selected by CVI for AST. These strains were tested by the participants for susceptibility to a panel of ten antibiotics. Twenty-eight laboratories participated in the AST of the strains, 23 of which were EU/EEA laboratories. Eleven of the participating laboratories employed a quantitative method producing minimum inhibitory concentrations (MIC values), and 17 laboratories employed a qualitative disk diffusion test producing zone diameters. The laboratories categorised the results as susceptible (S), intermediate (I) or resistant (R), based on their own interpretive criteria. Minor deviations in the interpretation of the AST results were found in 1.9% of all 2448 evaluated test results, and 1.1% of these results showed major deviations. Errors mostly occurred when inadequate interpretive criteria were applied.

With respect to AST results, all but two participating laboratories would have been approved, assuming a threshold of 90% accuracy. Twenty of the 23 EU/EEA laboratories (87%) and 23 of the 28 overall participants (79%) produced ≤ 5% deviations, which points towards a very high standard of antimicrobial susceptibility testing.

1 Introduction

1.1 Background

The European Centre for Disease Prevention and Control (ECDC) is a European Union (EU) agency with a mandate to operate the dedicated surveillance networks (DSNs) and to identify, assess, and communicate current and emerging threats to human health from communicable diseases. Within its mission, ECDC shall

> foster the development of sufficient capacity within the Community for the diagnosis, detection, identification and characterisation of infectious agents which may threaten public health. The Centre shall maintain and extend such cooperation and support the implementation of quality assurance schemes[1].

External quality assurance (EQA), as an integral part of quality management, evaluates performance of laboratories by commissioning third party providers which distribute a series of samples and also provide all laboratory testing supplies. ECDC's disease-specific networks organised a series of EQA schemes for EU/EEA countries. In some instances, these networks also include non-EU/EEA countries, which then also participate in ECDC's EQA activities. ECDC's EQA schemes are designed to identify areas for improvement in laboratory diagnostics relevant to disease surveillance as outlined in Decision No 2119/98/EC[2] and ensure the comparability of results between laboratories in EU/EEA countries. The main purposes of external quality assurance schemes include the:

- assessment of the general standard of performance;
- assessment of the effects of analytical procedures (method principle, instruments, reagents, calibration);
- evaluation of individual laboratory performance;
- identification and justification of problem areas;
- provision of continuing education; and
- identification of needs for training activities.

1.2 ECDC programme, role of EQA, and specific objectives

Since its inception, Enter-net, an international surveillance network of national reference laboratories and surveillance centres on selected human gastrointestinal infections, was funded by the European Commission. Since 2 October 2007 the Enter-net network has been subsumed into the ECDC disease programme for Food- and Waterborne Diseases and Zoonoses. In 2008, a framework contract on external quality assurance for *Salmonella* and verocytotoxin-producing *E. coli* (VTEC) was put in place for the years 2008 to 2011. The *Salmonella* EQA contract was won by a consortium led by the Laboratory for Zoonoses and Environmental Microbiology (LZO) of the National Institute for Public Health and the Environment (RIVM, Bilthoven, Netherlands), in collaboration with the *Salmonella* Reference unit of the Laboratory of Gastrointestinal Pathogens (LGP) of the Health Protection Agency (HPA, Colindale) in London and the Department of Bacteriology and TSEs at the Central Veterinary Institute (CVI) of Wageningen University (Lelystad, Netherlands). This consortium arranges annual EQA audits on serotyping, phage typing and AST for *Salmonella*. for national reference laboratories in EU/EEA countries. EU candidate countries are also invited to participate at cost. Non-EU/EEA countries can also participate at their own expense.

The main objective of the EQA scheme on typing of *Salmonella* spp. is to evaluate whether typing of *Salmonella* strains by different laboratories within and outside the EU is carried out uniformly and whether comparable results could be obtained.

[1] Regulation (EC) No 851/2004 of the European Parliament and of the Council of 21 April 2004 establishing a European Centre for Disease Prevention and Control, Article 5.3

[2] Decision No 2119/98/EC of the European Parliament and of the Council of 24 September 1998 setting up a network for the epidemiological surveillance and control of communicable diseases in the Community

2 Materials and methods

2.1 Organisation of the study

The third EQA scheme on typing of *Salmonella* spp was organised for the laboratories of the Food- and Waterborne Diseases and Zoonoses Network (FWD-Net). An invitation letter was sent to the national EU/EEA reference laboratories for serotyping, phage-typing and antimicrobial resistance testing for *Salmonella*. EU candidate countries were also invited to participate. Non-EU/EEA countries were invited to participate at their own expense. Participating laboratories were given a choice of employing either all or only selected typing methods. A full list of participants is given in Annex 1.

All participants were assigned a laboratory code (F1–F36), which, at the request of ECDC, was identical to the code used in the first and second EQA scheme.

Three weeks before the start of the study the laboratories received the protocol and a test report form (including a questionnaire) via e-mail. The protocol and test report form are reproduced in Annex 8 and Annex 9.

All samples were packed and classified as UN3373 (Biological Substance, Category B) and shipped by door-to-door courier service. The parcels containing the strains for serotyping, phage typing, and/or AST were mailed by RIVM-LZO on 8 November 2010.

2.2 *Salmonella* strains for serotyping

A total of 20 strains of the species *Salmonella enterica* subspecies *enterica* were selected by RIVM for serotyping. These *Salmonella* strains originated from the collection of the National *Salmonella* Centre (RIVM) in the Netherlands. The strains were typed once again by LZO before mailing. The antigenic formula of the 20 serovars, according to the most recent White-Kauffmann-Le Minor scheme (Grimont and Weill, 2007), are shown in Table 1.

Table 1: Antigenic formulas of the 20 *Salmonella* strains according to the White-Kauffmann-Le Minor scheme used in the third EQA scheme on *Salmonella* typing

No.	Serovar	O antigens	H antigens (phase 1)	H antigens (phase 2)
S1	Carno	1,3,19	z	l,w
S2	Bredeney	1,4,12,27	l,v	1,7
S3	Bracknell	13,23	b	1,6
S4	Plymouth	9,46	d	z_6
S5	Liverpool	1,3,19	d	e,n,z_{15}
S6	Meleagridis	3,10	e,h	l,w
S7	Chester	1,4,[5],12	e,h	e,n,x
S8	Agona	1,4,[5],12	f,g,s	-
S9	Hadar	6,8	z_{10}	e,n,x
S10	Typhimurium	1,4,[5],12	i	1,2
S11	Molade	8,20	z_{10}	z_6
S12	Give	3,10	l,v	1,7
S13	Derby	1,4,[5],12	f,g	-
S14	Anatum	3,10	e,h	1,6
S15	Enteritidis	1,9,12	g,m	-
S16	Virchow	6,7,14	r	1,2
S17	Schwarzengrund	1,4,12,27	d	1,7
S18	1,4,[5],12:i:-	1,4,[5],12	i	-
S19	Infantis	6,7,14	r	1,5
S20	Berta	1,9,12	[f],g,[t]	-

The evaluation of the serotyping results is described in Table 2.

Table 2: Evaluation of serotyping results

Results of serotyping	Evaluation
Auto agglutination or incomplete set of antisera (outside the range of antisera)	**nt = not typable**
Partly typable due to incomplete set of antisera or part of the formula (for the name of the serovar)	**+/- = partly correct**
Wrong serovar or mixed sera formula	**- = incorrect**

2.3 *Salmonella* strains for phage typing

The *Salmonella* strains for phage typing were obtained from the collection of the Salmonella Reference Unit of the Laboratory of Gastrointestinal Pathogens, Health Protection Agency, London, UK. Ten strains of *Salmonella* Enteritidis and 10 strains of *Salmonella* Typhimurium were selected (Table 3 and 4). After selection, the phage reactions of the strains were checked before forwarding them to RIVM for distribution to the participating laboratories. A set of strains for distribution were returned to the Salmonella Reference Unit and the phage reactions were re-checked.

Table 3: Phage reactions of the *Salmonella* Enteritidis strains used in the third EQA scheme on *Salmonella* typing

			Phage reactions at routine test dilution (*S.* Enteritidis)															
Strain no.	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
E1	55	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
E2	1b	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	SCL	CL	CL	CL	SCL	OL	OL	SCL
E3	15a	-	-	++	-	CL	+++	-	OL	-	OL	-	CL	CL	-	-	-	-
E4	6a	-	SCL	-	OL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	SCL
E5	13a	-	-	-	OL	-	SCL	-	OL	OL	SCL	-	-	-	-	-	-	SCL
E6	6	-	SCL	-	OL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	SCL
E7	8	-	-	SCL	<OL	CL	SCL	<CL	OL	OL	<OL	CL	CL	-	-	-	-	SCL
E8	1	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	<OL	CL	CL	CL	<CL	-	-	SCL
E9	13	-	-	-	SCL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	++
E10	4	-	SCL	CL	OL	CL	SCL	CL	OL	OL	<OL	CL	CL	CL	-	-	-	SCL

- = *no reaction*
± = *5–20 plaques*
+ = *21–40 plaques*
++ = *41–80 plaques*
+++ = *81–100 plaques*
SCL = *semi-confluent lysis*
CL = *confluent clear lysis*
OL = *confluent opaque lysis*
<< = *merging plaques towards semi-confluent lysis*

Table 4: Phage reactions of the *Salmonella* Typhimurium strains used in the third EQA scheme on Salmonella typing

		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Strain no.	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
T1	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T2	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T3	46a	-	SCL	OL	OL	OL	OL	-	-	OL	OL	-	-	OL	OL	OL	OL	-	OL
T4	7	-	-	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	CL	-
T5	15a	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	OL	-	OL	-	SCL
T6	24	-	-	SCL	-	-	-	-	-	-	-	-	-	CL	-	-	-	-	-
T7	15	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	OL	-	OL	CL	++
T8	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T9	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+++	-
T10	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL

		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Strain no.	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10 var 2**	**10 var 3**	**18**
T1	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	+	-
T2	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	OL
T3	46a	SCL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	OL	+	+	+	-	-	-	OL
T4	7	+	-	-	-	-	-	-	-	-	-	OL	-	+	+	+	SCL	OL	OL	-
T5	15a	SCL	-	-	-	-	-	-	-	-	-	OL	-	+	+	+	OL	OL	OL	+
T6	24	-	-	-	-	CL	-	CL	-	-	-	-	-	+	+	+	SCL	OL	OL	±
T7	15	SCL	-	-	-	-	-	-	-	-	-	OL	-	±	±	±	OL	OL	OL	±
T8	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
T9	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
T10	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	OL	++	++	++	OL	OL	OL	CL

For notations see Table 3.

2.4 Strains and antibiotics for antimicrobial susceptibility testing (AST)

The *Salmonella* strains used for the AST originated from the collection of the Department of Bacteriology and TSEs at the Central Veterinary Institute (CVI) of Wageningen UR (Lelystad, Netherlands). The ten strains were numbered A1 through A10. The strains were selected based on their resistance phenotype.

Compared to the second EQA strain collection used for AST, the aim was to include fewer isolates with susceptibility patterns close to the breakpoints in order to reduce the number of results showing artificial deviation.

A summary of the serotypes and sources of strains A1 to A10 is given in Table 5.

Table 5: Serotypes and sources of AST strains

AST strains	Source	Serotype	Characteristics
A1	Reconstituted meat	*S.* Indiana	Fully susceptible
A2	Faeces	*S.* Typhimurium	
A3	Faeces	*S.* Kentucky	Multiple QRDR mutations
A4	Poultry products	*S.* Paratyphi B var. Java	bla_{CMY-2}, multiple QRDR mutations
A5	Poultry products	*S.* Minnesota	
A6	Bovine products	*S.* Typhimurium	
A7	Poultry products	*S.* Infantis	$bla_{CTX-M-1}$
A8	Blood	*S.* Montevideo	*qnrS1*
A9	Blood	*S.* Typhimurium	
A10	Faeces	*S.* Typhimurium	Single QRDR mutation

The strains were tested in duplicate at CVI for their susceptibility by broth microdilution method using *Sensititre* plates (Trek Diagnostic Systems, UK) according to ISO-20776-1:2006 (International Organization for Standardization, 2006). Based on the results of the first EQA and in order to meet with EFSA guidelines for resistance surveillance in *Salmonella* (EFSA, 2007), amoxicillin-clavulanic acid, ceftazidime, kanamycin, neomycin, florfenicol and trimethoprim/sulphamethoxazole were excluded from the panel in the third EQA and the second EQA.

E. coli ATCC 25922 was used as control strain. The MIC values determined for the prescribed panel of antibiotics and the categories resistant (R), intermediate (I) and susceptible (S), based on EUCAST clinical breakpoints (www.eucast.org) are shown in Table 6.

Table 6: MIC results (in mg/L) and classification (S, I, R) of AST strains and quality control (QC) ranges (mg/L and mm) for *E. coli* ATCC 25922 (ISO-20776-1:2006, based on CLSI M100-S21))

	AMP	CTX	CHL	CIP	GEN	NAL	STR	SUL	TET	TMP
A 1	<= 0.5 (S)	<= 0.06 (S)	8 (S)	0.03 (S)	0.5 (S)	<= 4 (S)	16 (S)	<= 8 (S)	2 (S)	<= 0.5 (S)
A 2	>32 (R)	<= 0.06 (S)	8 (S)	0.03 (S)	1 (S)	<= 4 (S)	>128 (R)	>1024 (R)	>64 (R)	>32 (R)
A 3	>32 (R)	0.12 (S)	8 (S)	8 (R)	16 (R)	>64 (R)	>128 (R)	>1024 (R)	>64 (R)	<= 0.5 (S)
A 4	>32 (R)	>4 (R)	16 (R)	2 (R)	<= 0.25 (S)	>64 (R)	64 (R)	<= 8 (S)	4 (S)	>32 (R)
A 5	1 (S)	0.12 (S)	8 (S)	0.03 (S)	0.5 (S)	<=4 (S)	8 (S)	>1024 (R)	>64 (R)	<= 0.5 (S)
A 6	2 (S)	0.25 (S)	>64 (R)	0.03 (S)	<= 0.25 (S)	<=4 (S)	64 (R)	>1024 (R)	2 (S)	>32 (R)
A 7	>32 (R)	>4 (R)	8 (S)	0.03 (S)	0.5 (S)	<=4 (S)	32 (S)	>1024 (R)	2 (S)	>32 (R)
A 8	2 (S)	0.12 (S)	8 (S)	0.5 (S)	0.5 (S)	8 (S)	16 (S)	>1024 (R)	2 (S)	>32 (R)
A 9	1 (S)	0.12 (S)	8 (S)	0.03 (S)	1 (S)	<=4 (S)	128 (R)	<= 8 (S)	2 (S)	>32 (R)
A 10	>32 (R)	0.12 (S)	>64 (R)	0.25 (S)	0.5 (S)	>64 (R)	128 (R)	>1024 (R)	32 (R)	<= 0.5 (S)
QC range MIC[1]	2-8	0.03-0.12	2-8	0.004-0.015	0.25-1	1-4	No criteria	8-32	0.5-2	0.5-2
QC range disk	16-22	29-35[2]/25-31[3]	21-27	30-40	19-26	22-28	No criteria	No criteria	18-25	21-28

[1]ISO/CLSI QC ranges MIC; [2]CLSI 30 µg disk; [3]EUCAST 5 µg disk

Dark grey cells = resistant (R); light grey cells = intermediate susceptible (I); white cells = susceptible (S)

The participating laboratories were asked to use their standard method for susceptibility testing. When a disk diffusion test was used, the following antibiotics and concentrations in the disks were requested:

- ampicillin (10 µg)
- cefotaxime (30 µg CLSI, 5 µg EUCAST)
- chloramphenicol (30 µg)
- ciprofloxacin (5 µg)
- gentamicin (10 µg)
- nalidixic acid (30 µg)
- streptomycin (10 µg)
- sulfonamides (250 or 300 µg)
- tetracycline (30 µg)
- trimethoprim (5 µg)

Laboratories that did not have the disks with the required amount of antibiotics were asked to omit that antibiotic from their list. For the MIC determinations, the participants were asked to test the same antibiotics as required for the diffusion tests.

Those participants using a quantitative method were asked to record the determined MIC values. All participants were asked to categorise their results as susceptible (S), intermediate (I) or resistant (R), according to their own

breakpoint criteria. The deviations from the categories determined by CVI (Table 6) were classified as minor or major deviations. For example, an R-I (a resistant strain classified as intermediate or vice versa) or an S-I deviation were classified as a 'minor deviation', while an S-R or an R-S deviation constituted a 'major deviation'.

The clinical breakpoints for MICs (according to EUCAST) and interpretive criteria for disk diffusion (according to guideline EUCAST) are shown in Table 7.

Table 7: Interpretive criteria in mg/L for MIC and in mm for disk diffusion (EUCAST clinical breakpoints (v 1.1)

	MIC (www.EUCAST.org) (mg/L)		Disk diffusion (www.EUCAST.org) (mm)	
Ampicillin (AMP)	≤ 8	> 8	≥ 14	< 14
Cefotaxime (CTX)	≤ 1	> 2	≥ 21	< 18
Chloramphenicol (CHL)	≤ 8	> 8	≥ 17	< 17
Ciprofloxacin (CIP)	≤ 0.5	> 1	≥ 22	< 19
Gentamicin (GEN)	≤ 2	> 4	≥ 17	< 14
Nalidixic Acid (NAL)	≤ 16	> 16	≥ 15**	< 15**
Streptomycin (STR)	≤ 32	> 32	≥ 15*	< 12*
Sulfonamides* (SUL/SMX)	≤ 256*	> 256	≥ 17*	< 13*
Tetracycline (TET)	≤ 4*	> 8	≥ 15*	< 12*
Trimethoprim (TMP)	≤ 2	> 4	≥ 18	< 15

** CLSI breakpoints used; ** interpretive criteria based on EUCAST zone-diameter distribution (www.eucast.org)*

3 Results

3.1 Overview of participation and results

Overall, thirty-five laboratories participated in the third EQA scheme, but two laboratories did not return their results. Twenty-nine laboratories were located in the different Member States of the European Union (EU) or in countries of the European Economic Area (EEA); the remaining six were from countries outside the EU/EEA.

An overview of the number of laboratories scoring 100% according to intended results and the number of laboratories participating per test (laboratories in EU/EEA countries and all participating laboratories) is given in Table 8.

Table 8: Number of laboratories scoring 100% according to intended results and number of laboratories participating per test, EU/EEA countries and all participating laboratories

Tests	EU/EEA		All laboratories	
	All correct	**Participating**	**All correct**	**Participating**
Serotyping (20 strains)				
O antigens	21	26	30	32
H antigens	16	26	29	32
Serovar name	15	26	20	32
Phage typing				
S. Enteritidis (10 strains)	7	15	7	19
S. Typhimurium (10 strains)	3	13	5	17
Antimicrobial susceptibility testing (AST) (10 antimicrobials, 10 strains*)	4	23	5	28

** Chloramphenicol for AST-4; ciprofloxacin for AST-4, 8 and 10; and streptomycin for AST-7 and 8 were excluded from the evaluation.*

3.2 Questionnaire results

3.2.1 General questions

In this section the questions and answers of the questionnaire are summarised. For details please refer to Annex 2.

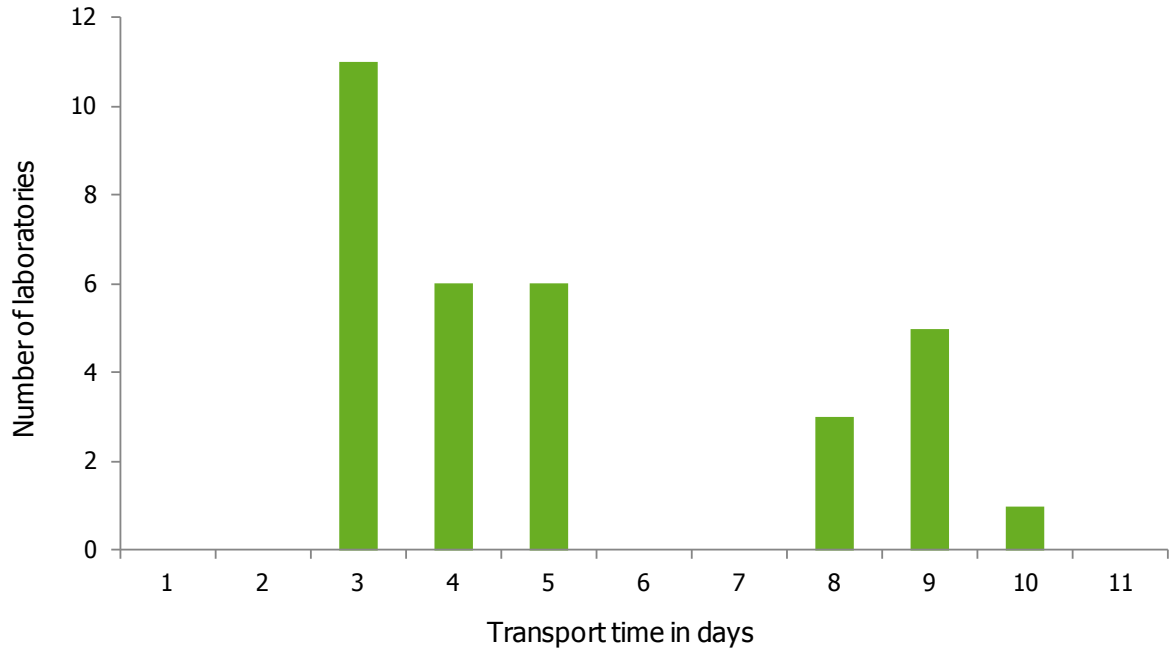
Question 1: Was your parcel damaged at arrival?

All parcels were received in perfect state and no damage was reported.

Question 2: What was the date of receipt at your laboratory?

Figure 1 shows the number of transit days for delivery of the parcels. Most laboratories received the parcels the same week they were sent (week 45/2010). For countries outside the EU/EEA, the parcels took more than four days to arrive (seven days: three laboratories, eight days: five laboratories, 10 days: one laboratory).

Figure 1: Duration of transport of the parcels to the laboratories



Question 3: What kind of medium did you use for sub-culturing the strains?

The laboratories used a variety of media from various manufacturers for the sub culturing of the *Salmonella* strains (see Table 1, Annex2). Nutrient agar and TSA were the most commonly used media.

3.2.2 Questions regarding serotyping

Details regarding serotyping are given in Annex 2, Table 2.

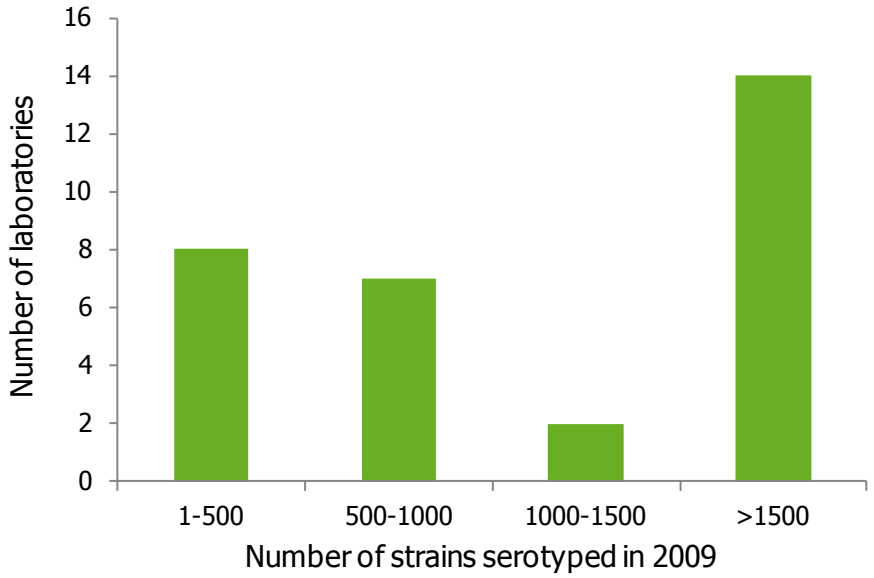
Question 4: What was the frequency of serotyping of **Salmonella** *at your laboratory in 2009?*

The majority of the laboratories (n=25) indicated that samples were serotyped daily. One laboratory serotypes twice a week, four laboratories serotype thrice a week. One (non-EU/EEA) laboratory only serotypes on demand.

Question 5: How many **Salmonella** *strains did your laboratory (approximately) serotype in 2009?*

Figure 2 shows the frequency distribution of the number of strains that were serotyped by the laboratories in 2009.

Figure 2: Frequency distribution of the number of strains serotyped by the laboratories in 2009



Question 6: What kind of sera do you use?

The number of laboratories that used sera from one or more manufacturers is given in Table 9. The different manufacturers and the number of laboratories that used their sera are given in Table 10.

Table 9: Number of laboratories that used sera from one or more manufacturers

Sera obtained from	Number of laboratories
One manufacturer	7
Two manufacturers	8
Three manufacturers	4
Four manufacturers	9
Five or more manufacturers	1

Table 10: Number of laboratories that used sera from each manufacturer

Manufacturer	Number of laboratories
SSI	24
Sifin	14
Bio-Rad	11
Denka Seiken	4
Reagensia AB	4
Dade Behring	3
Prolab	3
Remel	3
Difco	2
SiS Biomed	1
bioTRADING	1
Bio-Web	1
HillerØd	1
Immunolab	1
Mast Assure	1
Oxoid	1
Serobact	1

Question 7: Were the strains in this EQA scheme typed in your own laboratory?

All strains were typed in the participants' own laboratories.

3.2.3 Questions regarding phage typing

Details regarding phage typing are given in Annex 2, Table 3.

Question 8: Does your laboratory perform phage typing?

Nineteen laboratories carry out phage typing of *Salmonella* Enteritidis, and seventeen laboratories carry out phage typing of *Salmonella* Typhimurium.

Question 9: If yes, which Salmonella strains do you phage-type?

In addition to *S.* Enteritidis and *S.* Typhimurium, the most commonly phage-typed strains are *S.* Typhi (10 x), *S.* Paratyphi B (6 x), *S.* Hadar (5 x) and *S.* Virchow (6 x).

Question 10: Which typing system is used for **Salmonella Enteritidis***?*

Thirteen laboratories cite the Health Protection Agency, HPA Colindale, London, as the source of their typing system for *S.* Enteritidis. Five labs quote the 'Ward system', which is identical to the HPA's typing system. One country uses its own national system in addition to Ward's.

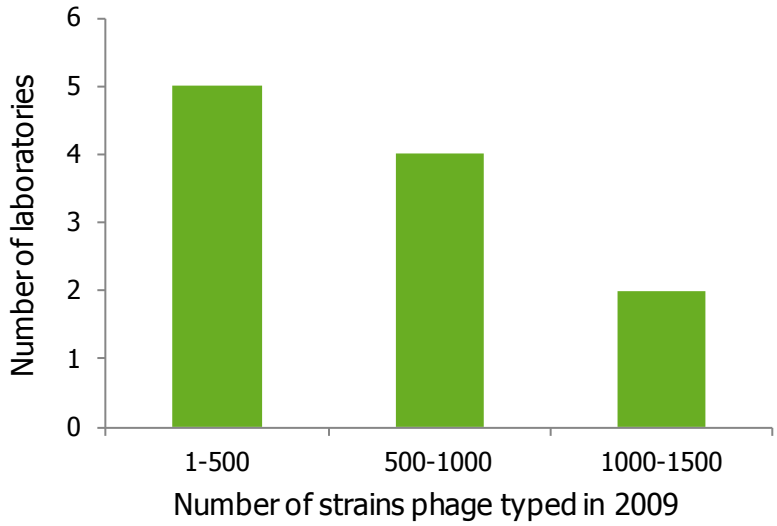
Question 11: Which typing system is used for **Salmonella** *Typhimurium?*

Thirteen laboratories refer to HPA Colindale as their typing system for *S.* Typhimurium. Four labs list 'Anderson's system', one laboratory uses the LEP system, and one country uses Felix-Callow's in addition to Anderson's, which is the same as the HPA Colindale system.

Question 12: How many strains did your laboratory (approximately) phage type in 2009?

Figure 3 shows the frequency distribution of the number of strains that were phage-typed by the laboratories in 2009.

Figure 3: Frequency distribution of the number of strains phage-typed by the laboratories in 2009



3.2.4 Questions regarding antimicrobial susceptibility testing (AST)

Details regarding AST in the questionnaire are given in Annex 2, Table 4 and 5. A summary is given below.

Question 13: What method do you use for AST?

A total of 17 laboratories, including one non-EU/EEA lab, used a disk diffusion method, and 11 laboratories, including three non-EU/EEA laboratories, used an MIC method for AST.

Question 14: Which control strain(s) do you use with routine analysis?

All but two laboratories used the *E. coli* ATTC 25922 strain as control strain. One laboratory did not supply information on this subject. Some laboratories also used additional strains, e.g. *E. faecalis, Klebsiella pneumoniae, Pseudomonas aeruginosa* or *Salmonella*.

Question 15: Which agar/broth medium do you use?

Mueller-Hinton agar was by far the most commonly used agar/broth medium.

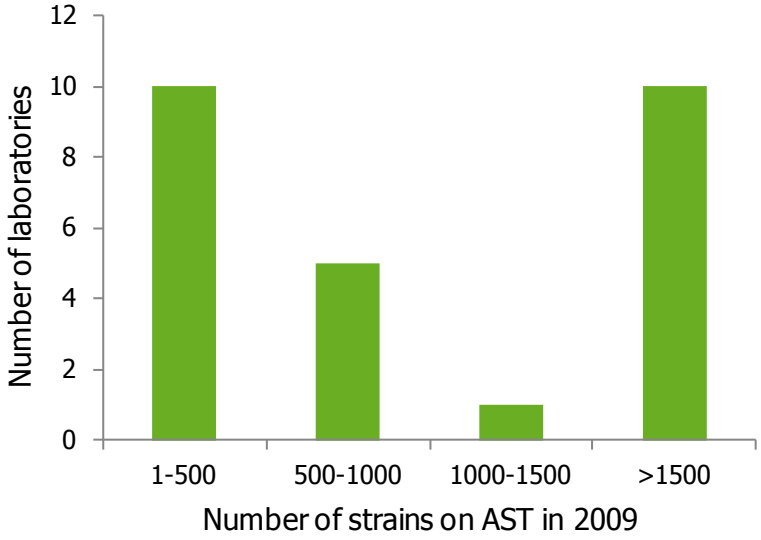
Question 16: What is the concentration of the inoculum in bacteria per ml?

Laboratories, using either method, commonly used approximately 1 x 10^8 cfu/ml (0.5 McFarland).

Question 17: How many strains were (approximately) tested for antimicrobial susceptibility in your laboratory in 2009?

Figure 4 shows the frequency distribution of the number of strains that were tested for antimicrobial susceptibility by the laboratories in 2009.

Figure 4: Frequency distribution of the number of strains tested for antimicrobial susceptibility by the laboratories in 2009



Question 18: Which antibiotics did you use in this EQA scheme?

The majority of the laboratories tested the entire range of antibiotics as indicated by the study. Some laboratories omitted one or more of these antibiotics, see overview Annex 2, Table 5.

3.3 Serotyping results

3.3.1 Serotyping results for the EU/EEA laboratories

Exact numbers on the correct or incorrect identification of O and H antigens and serovars (EU/EEA laboratories) are given in Annex 3 and summarised in Figures 5, 6, and 7.

Generally, the identification of H antigen produced more deviations than O antigen detection. Six laboratories had one to three incorrect results in the serotype name, one laboratory had four to six incorrect results, two laboratories had seven to nine incorrect results, and one laboratory had 13 to 15 incorrect results in the naming of the 20 serotypes. This particular laboratory also encountered difficulties in serotyping the H antigens.

Figure 5: Distribution of deviations in O antigen typing; EU/EEA laboratories

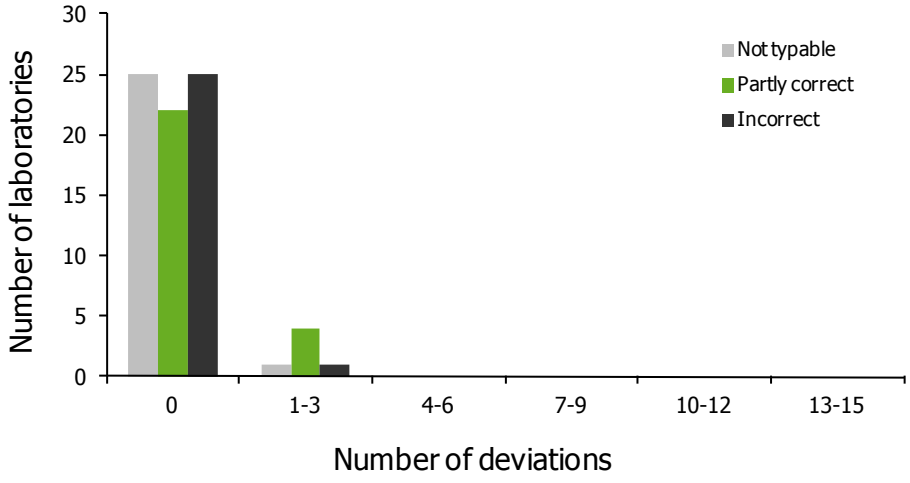


Figure 6: Distribution of deviations in H antigen typing; EU/EEA laboratories

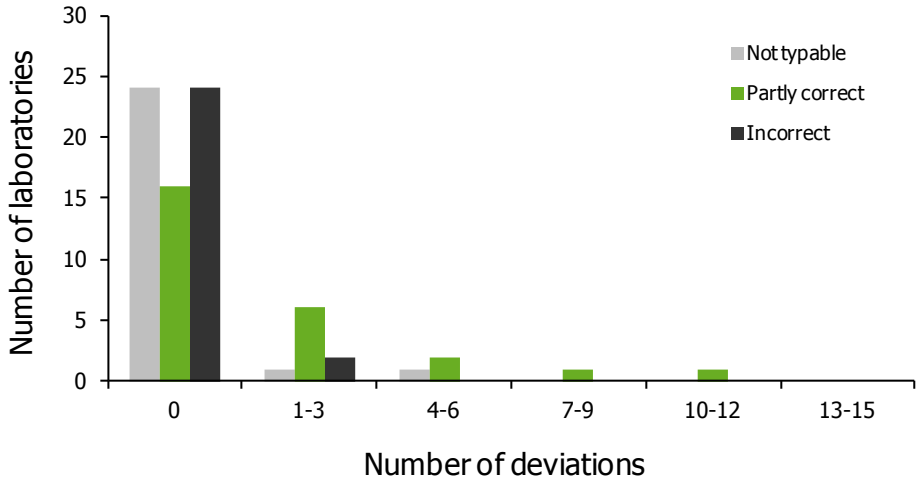


Figure 7: Distribution of deviations in serovar names; EU/EEA laboratories

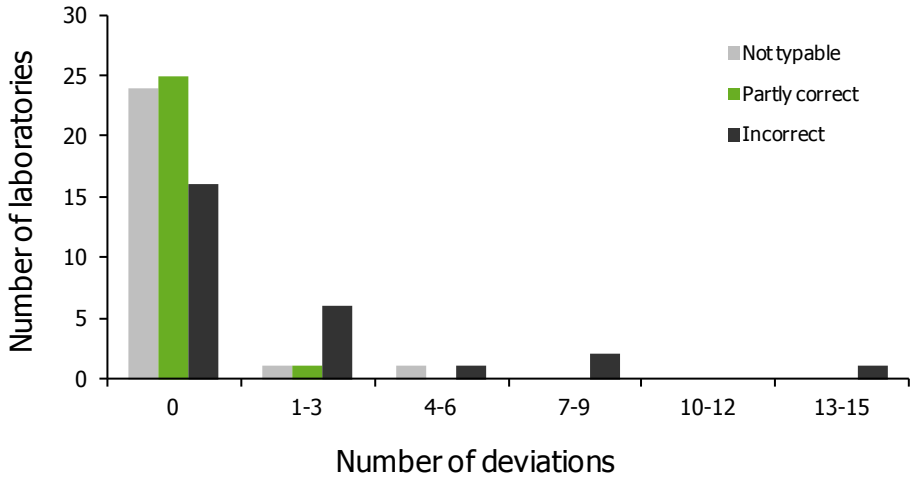


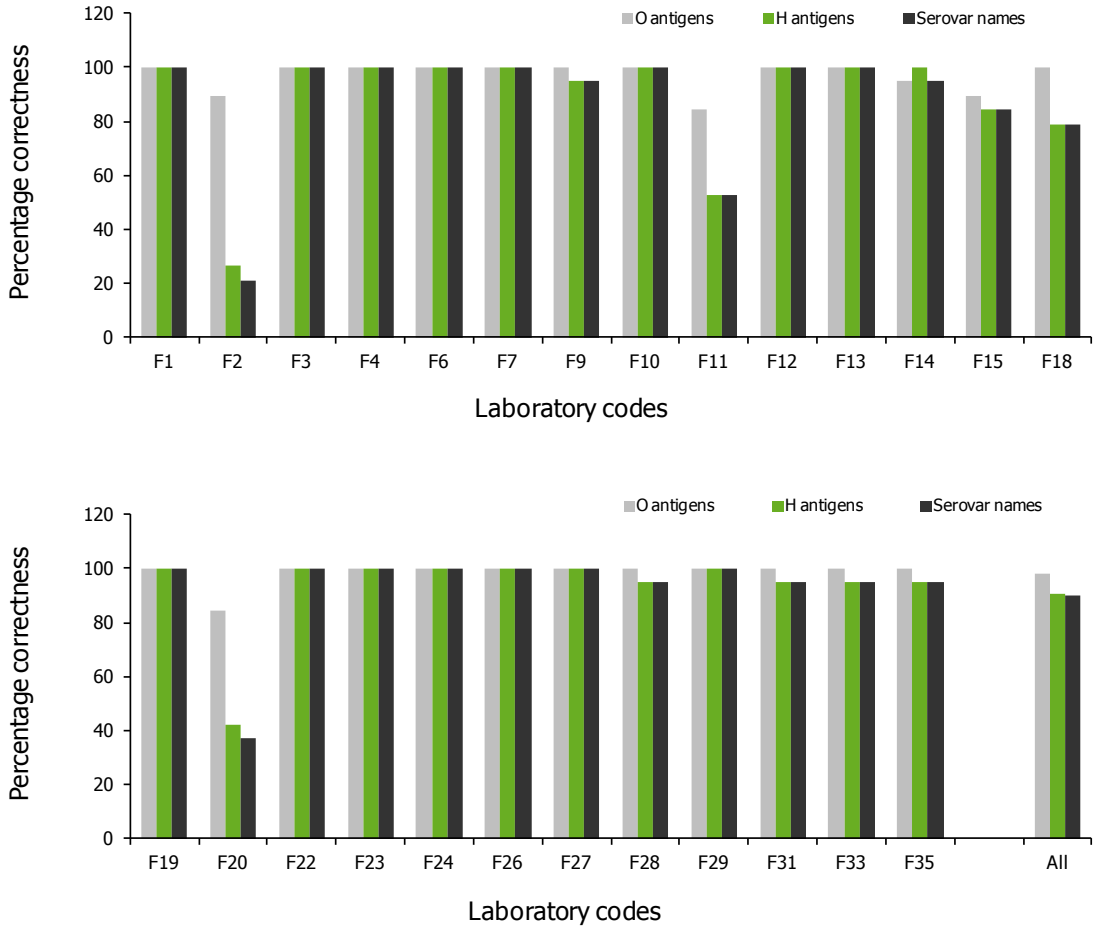
Figure 8 provides the percentage of correct identifications for O and H antigens and serovars for EU/EEA laboratories.

Twenty-one of the 26 participating EU/EEA laboratories (81%) typed all O antigens correctly. This corresponds to 98% of the total amount of strains.

Sixteen (62%) EU/EEA laboratories typed all H antigens correctly, corresponding to 91% of the total amount of strains.

Fifteen (58%) EU/EEA laboratories identified all serovar names correctly, corresponding to 90% of all strains.

Figure 8: Correctly serotyped samples in percent; EU/EEA laboratories



3.3.2 Serotyping results for all participants

Numbers on the detection of O and H antigens as well as serovar identification for all participating laboratories are shown in Annex 4. These results are summarised in Figures 9, 10, and 11.

In general, H antigen detection produced more deviations than O antigen detection. Eight laboratories had one to three incorrect results in the serotype name, one laboratory had four to six incorrect results, two laboratories had seven to nine incorrect results, and one laboratory had 13 to 15 incorrect results in the naming the 20 serotypes.

Figure 9: Distribution of deviations in O antigen detection for all laboratories

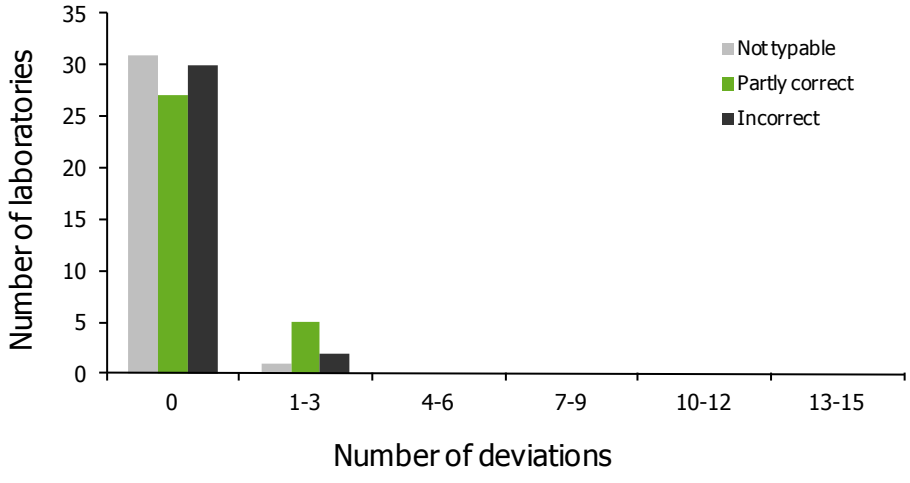


Figure 10: Distribution of deviations in H antigen detection for all laboratories

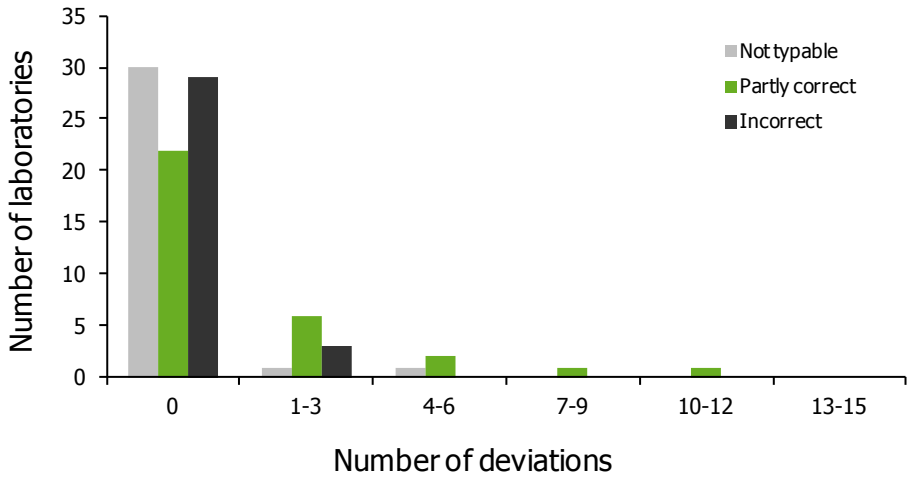
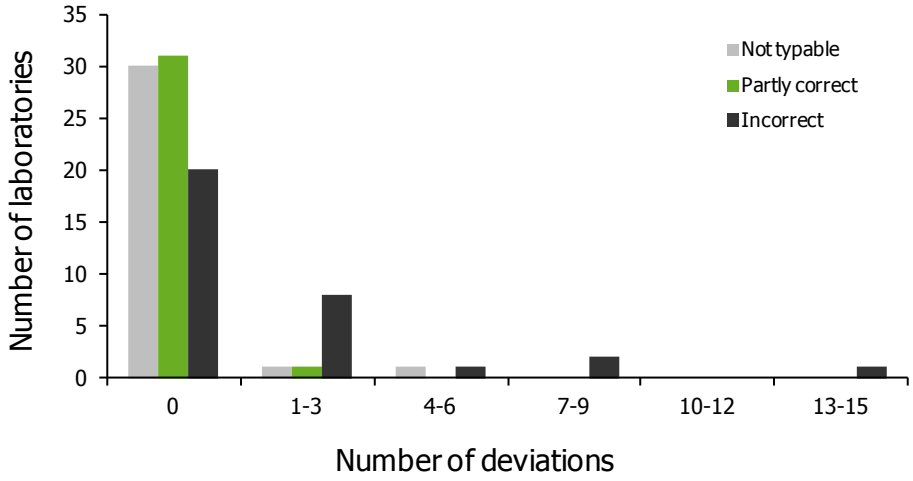
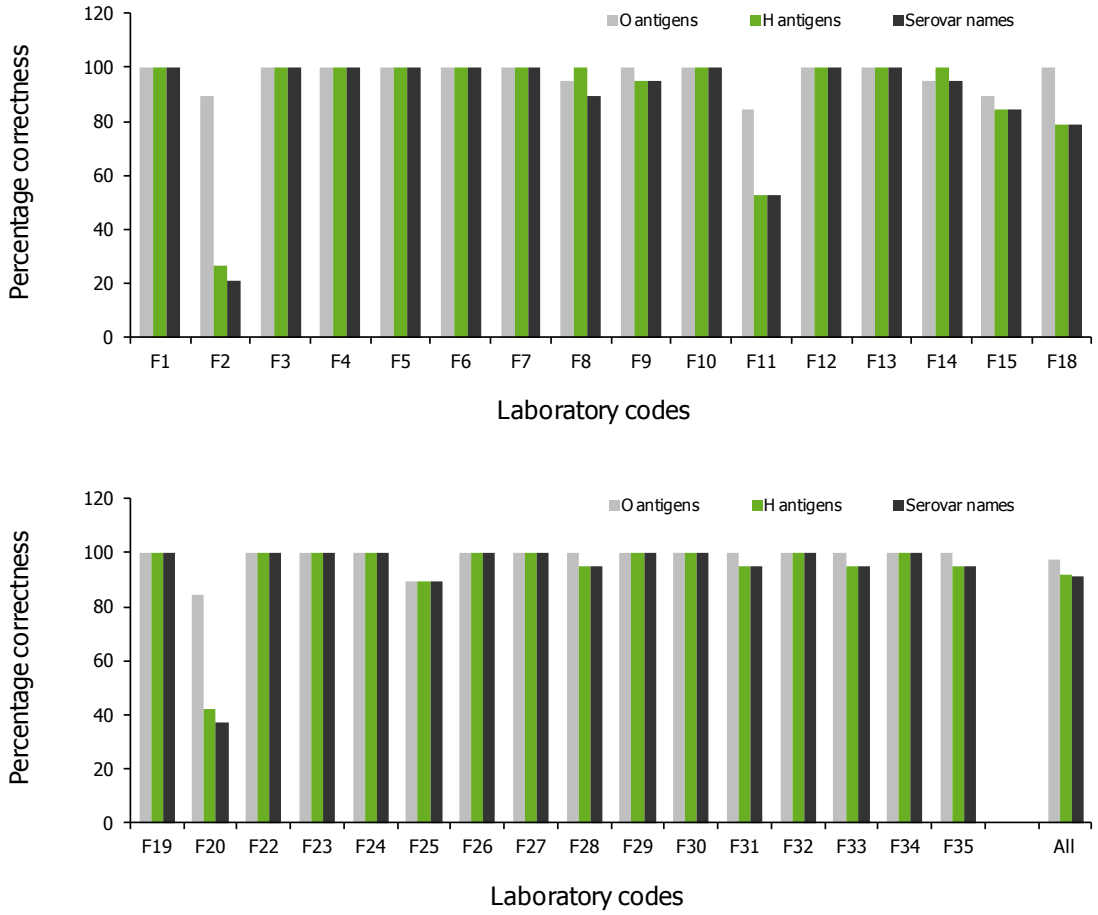


Figure 11: Distribution of deviations in serovar names for all laboratories



The percentage correctness of the detection of O and H antigens and identification of the strains for all laboratories are given in Figure 12. Twenty-five of the thirty-two participating laboratories (78%) typed all O antigens correctly. This corresponds to 98% of the total amount of strains. Twenty-one (66%) laboratories typed all H antigens correctly, corresponding to 92% of the total amount of strains. Nineteen laboratories (59%) identified all serovar names correctly, corresponding to 91% of all strains.

Figure 12: Correctly serotyped samples in percent; all participants



3.3.3 Results of serotyping per strain

Results for each strain and each laboratory are given in Table 11. The serovar names for strain S18 reported by the FWD laboratories showed a large variation of 'Typhimurium-like' names. An overview of reported serovar names can be found in Annex 5. These results confirm the recent findings published in an EFSA opinion in September 2010. In this opinion a proposal is made to harmonise reporting of this serovar by reporting the full antigenic formula in as much detail as possible.

In this year's study, strain S1 was excluded from the evaluation since it showed too many rough colonies.

A correct identification by all participants was obtained for one strain: *S.* Agona (S8).

Most problems occurred with serovar *S.* Liverpool (S5) and *S.* Chester (S 7). Six laboratories had difficulties reporting the correct serovar names for these two strains. Serovar *S.* Schwarzengrund (S17) was difficult to determine for five laboratories.

The characterisations of strains that were difficult to serotype are shown in Table 12. Investigations on the used sera (see section 3.2.2) showed that the overall serotyping problems were neither directly related to the use of a particular brand of sera nor to the number of different brands used.

Table 11: Test results of serotyping per strain for all laboratories

Lab	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	Y
REF	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	4,5,12:i:-	Infantis	Berta	
F1	Clerkenwell	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F2	Birmingham	Bredeney	Oudwijk	Strasbourg	Wanatah	Assinie	Tokoin	Agona	Glostrup	Haifa	Chomedey	Give	Limete	Ruzizi	Enteritidis	Colindale	Typhimurium	Tumodi	Virchow	Kiel	15
F3	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F4	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F5	Carno	Bredeney	Bracknell	Plymouth	Liverpool	Meleagridis	Chester	Agona	Hadar	Typhimurium	Molade	Give	Derby	Anatum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F6	Clerkenwell	Bre-	Bracknell	Plymouth	Liverpool	Melea-	Chester	Agona	Hadar	Typhi-	Molade	Give	Derby	Ana-	Enteritidis	Virchow	Schwarzengrund	see	Infantis	Berta	0

Lab	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	Y
		deney				gridis				murium				tum				Table X			
F7	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F8	Carno	Kortrijk	Oudwijk	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Malode	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	2
F9	Clerkenwell	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	San Diego	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	1
F10	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F11	Fulda	Bre-deney	Bracknell	Plymouth	Eingedi	Assinii	Chester	Agona	Bovismorb ificans	Typhi-murium	Molade	Bilu	Agona II	Newl ands	Enteritidis	Oranien-burg	Niloese	Farsta	Infantis	Berta	9
F12	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F13	Lerum	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Istambul/H adar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F14	Carno	Bre-deney	Bracknell	Zega	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	1
F15	Carno	Bre-deney	Bracknell	Plymouth	Strain in R-phase	Melea-gridis	4:e,h:-	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Strain in R-phase	see Table X	Infantis	Berta	3
F18	Carno	Bre-deney	Bracknell	Plymouth	Tilburg	Assinie	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Ayinde	Glou-cester	Infantis	Berta	4
F19	O:3,10,15,19	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F20	Harley-street	Bre-deney	Durham	?	?	Melea-gridis	?	Agona	Wippra	Typhi-murium	Kentucky	Give	Agona	Ana-tum	Enteritidis or Hilling-don	Infantis	Indiana	see Table X	untyp-able	Næst-ved	12
F22	Clerkenwell	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F23	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F24	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F25	Clerkenwell	Bre-deney	Bracknell	Plymouth	Liverpool	Meleagri tis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Berta	Infantis	2
F26	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F27	Clerkenwell	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F28	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	San Diego	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	1
F29	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F30	Clerkenwell	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F31	ssp I	Bre-deney	Bracknell	Plymouth	Um-badah	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	1
F32	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F33	Clerkenwell	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	Lagos	Infantis	Berta	1
F34	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	Chester	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	0
F35	Carno	Bre-deney	Bracknell	Plymouth	Liverpool	Melea-gridis	San Diego	Agona	Hadar	Typhi-murium	Molade	Give	Derby	Ana-tum	Enteritidis	Virchow	Schwarzengrund	see Table X	Infantis	Berta	1
X	14	1	3	3	6	3	6	0	3	1	2	1	3	2	1	3	5	4	3	3	53

X: number of deviating laboratories per strain

Y: number of deviating strains per laboratory

Table 12: Identifications per strain that caused problems in serotyping for all laboratories

Strain	O antigens	H antigens, phase 1	H antigens, phase 2	Serovar	Lab code
S-1	1,3,19	z	l,w	Carno	REF
S-1	1,3,10,15,	d	lw	Birmingham	F2
S-1	10	z	l,w	Clerkenwell	F33
S-1	3,10	z	l,v	Clerkenwell	F30
S-1	3,10	z	l, w	Clerkenwell	F27
S-1	3,10	z	l,w	Clerkenwell	F25
S-1	3,10	z	l,w	Clerkenwell	F22
S-1	3,10	z	l, w	Clerkenwell	F6
S-1	3,10	z	l,w	Clerkenwell	F1
S-1	3,10	z	l,w	Clerkenwell	F9
S-1	1,3,19	l ,w	5	Fulda	F11
S-1	3,10	z	6	Harleystreet	F20
S-1	1,3,19	z	1,7	Lerum	F13
S-1	3	z	l,w	O:3,10,15,19	F19
S-1	3,15	z	l,w	*S.* ssp I	F31
S-2	1,4,12,27	l,v	1,7	Bredeney	REF

Strain	O antigens	H antigens, phase 1	H antigens, phase 2	Serovar	Lab code
S-2	4	l,v	1,7	Kortrijk	F8
S-3	13,23	b	1,6	Bracknell	REF
S-3	13,23	b	z_{15}	Durham	F20
S-3	13,22	b	1,6	Oudwijk	F8
S-3	13,22	b	1,6	Oudwijk	F2
S-4	9,46	d	z_6	Plymouth	REF
S-4	9	?	?	?	F20
S-4	9,12	d	z_6	Zega	F14
S-4	9,46	d	1,7	Strasbourg	F2
S-5	1,3,19	d	e,n,z_{15}	Liverpool	REF
S-5	6,7	f,g,t	7	Eingedi	F11
S-5	1,3,19	d	1,2	Umbadah	F31
S-5	1,3,19	d	Lw	Tilburg	F18
S-5	1,3,19	d	1,7	Wanatah	F2
S-5	3,15	No response	No response	?	F20
S-5	Strain in R-phase	Strain in R-phase	Strain in R-phase	Strain in R-phase	F15
S-6	3,1	e,h	l,w	Meleagridis	REF
S-6	3,10	lw	z_6	Assinie	F18
S-6	3,10	l,w	z_6	Assinii	F11
S-6	3,10	l,w	z_6	Assinie	F2
S-7	1,4,[5],12	e,h	e,n,x	Chester	REF
S-7	4,12	eh	Enz_{15}	San Diego	F35
S-7	4,12	e,h	e,n,z_{15}	San Diego	F28
S-7	4,12	e,h	e,n,z_{15}	San Diego	F9
S-7	4	e,h	-	4:e,h:-	F15
S-7	4,12	z10	enz_{15}	Tokoin	F2
S-7	4	z_4,23;z_4,24	No response	?	F20
S-7	4	e,h	-	4:e,h:-	F15
S-8	1,4,[5],12	f,g,s	-	Agona	REF
S-9	6,8	z_{10}	e,n,x	Hadar	REF
S-9	6,8	z_{10}	z_6	Wippra	F20
S-9	6,8	z_{10}	e,n,z_{15}	Glostrup	F2
S-9	6,8,20	r	5	Bovismorbificans	F11
S-10	1,4,[5],12	i	1,2	Typhimurium	REF
S-10	1,4,5,12	z_{10}	1,2	Haifa	F2
S-11	8,2	z_{10}	Z_6	Molade	REF
S-11	8	i	Z_6	Kentucky	F20
S-11	8,2	z_{10}	e,n,z_{15}	Chomedey	F2
S-12	3,1	l,v	1,7	Give	REF
S-12	1,3,10,19	t	7	Bilu	F11
S-13	1,4,[5],12	f,g	-	Derby	REF
S-13	4	f,g,s	Z_6	Agona	F20
S-13	1,4,12	f,g,t	z_6, z $_{42}$	Agona II	F11
S-13	1,4,12	b	1,5	Limete	F2
S-14	3,10	e,h	1,6	Anatum	REF
S-14	3,10	l,v	e,n,z_{15}	Ruzizi	F2
S-14	3,10,34	e,h	enx	Newlands	F11
S-15	1,9,12	g,m	-	Enteritidis	REF
S-15	9	g,m	-	Enteritidis or Hillingdon	F20
S-16	6,7,14	r	1,2	Virchow	REF
S-16	6,7	r	1,5	Infantis	F20
S-16	6,7	r	1,7	Colindale	F2

Strain	O antigens	H antigens, phase 1	H antigens, phase 2	Serovar	Lab code
S-16	6,7	t	z_{57}	Oranienburg	F11
S-17	1,4,12,27	d	1,7	Schwarzengrund	REF
S-17	4	z	1,7	Indiana	F20
S-17	1,4,12	d	z_6	Ayinde	F18
S-17	1,4,5,12	i	1,2	Typhimurium	F2
S-17	1,3,19	d	z_6	Niloese	F11
S-17	Strain in R-phase	Strain in R-phase	Strain in R-phase	Strain in R-phase	F15
S-19	6,7,14	r	1,5	Infantis	REF
S-19	9,12	f,g	-	Berta	F25
S-19	6,7	r	1,2	Virchow	F2
S-19	6,7	Rough strain	Rough strain	untypable	F20
S-20	1,9,12	[f],g,[t]	-	Berta	REF
S-20	6,7	r	1,5	Infantis	F25
S-20	9	g,p,s	-	Næstved	F20
S-20	1,2,12	g,p	-	Kiel	F2

3.4 Phage-typing results

3.4.1 Phage-typing results for the EU/EEA laboratories

Thirteen laboratories carried out phage typing of both *Salmonella* Enteritidis and *Salmonella* Typhimurium. Two further laboratories only carried out phage typing of *S.* Enteritidis. Separate notations per phage type and per laboratory are given in Annex 6. The phage-typing results of the EU/EEA laboratories were evaluated by strain and by laboratory. Data for *S.* Enteritidis are shown in Table 13 and data for *S.* Typhimurium are shown in Table 14. Figure 13 displays the distribution of deviations in the phage typing of *S.* Enteritidis and *S.* Typhimurium for the EU/EEA laboratories. Correct phage types for the EU/EEA laboratories (in per cent) are shown in Figure 14.

Table 13: Results of *Salmonella* Enteritidis phage typing for EU/EEA laboratories

Lab code	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	Y
REF	**55**	**1b**	**15a**	**6a**	**13a**	**6**	**8**	**1**	**13**	**4**	0
F1	55	1b	15a	6a	28	6	8	1b	14c	4	3
F2	55	1b	15a	6a	13a	6	8	1	13	4	0
F4	55	1b	15a	6a	13a	6	8	1	13	4	0
F6	55	1b	15	6a	13a	6c	8	1b	14c	4b	5
F7	18	1b	15	6b	28	6c	8	1	14b	4b	7
F13	55	1b	15a	6a	13a	6	28	1	14b	4	2
F14	55	1b	15a	6a	13a	6	8	1	14b	4	1
F17	55	1d	15	6a	19	6	8	1b	13	45	5
F19	55	1b	15a	6a	13a	6	8	1	13	4	0
F23	55	1b	15a	6a	13a	6	8	1	13	4	0
F24	55	4a	15	14c	28	6	8	1b	13	23	6
F26	55	1b	15a	6a	13a	6	8	1	13	4	0
F27	55	1b	15a	6a	13a	6	8	1	13	4	0
F31	55	1b	15a	6a	13a	6	8	1	13	4	0
F35	55	1b	15a	6a	13a	6	8	1	14b	4	1
X	1	2	4	2	4	2	1	4	6	4	30

Grey cells = deviating results

X: number of deviating laboratories per strain; Y: number of deviating strains per laboratory

Table 14: Results of *Salmonella* Typhimurium phage typing for EU/EEA laboratories

Lab code	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Y
REF	**U310**	**208**	**46a**	**7**	**15a**	**24**	**15**	**193**	**104**	**36**	0
F1	U310	208	46a	59	75	24	15	193	104	36	2
F2	U310	U302	3	7	15a	24	120	193	110	36	4
F4	U310	208	46a	7	15a	24	15	193	104	36	0
F6	U302	208	46a	59	15a	24	15a	193	12	36	4
F7	195	U302	3	7	15a	24	15	193	104	36	3
F13	U310	208	46	20a	U289	24	15	193	104	36	3
F14	U310	208	46a	7	15a	24	15	193	104	36	0
F19	U310	208	46a	120	75	24	11	193	104	36	3

Lab code	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Y
F23	U310	208	46a	7	15a	24	15	193	104	36	0
F24	U310	U302	46a	20	15a	24	75	NT	12	36	5
F27	U310	208	46a	120	15a	24	15	193	104	36	1
F31	195	208	46a	7	15a	24	15	193	104	36	1
F35	U310	208	46a	104b	15a	24	15	193	104	36	1
X	3	3	3	7	3	0	4	1	3	0	27

Grey cells = deviating results

X: number of deviating laboratories per strain; Y: number of deviating strains per laboratory

Figure 13: Distribution of deviations in phage typing of *Salmonella* Enteritidis and *Salmonella* Typhimurium for the EU/EEA laboratories

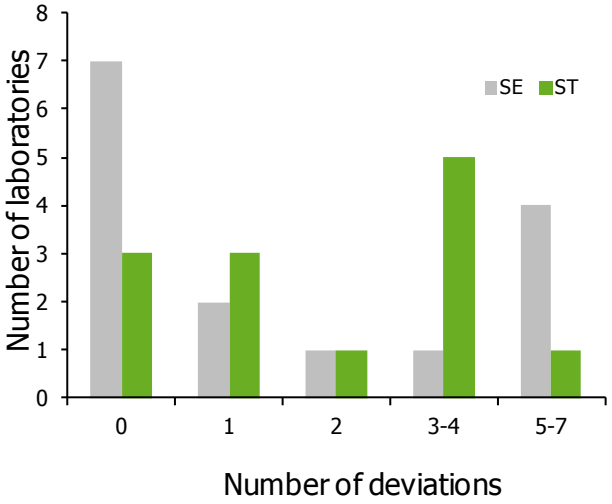
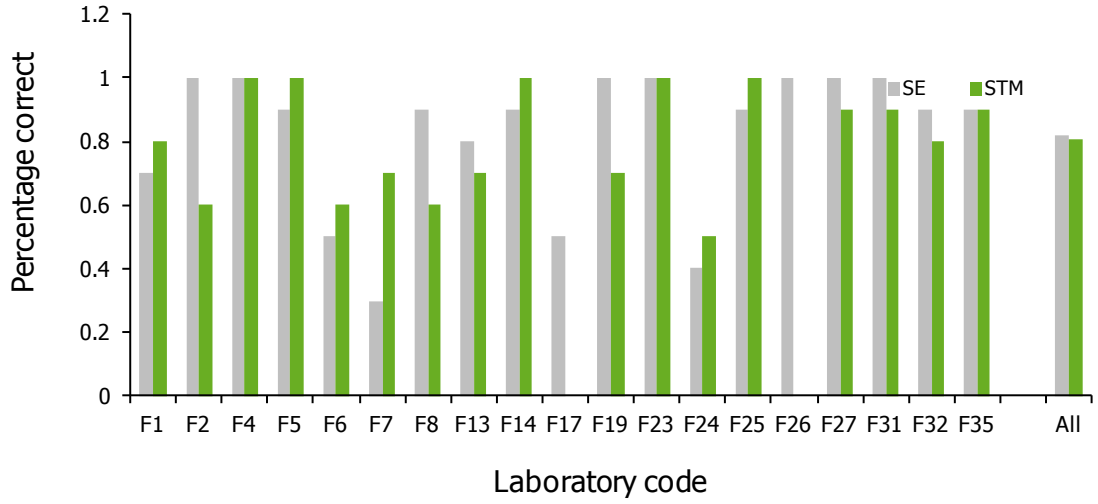


Figure 14: Percentage of strains correctly phage-typed for each of the EU/EEA laboratories



3.4.2 *S.* Enteritidis phage-typing results for the EU/EEA laboratories

Seven out of 15 laboratories assigned the correct phage type for all ten strains of *S.* Enteritidis. Three laboratories had one to two deviations each from the intended results. One laboratory had three to four deviations while four laboratories had five to seven deviations from the intended results (Figure 13).

Table 13 shows that no *S.* Enteritidis strain was phage-typed correctly by all participating laboratories.

The *S.* Enteritidis strain that caused most problems was **PT13 (strain E9)**; it was incorrectly phage-typed by six laboratories. Four laboratories incorrectly phage-typed PT13 as PT14b, and two laboratories phage-typed it as PT14c. These laboratories either obtained no or very low reactions with phages 4 and 9, and the two laboratories

that typed it as PT14c also had no reaction with phage 17. As all these laboratories correctly phage-typed the PT1b. The incorrect results for PT13 were probably due to the incorrect inoculum size of the broth culture used for the phage typing.

Four laboratories incorrectly phage-typed **PT15a (strain E3)** as PT15. The difference between these two phage types is the reaction with phage 16. The results suggest the titre of this phage was too high, as PT15a does not react with phage 16, and PT15 has a high reaction with this phage.

PT13a (strain E5) was incorrectly phage-typed by four laboratories. Three laboratories phage-typed it as PT28. These laboratories all obtained phage reactions with several phages that PT13a does not react with. This suggests that either the titre of the phages was too high or the inoculum size of the broth culture was not correct. One laboratory typed this strain as PT19, as it did not obtain any reaction with two of the phages, suggesting the titre of these two phages was too low.

Four laboratories incorrectly phage-typed the **PT1 (strain E8)** as PT1b and obtained a reaction with phage 16. As PT1 does not react with phage 16, these results suggest the titre of this phage was too high.

Four laboratories also incorrectly phage-typed **PT4 (strain E10)**. Two laboratories phage-typed this strain as PT4b. Again, these results were due to a reaction obtained with phage 16, and PT4 does not react with this phage. One laboratory phage-typed this strain as PT45, as they obtained some low reactions with some of the phages, and this may have been due to the titre of these phages being too low. PT4 (strain E10) was phage-typed as PT23 by one laboratory. Strains that have become rough could incorrectly be typed as PT23, so it is likely this strain had become rough in this laboratory.

One laboratory incorrectly phage-typed **PT1b (strain E2)** as PT1d because some of the phage reactions they obtained were too low. This laboratory also incorrectly typed the PT4 because of low phage reactions, suggesting the titres of the phages were incorrect. One laboratory incorrectly phage-typed the PT1 as PT4a as they did not obtain any phage reactions with some of the phages. This was probably due to the inoculum size of the broth culture being incorrect.

PT6a (strain E4) was incorrectly phage-typed by two laboratories. One laboratory phage-typed this strain as PT6b as they obtained reactions with two phages that do not react with PT6a. This laboratory also misinterpreted their results as they were the reactions for PT6. One laboratory incorrectly phage-typed this strain as PT14c as they did not obtain any reactions with several of the phages that react with PT6a. This laboratory had similar problems with several of the strains, probably due to the incorrect inoculum size of the broth culture.

Two laboratories phage-typed **PT6 (strain E6)** as PT6c as they obtained a reaction with phage 16. PT6 does not react with phage 16 so this suggests the titre of this phage was too high. Both of these laboratories had the same problem with PT15a (strain E3).

PT55 (strain E1) was incorrectly phage-typed as PT18 by one laboratory as they obtained reactions with several phages that do not react with PT55.

One laboratory incorrectly typed **PT8 (strain E7)** as PT28 because they obtained low reactions with several of the phages. As this laboratory reported correct reactions with these phages on the other strains, this incorrect result was probably due to an incorrect inoculum size of the broth culture.

3.4.3 *S.* Typhimurium phage-typing results for the EU/EEA laboratories

Three out of 13 laboratories assigned the correct phage type for all ten strains of *S.* Typhimurium. Four laboratories had one to two deviations each from the intended results, five laboratories had three to four deviations, and one laboratory had five to seven deviations (Figure 13).

Table 14 shows that two of the ten *S.* Typhimurium strains were phage-typed correctly by all participating laboratories, **DT24 (strain T6)** and **DT36 (strain T10)**.

The *S.* Typhimurium strain that caused most problems was **DT7 (strain T4)**. This strain was phage-typed as DT59 by two laboratories. One of these laboratories obtained the correct phage reactions but misinterpreted the results. The second laboratory did not obtain a reaction with phage 18, suggesting the titre of this phage was too low. This strain was also incorrectly phage-typed by five other laboratories which phage-typed DT7 (strain T4) as DT120 (two laboratories), DT20, DT20a, and DT104b. These incorrect results were due to a low or no reaction with some of the phages that react with DT7.

PT U310 (strain T1) was incorrectly phage-typed by two laboratories as DT195. This was due to obtaining a reaction with additional phage 3, suggesting the titre of this phage was too high, as PT U310 does not react with this phage. One laboratory incorrectly phage-typed this strain as PT U302, which was due to obtaining phage reactions with the additional 10 and 10var3 phages. This suggests the titre of these two phages was too high.

Three laboratories incorrectly phage-typed DT208 (strain T2) as PT U302. These laboratories obtained this result because they did not get any reaction with additional phage 18, which was probably due to the titre of this phage being too low.

Three laboratories incorrectly phage-typed DT46a (strainT3). Two laboratories phage-typed this strain as DT3. They obtained only a low reaction with phage 28 which resulted in the incorrect phage type being allocated. One laboratory typed this strain as DT46. They obtained the correct phage reactions but allocated the wrong phage type.

S. Typhimurium DT15a (strain T5) was incorrectly phage-typed by three laboratories. Two laboratories phage-typed this strain as DT75; one of these laboratories actually obtained the correct phage reactions but misinterpreted their results; the other laboratory did not obtain a reaction with phage 15. This suggests the titre of this phage was too low or a reaction was not observed. Phage 15 frequently gives an opaque reaction, which can be difficult to interpret. One laboratory phage-typed the DT15a as PT U289. This laboratory obtained correct phage reactions but misinterpreted the results and allocated the wrong phage type.

Three laboratories incorrectly phage-typed DT104 (strain T9). Two laboratories phage-typed it as DT12 because they did not obtain any reaction with phage 18. This suggests the titre of this phage was too low. One laboratory phage-typed this strain as DT110 as they failed to obtain a reaction with phage 12.

One laboratory did not allocate the correct phage type to DT193 (strain T8) as they did not obtain any reaction with any of the phages. DT193 only reacts with the additional phages 1, 2 and 3, so this suggests the titre of these three phages was too low.

3.4.4 Phage-typing results for all participants

Overall, 17 participants performed phage typing of both *Salmonella* Enteritidis and *Salmonella* Typhimurium. Two further laboratories (EU/EEA) performed only phage typing of *S.* Enteritidis. Separate notations per phage type and per laboratory are given in Annex 6. The phage-typing results of all laboratories were evaluated by strain and by laboratory. Data for *S.* Enteritidis and *S.* Typhimurium are shown in Tables 15 and 16.

Figure 15 displays the distribution of deviations in the phage typing of *S.* Enteritidis and *S.* Typhimurium for all participants. Correct phage types for all participants (in per cent) are shown in Figure 16.

Seven out of 19 laboratories assigned the correct phage type for all ten strains of *S.* Enteritidis. Seven laboratories had one to two deviations each from the intended results. One laboratory had three to four deviations, while four laboratories had five to seven deviations from the intended results (Figure 15).

Table 15 shows that none of the ten *S.* Enteritidis strains were phage-typed correctly by all participating laboratories.

Five out of 17 laboratories assigned the correct phage type for all ten strains of *S.* Typhimurium. Five laboratories had one to two deviations each from the intended results, six laboratories had three to four deviations from the intended results, and one laboratory had five to seven deviations from the intended results (Figure 15).

Table 16 shows also that two of the ten *S.* Typhimurium strains were phage-typed correctly by all participating laboratories: PT 24 (strain T6) and PT 36 (strain T12).

Table 15: Results of *Salmonella* Enteritidis phage typing for all participants

Lab code	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	Y
REF	**55**	**1b**	**15a**	**6a**	**13a**	**6**	**8**	**1**	**13**	**4**	0
F1	55	1b	15a	6a	28	6	8	1b	14c	4	3
F2	55	1b	15a	6a	13a	6	8	1	13	4	0
F4	55	1b	15a	6a	13a	6	8	1	13	4	0
F5	55	1b	15	6a	13a	6	8	1	13	4	1
F6	55	1b	15	6a	13a	6c	8	1b	14c	4b	5
F7	18	1b	15	6b	28	6c	8	1	14b	4b	7
F8	55	1b	15a	6a	13a	6	8	1	14c	4	1
F13	55	1b	15a	6a	13a	6	28	1	14b	4	2
F14	55	1b	15a	6a	13a	6	8	1	14b	4	1
F17	55	1d	15	6a	19	6	8	1b	13	45	5
F19	55	1b	15a	6a	13a	6	8	1	13	4	0
F23	55	1b	15a	6a	13a	6	8	1	13	4	0
F24	55	4a	15	14c	28	6	8	1b	13	23	6
F25	55	1b	15a	6a	28	6	8	1	13	4	1
F26	55	1b	15a	6a	13a	6	8	1	13	4	0
F27	55	1b	15a	6a	13a	6	8	1	13	4	0
F31	55	1b	15a	6a	13a	6	8	1	13	4	0
F32	55	1b	15a	6a	13a	6	8	1	14b	4	1

Lab code	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	Y
F35	55	1b	15a	6a	13a	6	8	1	14b	4	1
X	1	2	5	2	5	2	1	4	8	4	34

Grey cells = deviating results.

X: number of deviating laboratories per strain; Y: number of deviating strains per laboratory.

Table 16: Results of *Salmonella* Typhimurium phage typing for all participants

Lab code	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	Y
REF	**U310**	**208**	**46a**	**7**	**15a**	**24**	**15**	**193**	**104**	**36**	0
F1	U310	208	46a	59	75	24	15	193	104	36	2
F2	U310	U302	3	7	15a	24	120	193	110	36	4
F4	U310	208	46a	7	15a	24	15	193	104	36	0
F5	U310	208	46a	7	15a	24	15	193	104	36	0
F6	U302	208	46a	59	15a	24	15a	193	12	36	4
F7	195	U302	3	7	15a	24	15	193	104	36	3
F8	U310	U312	46a	104b	75	24	11	193	104	36	4
F13	U310	208	46	20a	U289	24	15	193	104	36	3
F14	U310	208	46a	7	15a	24	15	193	104	36	0
F19	U310	208	46a	120	75	24	11	193	104	36	3
F23	U310	208	46a	7	15a	24	15	193	104	36	0
F24	U310	U302	46a	20	15a	24	75	NT	12	36	5
F25	U310	208	46a	7	15a	24	15	193	104	36	0
F27	U310	208	46a	120	15a	24	15	193	104	36	1
F31	195	208	46a	7	15a	24	15	193	104	36	1
F32	195	193a	46a	7	15a	24	15	193	104	36	2
F35	U310	208	46a	104b	15a	24	15	193	104	36	1
X	4	5	3	8	4	0	5	1	3	0	33

Grey cells = deviating results

X: number of deviating laboratories per strain; Y: number of deviating strains per laboratory

Figure 15: Distribution of deviations in phage typing of *Salmonella* Enteritidis and *Salmonella* Typhimurium for all participants

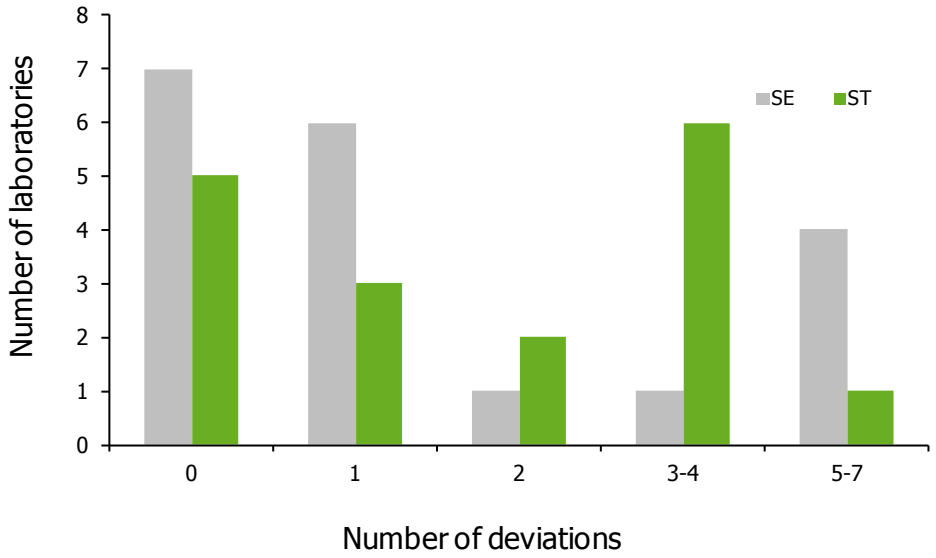
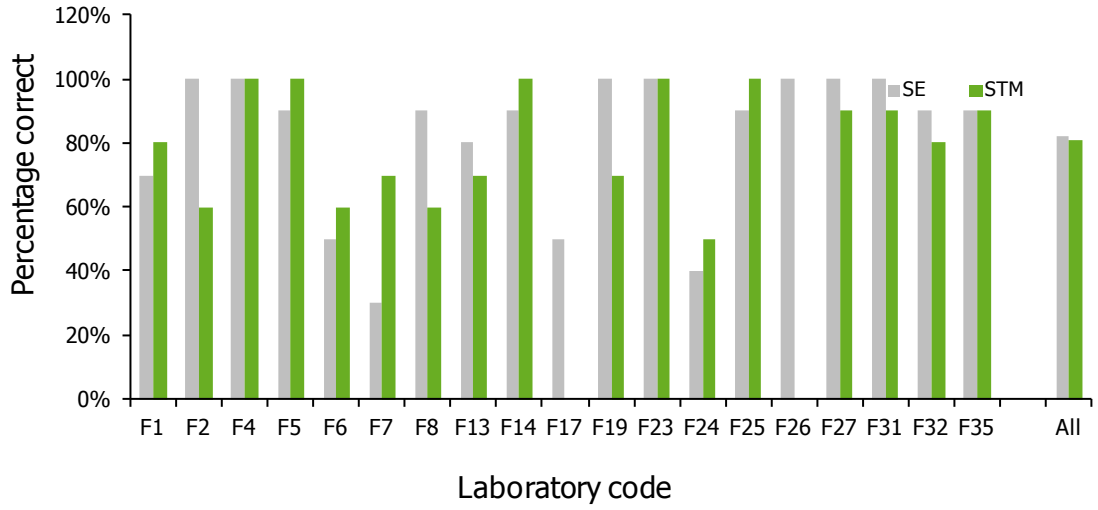


Figure 16: Percentage of strains correctly phage-typed for each participant



3.5 Antimicrobial susceptibility testing (AST)

3.5.1 Results per antibiotic

In the third EQA, 28 laboratories completed AST of the 10 strains as required by the EQA. Eleven laboratories (eight from the EU/EEA) determined MICs, while 17 laboratories (15 from the EU/EEA) determined zone diameters by disk diffusion. MICs were determined by broth microdilution according to CLSI/ISO, E-test (mostly for confirmation) and automated systems (VITEK2, Sensititre Aris, MIDITECH) and a breakpoint method with antibiotics dissolved in agar (see section 3.2.4 or Annex 2). Of the laboratories that used disk diffusion, nine carried out the tests according to CLSI and eight laboratories according to national guidelines.

EUCAST clinical breakpoints were used for the interpretation of the reference MICs (determined by CVI), using broth micro dilution according to ISO-20776-1:2006. Although there is no global consensus on reference breakpoints and interpretive criteria, ECDC considers EUCAST to be the reference organisation for susceptibility tests. Since EUCAST published its European disk test (based on CLSI methodology) and interpretive criteria in 2010, they could be included in the evaluation of the results of this EQA. As many participating laboratories still use CLSI or local criteria, the discrepancies may be in the use of breakpoints (i.e. the criteria for interpretation). To avoid these potentially confusing discrepancies, strain collection was based on a clear R or S phenotype.

CVI participated in the EQA and used EUCAST epidemiological cut-off values for the classification of the isolates as prescribed for EU national reference laboratories on antimicrobial resistance by the European Food Safety Authority (EFSA) for surveillance purposes.

The interpretive criteria used by the participating laboratories varied substantially, although this differed by antibiotic (see Annex 7).

This section describes the results of this EQA for each antibiotic, while taking into account the variation mentioned above and the characteristics of the used isolates, methods and interpretive criteria.

The results for all laboratories per antibiotic are shown in Annex 7. For those laboratories that determined MICs, the concentration is given in mg/L. For the laboratories using disk diffusion, the zone diameters are given in millimetres.

Ampicillin

Ampicillin susceptibility was tested accurately by 25 of the 28 participating laboratories. Six minor and three major deviating results were produced by three of the laboratories. Laboratory F1 misclassified the highly ampicillin-resistant AST-3 as susceptible based on a zone diameter of 18 mm. Laboratory F8 misclassified AST-7 and AST-10 as susceptible due to an administrative error. Laboratory F29 misclassified six isolates based on seemingly inadequate interpretive criteria, a fact also noted in the two previous EQAs.

Classification of results as S/I/R (based on EUCAST breakpoints and interpretive criteria) would have resulted in only one deviation by disk diffusion.

As in the previous EQA, laboratory F33 determined a high MIC value (> 256 mg/L) for the *E. coli* ATCC 25922 strain, most probably the result of some kind of contamination.

Cefotaxime

Cefotaxime susceptibility was tested correctly by 17 of the 28 participating laboratories. Seven minor and three major deviating results were produced by eleven laboratories. The laboratories that determined MICs produced correct results for all isolates, with the exception of one administrative error by F33 for cefotaxime-susceptible AST-3. The susceptible AST strains were all classified correctly by all participants. The deviations were all produced on the CMY-2-producing AST-4 strain. Laboratories F8 and F14 misclassified AST-7 as S, while both laboratories correctly reported small inhibition zones. For AST-4 all laboratories reported zones of inhibition ≤ 18, indicating reduced susceptibility. Based on the interpretive criteria used, seven laboratories reported AST-4 as I.

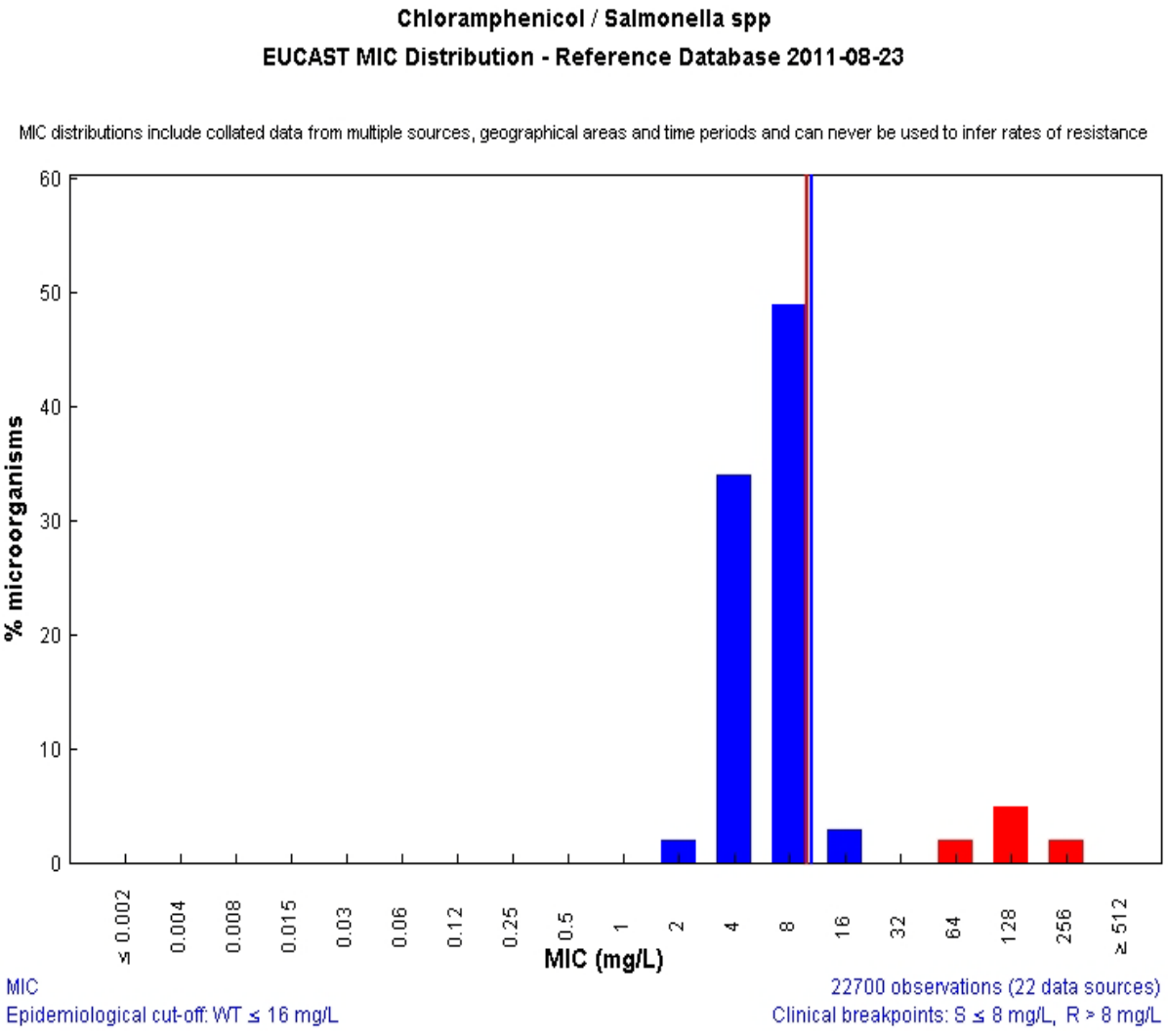
Classification of the results as S/I/R (based on EUCAST breakpoints and interpretive criteria) would have resulted in only three minor deviations by disk diffusion.

Chloramphenicol

Chloramphenicol susceptibility was tested correctly by all laboratories for the AST-strains (excluding AST-4), except for one administrative error made by F8 on AST-10. AST-4 showed reduced susceptibility (MIC 16 mg/L) to chloramphenicol which resulted in the reference classification R (based on EUCAST clinical breakpoints). Both CLSI R breakpoint ≥ 32 mg/L and the EUCAST epidemiological cut-off value for non-wild-type susceptibility (> 16 mg/L), result in a S classification (see EUCAST MIC distribution in Figure 17). Based on the variability in the obtained results, it can be concluded that the EUCAST clinical breakpoint (R >8 mg/L) is not fully appropriate. Therefore this isolate with its typical borderline susceptibility will be excluded from the analysis.

The results for the QC strain *E. coli* ATCC25922 all complied with the QC ranges, except for F11 and F35. F35 produced systematically smaller zones of inhibition for all antibiotics compared to the other laboratories.

Figure 17: EUCAST MIC distribution of chloramphenicol on *Salmonella* spp.



Ciprofloxacin

Ciprofloxacin susceptibility testing, as in the previous EQA rounds, resulted in a lot of variation.

The fully susceptible isolates (AST-1, -2, -5, -6, -7, -9) and the highly resistant AST-3 were tested correctly by all laboratories. Strains AST-4, AST-8 and AST-10, which harbour different fluoroquinolone resistance mechanisms resulting in reduced susceptibility to ciprofloxacin, were difficult to test. The EUCAST expert rules state that there is evidence for clinical failure of fluoroquinolones in case of resistance to nalidixic acid due to the acquisition of at least one target mutation in *gyrA* in *Salmonella enterica.* This applies to strains AST-3, AST-4 and AST-10, that by definition should be classified R to ciprofloxacin. The *qnrS1*-positive AST-8 is classified as S, based on EUCAST clinical breakpoints, but classified as non-wild type based on epidemiological cut-off values and classified as S according to CLSI.

Again these differences in interpretive criteria caused a lot of confusing deviations. Since the non-standardised interpretive criteria caused most of the deviations (and not a lack of accuracy or performance in the laboratories), the results of AST4, AST-8 and AST-10 will be excluded from the analysis.

The results for QC strain *E. coli* ATCC25922 complied with the QC ranges, except for F29 and F35. F35 produced systematically smaller zones of inhibition for all antibiotics compared to the other laboratories.

Gentamicin

Gentamicin susceptibility was correctly tested by all laboratories except for F5 and F30 which both produced one deviating result. F5's deviation was due to an administrative error; F30 measured the zone diameter incorrectly and then applied EUCAST criteria.

The results of the QC strain *E. coli* ATCC25922 all complied with the QC ranges, except for one deviation produced by F10 and F11.

Nalidixic acid

Nalidixic acid susceptibility was tested correctly by 15 laboratories. Two deviations were produced by laboratories that determined MICs (F4 and F24), both on the *qnrS1*-positive AST-8. The typical quinolone resistance phenotype associated with the presence of a *qnr* gene in *Salmonella* is characterised by reduced susceptibility to ciprofloxacin (MIC 0.5–1 mg/) and nalidixic acid (MIC 8–16 mg/L). This also resulted in difficulties in the interpretation of the disk diffusion results for AST-8. Eight laboratories misclassified this isolate as I, and one as R. All susceptible and resistant AST strains were tested correctly, except for one misclassification by F6 and one administrative error by F8.

The results of the QC strain *E. coli* ATCC25922 all complied with the QC ranges, except for one deviation (F24 and F29).

Streptomycin

Streptomycin is traditionally an antibiotic that causes a lot of variations in the interpretations. Only four laboratories classified all isolates according to the reference values, which are disputable. A clinical breakpoint is not defined; the R breakpoint > 32 mg/L is used for epidemiological purposes with the aim to detect DT104. A recent publication of Garcia-Migura et al. in Microbial Drug Resistance (2011) suggests WT ≤ 16 mg/L as epidemiological cut-off value for *Salmonella*. Due to the poor standardisation of breakpoints and the absence of appropriate interpretive criteria for disk diffusion, the results of AST-7 (MIC 32 mg/L) and AST-8 (MIC 16 mg/L) will be excluded from the analysis.

After exclusion of AST-7 and AST-8, 18 laboratories produced correct results. In total, seven minor and eight major deviations were produced, the majority by laboratories that determined MICs.

Sulphamethoxazole

Sulphamethoxazole susceptibility was tested accurately by 18 of the 28 participating laboratories. Four minor and four major deviating results were produced by five of the laboratories that used disk diffusion. Laboratories F11 and F20 were considered outliers and excluded from the results because the results were not linked to the correct AST strains. Laboratory F8 misclassified three resistant isolates as S due to administrative errors.

Tetracycline

Tetracycline susceptibility was tested accurately by 21 of the 28 participating laboratories. Thirteen minor and two major deviating results were produced by seven of the laboratories. Four minor deviations were produced by F9, which used an agar dilution breakpoint method and classified all highly resistant isolates as I. Laboratory F4 misclassified the tetracycline susceptible isolates with MIC 2 mg/L as I, which resulted in six minor deviations.

Trimethoprim

Trimethoprim susceptibility has in the previous EQA rounds been tested correctly by most laboratories. Only one deviation was produced by F10 due to an administrative error.

3.5.2 AST results for participating EU/EEA laboratories

The number of deviating results are summarised in Table 17. Figure 18 gives percentages.

For the analysis of the accuracy of the 28 laboratories, 2448 datasets were evaluated, resulting in 47 minor (1.9%) and 27 major deviations (1.1%). After exclusion of some outliers and those antibiotic-bacteria combinations for which the interpretive criteria and breakpoints were not appropriately standardised (chloramphenicol for AST-4, ciprofloxacin for AST-4, AST-8, AST-10, and streptomycin for AST-7 and AST-8), the number of deviating results produced by the EU/EEA laboratories varied from 0–8, with a median value of 1–2 (Table 17).

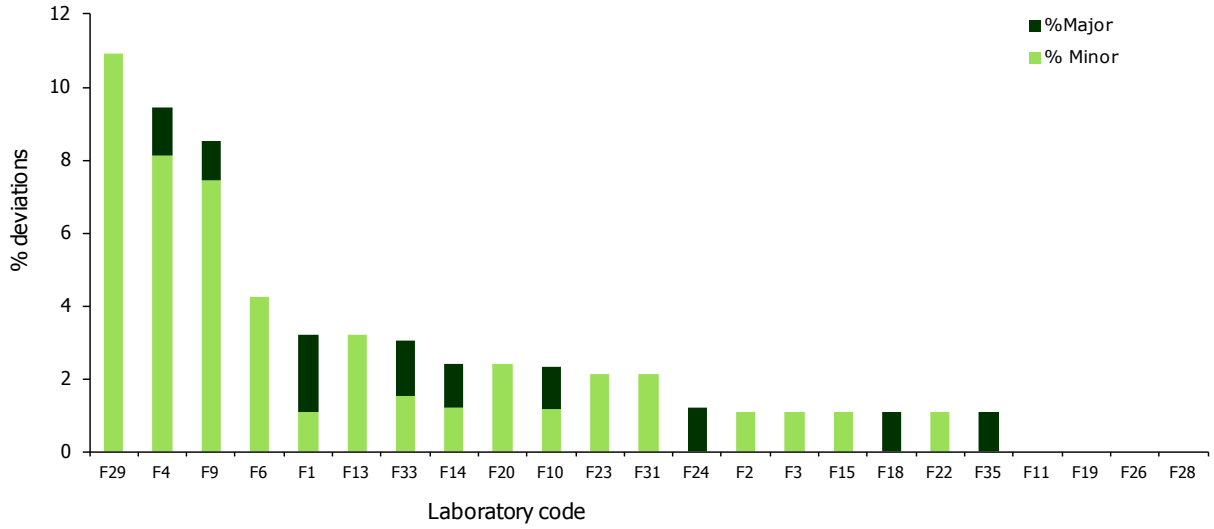
Of the 23 EU/EEA laboratories, 20 accounted for more than 95% of the correct results, which shows that the quality of susceptibility testing in the laboratories is very good. F9 used a breakpoint-MIC method which resulted in minor deviations. F29 used a disk test with interpretive criteria not fully adequate for ampicillin, and F4 used breakpoints that were not fully adequate for the interpretation of tetracycline MICs. All these inconsistencies can be corrected relatively easily.

Standardisation is essential in order to harmonise the results produced for those bacteria/antibiotic combinations that are responsible for many of the conflicting results in the susceptibility testing of *Salmonella*.

Table 17: Number of minor and major deviating results recorded for the EU/EEA laboratories for all strains and all antibiotics, except for chloramphenicol for AST-4, ciprofloxacin for AST-4, AST- 8 and AST-10, and streptomycin for AST-7 and AST-8

Laboratory code	No. of tests (N)	Minor deviations (N)	Major deviations (N)
F1	94	1	2
F2	94	1	0
F3	94	1	0
F4	74	6	1
F6	94	4	0
F9	94	7	1
F10	86	1	1
F11	66	0	0
F13	94	3	0
F14	84	1	1
F15	94	1	0
F18	94	0	1
F19	94	0	0
F20	84	2	0
F22	94	1	0
F23	94	2	0
F24	84	0	1
F26	94	0	0
F28	94	0	0
F29	64	7	0
F31	94	2	0
F33	66	1	1
F35	94	0	1

Figure 18: Percentage of minor and major deviations recorded for the EU/EEA laboratories (for all strains and all antibiotics, except for chloramphenicol for AST-4, ciprofloxacin for AST-4, AST-8 and AST-10, and streptomycin for AST-7 and AST-8



3.5.3 AST results for all participants

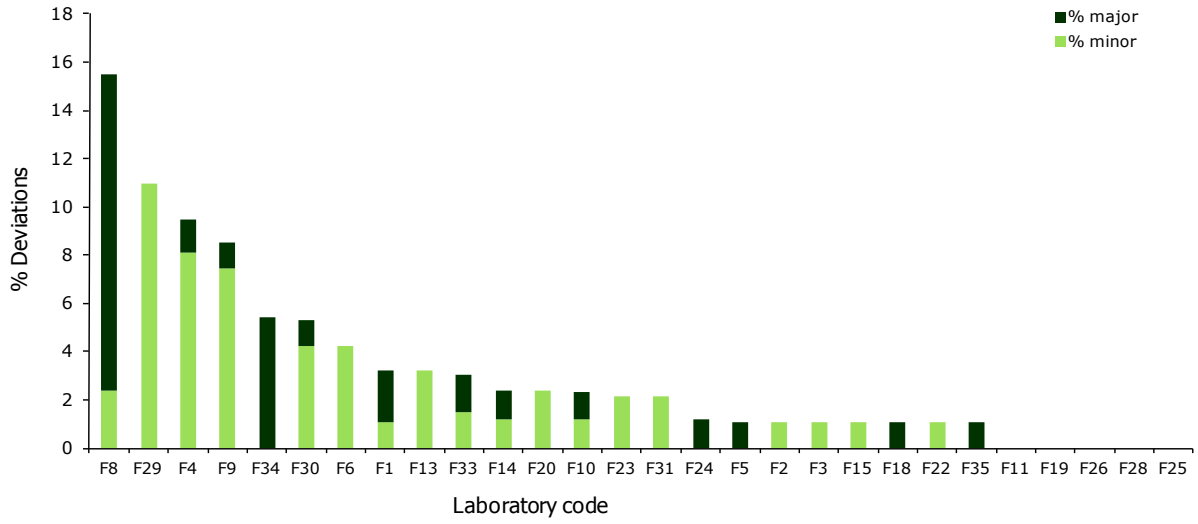
The number of deviating results for non-EU/EEA laboratories are summarised in Table 18 and presented as percentages for all laboratories in Figure 19.

Of the non-EU/EEA laboratories, F8 produced the highest number of deviating results. However, 11 of the 13 deviations were the result of inaccurate classifications and incorrect reporting of correct results. The remaining non-EU/EEA laboratories produced mostly correct results (95% or more).

Table18: Number of minor and major deviating results recorded for the non-EU/EEA laboratories for all strains and all antibiotics, except for chloramphenicol for AST-4, ciprofloxacin for AST-4, AST-8 and AST-10, and streptomycin for AST-7 and AST-8

Laboratory code	No. of tests	Minor deviations (N)	Major deviations (N)
F5	94	0	1
F8	84	2	11
F25	84	0	0
F30	94	4	1
F34	74	0	4

Figure 19: Percentage of minor and major deviations recorded for all participating laboratories (for all strains and all antibiotics, except for chloramphenicol for AST-4, ciprofloxacin for AST-4, AST-8 and AST-10, and streptomycin for AST-7 and AST-8

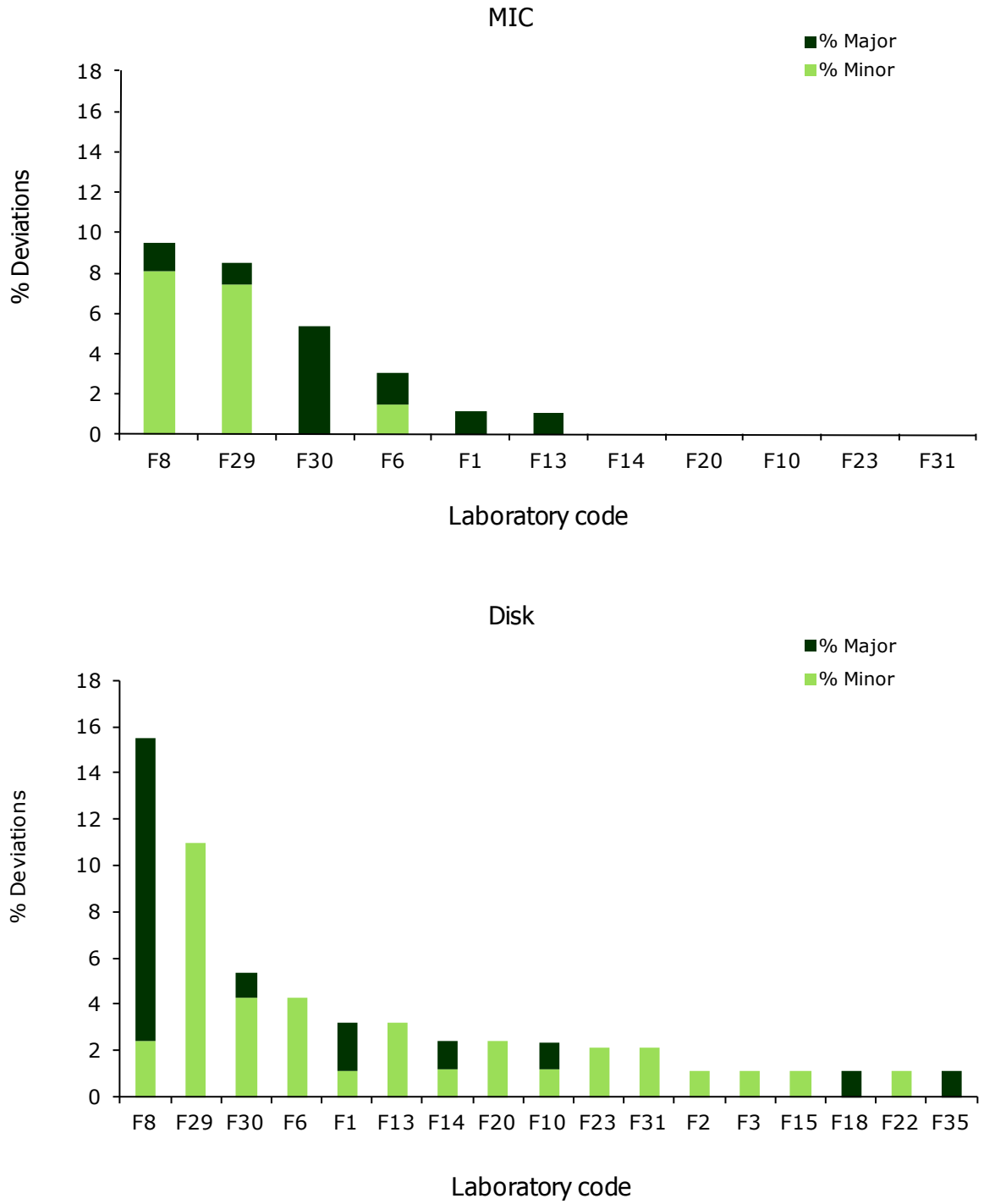


3.5.4 Comparison between MIC and disk diffusion

Figure 20 shows the percentage of minor and major deviations for laboratories that determined either MICs or disk diffusion. There were no major differences in accuracy for both methodologies. Five out of eleven laboratories that determined MICs produced no deviations, while none of the 17 laboratories using disk diffusion produced any deviations. Only 3% of all participating laboratories were less than 95% accurate. As described in the previous paragraph, improvements in accuracy should be easy, regardless of the employed method.

The problems that some laboratories encountered when analysing certain bacteria-antibiotic combinations (which were subsequently excluded from the analysis) were not related to the applied method, but to the absence of standardised criteria.

Figure 20: Percentage of minor and major deviations recorded for laboratories (MIC versus disk diffusion)



4 Discussion

4.1 Serotyping

Twenty strains of the species *Salmonella enterica* subspecies *enterica* were selected for serotyping by RIVM. Thirty-two participants carried out serotyping of the strains, 27 of these were EU/EEA laboratories. The laboratories had to report the detected H and O antigens and the serovar names according to the White-Kauffmann-Le Minor scheme.

The incorrect typing of the H antigens is still the most frequently occurring problem although numbers slightly improved compared with the results of the second EQA. However, the second EQA did not reach the performance level of the first EQA. The majority of the laboratories did not encounter any difficulties in correctly serotyping the O antigens. Problems with serotyping could not be directly linked to the use of a particular brand of culture medium or preparation.

An overview of the results as obtained in the first, the second and the third EQA scheme is given in Table 19. A comparison of the percentage of correctly named serovars per laboratory in the first, second and third EQA scheme is shown in Figure 21.

In the third EQA study only one strain, *S.* Agona, was correctly serotyped by all participants. In the second EQA two serovars, *S.* Stanley and *S.* Typhimurium, were correctly typed by all participants. In the first EQA nine serovars were identified correctly: *S.* Dublin, *S.* Heidelberg, *S.* Coeln, *S.* Brandenburg, *S.* Bredeney, *S.* Virchow, *S.* Infantis, *S.* Enteritidis, and *S.* Typhimurium, five of which were also included in the third EQA (including *S.* Typhimurium).

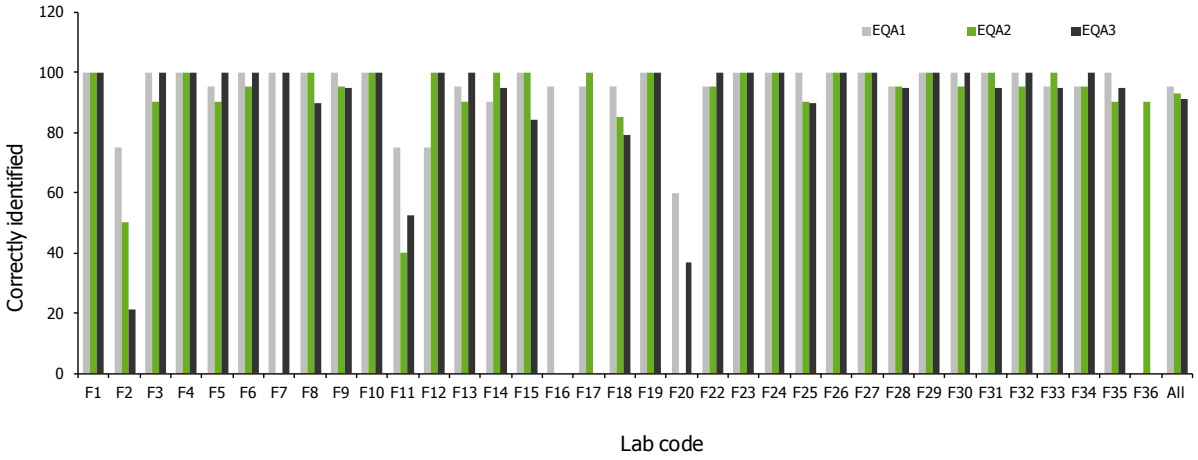
Overall, the third EQA scheme showed that more laboratories have fewer deviating serotyping results compared with the second EQA, while results were overall comparable with the first EQA.

Table 19: Overview of the serotyping results for EU/EEA laboratories and the total number of laboratories participating in the first, second and third EQA scheme

	First EQA EU-EEA	First EQA All labs	Second EQA EU-EEA	Second EQA All labs	Third EQA EU-EEA	Third EQA All labs
O antigens, laboratories	21/28* (75%)	25/34 (74%)	22/25 (88%)	26/32 (81%)	21/26 (81%)	25/32 (78%)
O antigens, strains	547/560 (98%)	665/680 (98%)	495/500 (99%)	631/640 (99%)	483/494 (98%)	594/608 (98%)
H antigens, laboratories	19/28 (68%)	25/34 (74%)	15/25 (58%)	17/32 (53%)	16/26 (62%)	21/32 (66%)
H antigens, strains	539/560 (96%)	659/680 (97%)	465/500 (93%)	599/640 (94%)	448/494 (91%)	560/608 (92%)
Serovar names, laboratories	16/28 (57%)	20/34 (59%)	15/25 (58%)	16/32 (50%)	15/26 (58%)	19/32 (59%)
Serovar names, strains	528/560 (94%)	646/680 (95%)	465/500 (93%)	596/640 (93%)	445/494 (90%)	555/608 (91%)

** Number correct/total number (%)*

Figure 21: Results for all participating laboratories in the first, second and third EQA serotyping scheme: correctly identified strains, in percent



4.2 Phage typing

Ten strains of *S*. Enteritidis and ten strains of *S*. Typhimurium were selected for this study by the *Salmonella* Reference Unit of the HPA, London.

None of the *S*. Enteritidis strains were correctly phage-typed by all participating laboratories. Two strains of *S*. Typhimurium, DT24 and DT 36, were correctly phage-typed by all participating laboratories.

In this study, phage typing the *S*. Typhimurium strains proved more difficult than the *S*. Enteritidis strains, for both the subgroup of EU/EEA laboratories (n=15) and the group of all participating laboratories (n=19).

There are three probable reasons for the deviations in the phage-typing results:

- The inoculum size of the broth culture used for the phage typing. For *S*. Enteritidis, a heavy inoculum is needed to obtain the correct phage reactions; for *S*. Typhimurium a lighter inoculum is required. To obtain the correct inoculum size, the incubation conditions for the broth cultures in the phage typing procedure should be followed.
- The phages are supplied concentrated and must be diluted before use. It is important that the titre of the diluted phage solution is correct. The titre of the phages can also change on storage. The phages should be checked by observing the reactions obtained on strains with a known phage type. For *S*. Enteritidis this is PT 1b, for *S*. Typhimurium DT 36.
- Some of the deviations were due to the misinterpretation of the reactions obtained with the phages. Misinterpretation of results may be due to lack of experience in phage typing, new staff in the laboratory, or a lack of familiarity with certain phage types.

Overall, the results for the *S*. Enteritidis were good, with 82% of the strains correctly phage-typed. The results for the *S*. Typhimurium were similar. Overall 81% of the strains were correctly phage-typed.

For the phage typing of *S*. Enteritidis, thirteen laboratories had good results, with one or no deviations. Two laboratories had acceptable results (two to three deviations) and four laboratories had four or more deviations.

For *S*. Typhimurium, eight laboratories had good results, with one or no deviations. Five laboratories had acceptable results (two to three deviations) and four laboratories had four or more deviations.

The results for the EU/EEA laboratories were comparable to the results for all 19 participating laboratories. For the phage typing of *S*. Enteritidis, 80% of the strains were correctly phage-typed. For *S*. Typhimurium, 79% of the strains were correctly phage-typed.

An overview of the phage-typing results as obtained in the first, second and third EQA, both for EU/EEA laboratories and all participants, is given in Table 20. A comparison by laboratory of the percentage of correctly phage-typed strains in the first, second and third EQA scheme is shown in Figure 22.

In general, phage-typing results in the third EQA scheme were good, although there were more deviations in the results for *S*. Typhimurium when compared with the second EQA. However, results were better compared to the first EQA. The results for *S*. Enteritidis show less laboratories having deviations in the third EQA scheme when compared to the second and the first EQA scheme, although more strains were incorrectly phage-typed.

Table 20: Overview of the phage-typing results for EU/EEA laboratories and all participating laboratories; first, second and third EQA scheme

	First EQA EU-EEA	First EQA All labs	Second EQA EU-EEA	Second EQA All labs	Third EQA EU-EEA	Third EQA All labs
S. Enteritidis, laboratories	4/16 (25%)*	7/20 (35%)	6/16 (38%)	6/20 (30%)	7/15 (47%)	7/19 (37%)
S. Enteritidis, strains	140/160 (88%)	178/200 (89%)	134/160 (84%)	169/200 (85%)	120/150 (80%)	156/190 (82%)
S. Typhimurium, laboratories	2/15 (13%)	3/19 (16%)	7/14 (50%)	10/18 (56%)	3/13 (23%)	5/17 (29%)
S. Typhimurium, strains	119/150 (79%)	153/190 (81%)	125/140 (89%)	163/180 (91%)	103/130 (79%)	137/170 (81%)

** Number correct/total number (%)*

Figure 22a: Phage-typing results for *Salmonella* Enteritidis (SE) for all participating laboratories in the first, second and third EQA phage-typing scheme: correctly identified strains, in percentage of correctly typed strains

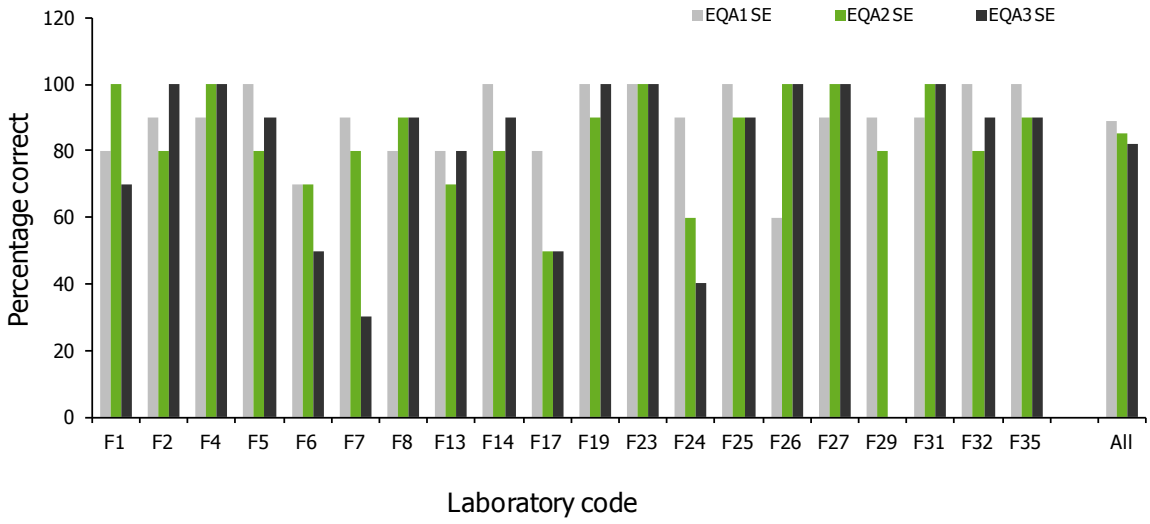
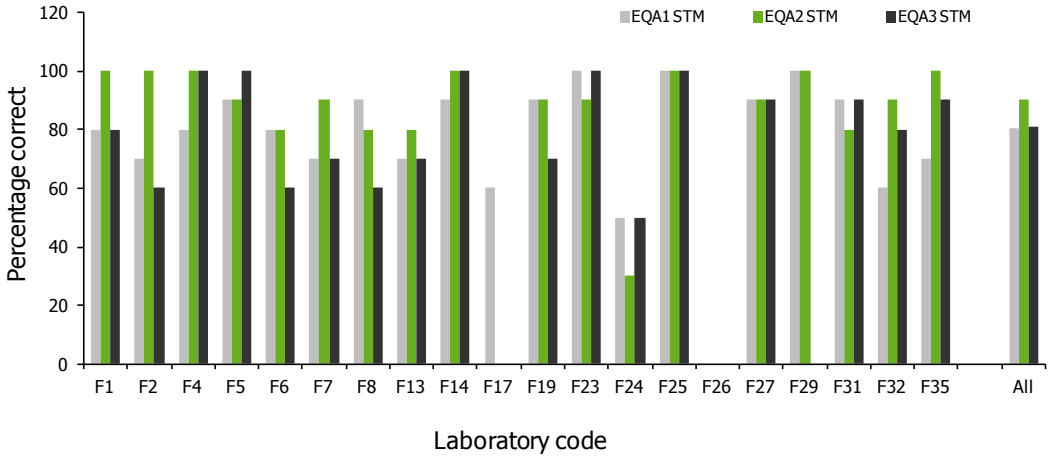


Figure 22b: Phage-typing results for *Salmonella* Typhimurium (STM) for all participating laboratories in the first, second and third EQA phage-typing scheme: correctly identified strains, in percentage of strains that were correctly typed



4.3 Antimicrobial susceptibility testing (AST)

The third antimicrobial EQA tested the susceptibility of ten strains against a panel of ten antibiotics. In this study, a few antibiotic-bacteria combinations were excluded because of the absence of standardised criteria

(chloramphenicol for AST-4, ciprofloxacin for AST-4, AST-8 and AST-10, and streptomycin for AST-7 and AST-8). In the second EQA, ampicillin (for one strain), cefotaxime (for one strain) and ciprofloxacin were excluded. Exclusions in the first EQA were: amoxicillin-clavanulate acid for one strain, chloramphenicol for two strains, and ciprofloxacin. Ciprofloxacin was excluded in both EQA 1 and EQA 2 because of inconsistent interpretive criteria.

In the third EQA, 97% of the participating EU/EEA and non-EU/EEA laboratories tested the susceptibility of *Salmonella* with an accuracy of ≥ 95%.

However, some difficulties were encountered in the testing of specific antibiotics and isolates.

The correct classification of a bla_{CMY-2}-producing isolate (AST-4 strain) proved to be problematic. Accurate identification of isolates producing these AmpC-type beta-lactamases is considered to be very important. It can be concluded that any apparent reduction in cefotaxime susceptibility is indicative of the presence of such a gene. The presence of an AmpC beta-lactamase should be confirmed by molecular methods.

The most striking variation in breakpoints and interpretive criteria was observed for ciprofloxacin. The EUCAST expert rules state that there is evidence for clinical failure of fluoroquinolones in case of resistance to nalidixic acid due to the acquisition of at least one target mutation in *gyrA* in *S. enteric*. It is very important that such isolates are correctly classified. Although some laboratories choose to classify isolates with ciprofloxacin MICs varying from 0.25 – 1 mg/L as reduced susceptibility, this does not fully comply with the EUCAST expert rules. Isolates with a single point mutation are always nalidixic acid resistant; therefore the advice to include nalidixic acid in the test panel is very instructive and should be promoted in order to avoid confusing results. With regard to nalidixic acid, the use of an intermediate criterion is not helpful and should be avoided.

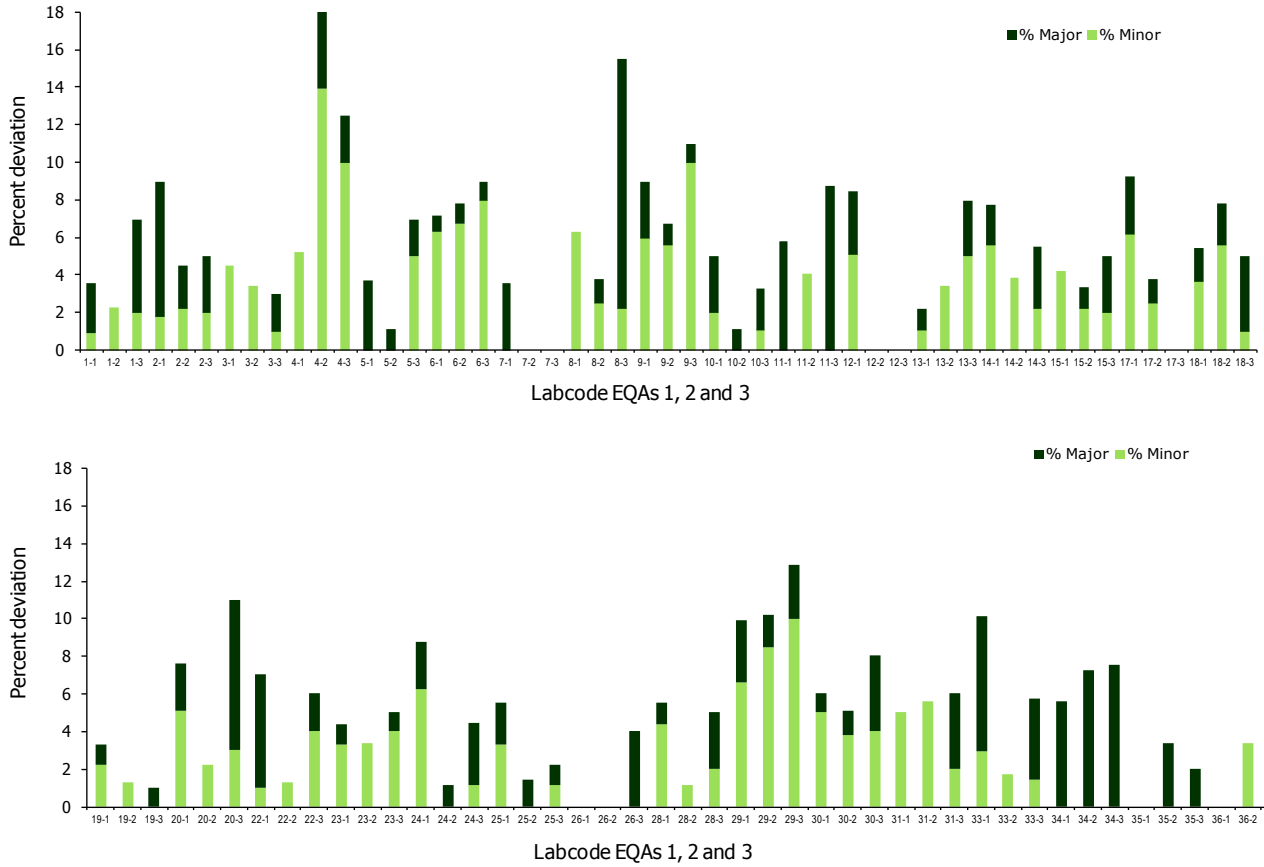
Streptomycin is used in combination with, amongst others, chloramphenicol for detection of DT104 or *Salmonella* genomic island1 (SGI1)-positive isolates, but not for clinical advice. The currently used breakpoint > 32 mg/L will generally identify these isolates. Lowering the breakpoint may result in overestimation of SGI1. A final decision on the best breakpoint will have to be made through the EURL network, taking into account the reasons why this drug is included in the test panels.

Chloramphenicol has a similar epidemiological relevance as streptomycin. EUCAST defined the clinical breakpoint >8 mg/L, which splits the wild-type population. This will inevitable result in misinterpretations of isolates at 16 mg/L. Since the majority of the susceptible isolates show a MIC value of ≤ 8 mg/L, the discrepancy is not likely to have a major effect on the results.

If a threshold of 90% accuracy were to be used, all laboratories but two (one EU/EEA country, one non-EU/EEA) would have been approved. Eighty-seven percent of EU/EEA laboratories and 79% of all participating laboratories produced ≤ 5% deviations, which demonstrates a high level of test performance.

A comparison of the percentage of minor and major deviations in AST for every laboratory in the first, second and third EQA scheme is shown in Figure 23. Of the 2248 evaluated test results, only 1.9% showed minor deviations, while 1.1% showed major deviations. This proved to be slightly less than in the previous EQAs (first EQA: 3% minor, 2% major deviations; second EQA: 3% minor, 1% major deviations).

Figure 23: Percentage of minor and major deviations in AST in the first, second and third EQA typing scheme, all participants



5 Conclusions

5.1 Serotyping

The serotyping results showed that the EU/EEA laboratories identified the correct serovar names for 90% of the samples (all participating laboratories: 92%). In this third EQA scheme fewer laboratories produced deviating results (EU/EEA 58%, all laboratories 59%) compared with the second EQA (58% and 50%, respectively), while overall results were comparable with the first EQA (57% and 59%, respectively).

- The participating laboratories must ensure they follow the procedures for serotyping as described in the manufacturer's instructions; they should be aware that instructions may differ significantly between the various sera manufacturers.

5.2 Phage typing

The overall results for the phage typing of *S.* Enteritidis and *S.* Typhimurium in the third EQA scheme were good, but compared with the results of the second EQA scheme, more deviations were produced for *S.* Typhimurium. However, when compared with the first EQA, results were better this time around. The results for *S.* Enteritidis show fewer laboratories having deviations in the third EQA scheme when compared with the second and the first EQA scheme, although more strains were incorrectly phage-typed in the third EQA compared to the first and the second EQA.

- The participating laboratories must ensure they follow the published procedures for phage typing to ensure consistent results.
- It is important that the titres of the phage solutions are checked on strains with a known phage type to ensure the correct phage reactions are obtained.
- New members of the laboratory staff should be given adequate training in phage typing and the interpretation of the results.

5.3 Antimicrobial susceptibility testing (AST)

After the exclusion of a few antibiotic-bacteria combinations for which no standardised criteria exist, the third antimicrobial susceptibility EQA showed that 87% of the participating EU/EEA laboratories tested the susceptibility of *Salmonella* with an accuracy of ≥ 95%. 79% of all participating laboratories achieved the same accuracy.

Deviations were mainly noticed where the standardisation of breakpoints is poor and adequate interpretive criteria for disk diffusion are missing.

Of the 2248 evaluated test results, minor deviations accounted for 1.9% (major deviations: 1.1%). This proved to be slightly less when compared to the results of the first and second EQA (first EQA: 3% minor deviations and 2% major deviations first EQA; second EQA: 3% minor and 1% major deviations).

The current discussion regarding the global acceptance of the coming European disk diffusion test (based on CLSI) and a set of interpretive criteria derived from EUCAST MIC breakpoints (as ISO standard) will be an important step towards the standardisation and harmonisation of AST results.

5.4 ECDC comment on the results of EU/EEA laboratories in the third round of the external quality assurance (EQA) scheme for *Salmonella* typing

Serotyping is the basic phenotypic typing method for *Salmonella* used to separate this large genus into smaller entities. The standard reference for nomenclature is the White-Kauffman-Le Minor scheme, but for the typing method itself an international standard is still in the development stage. For salmonellosis, serotyping is the basis for surveillance, outbreak detection, and linkage to suspected sources. Consequently, correct serotyping in the national reference laboratories is a key priority in EU/EEA countries.

Serotyping scores in the third EQA were acceptable, with 90% of all strains correctly serotyped, and 15 out of 26 (58%) laboratories producing results that were 100% correct. Only one serovar was correctly typed by all participants. If the acceptance threshold was set to 90% of correct results, 21 out of 26 (81%) laboratories would pass. This would also imply that of the more than 100 000 salmonellosis cases that are reported to ECDC annually,

about 10 000 cases could would be reported with the wrong serotype. The problems mainly lie in the typing of H antigens, with subsequent misnaming of the serotypes: one EU laboratory only identified 20% of the serotypes correctly, while another EU laboratory had an error rate of 50 to 60%, misclassifying some of the most common serotypes.

Phage typing for the EQA was carried out by 15 EU/EEA laboratories. Phage typing has proven very useful as a subtyping method for common serotypes, for example when linking human cases and food sources. The disadvantage is its steep learning curve. Lab personnel needs to be experienced and knowledgeable to apply the correct inoculum size, use the correct dilution, and correctly interpret the results. An international standard for the methodology is also still lacking. Overall, 80% of the *S*. Enteritidis and 79% of the *S*. Typhimurium strains were correctly phage-typed. In the third EQA, phage typing the *S*. Typhimurium strains proved to be more difficult than typing the *S*. Enteritidis strains. However, none of the *S*. Enteritidis strains were correctly phage-typed by all participating laboratories, whereas two strains of *S*. Typhimurium, DT24 and DT 36, were correctly phage-typed by all laboratories. One laboratory only classified three out of ten *S*. Enteritidis strains correctly. It is notable that *S*. Enteritidis PT4, one of the five most common phage types in the EU/EEA, was misclassified by 40% of the participating laboratories.

The AST results achieved by the participating laboratories were very good: twenty of the 23 EU/EEA laboratories produced less than 5% deviations. If a threshold of 90% accuracy was used, all laboratories but one would have been approved. Fifteen of 23 EU/EEA laboratories used a disk diffusion method and eight a dilution method (either agar dilution or broth dilution). These variations in standards and interpretative criteria hamper the comparability of results reported to ECDC because they have already been interpreted at the national level. ECDC therefore supports the use of EUCAST methods and interpretive criteria. The EQA showed that disk diffusion and MIC dilution produced comparable results. It is thus important that EUCAST continues the development of disk diffusion critical zone size diameters corresponding to breakpoints for more antimicrobials for *Salmonella* spp.

Comparing the results of the third round of EQA with those of the second and first EQA, no clear improvements were observed in serotyping between the three rounds. The typing of antigen O improved in the second round compared to the first but worsened again in the third, while the typing of antigen H became less accurate from round to round. While the proportion of correct results was about the same in the first two rounds, round three had the worst serotyping results of all rounds. The number of laboratories with deviations also increased, while the number of deviations per laboratory decreased, which may indicate that the serotypes in the second and third rounds were generally more difficult to type. Compared to the previous rounds, an increasing number of laboratories in round three showed a decreasing number of deviations in their serotyping results.

Some improvements were observed in the phage typing in the second round, with fewer laboratories showing deviations from the intended results, especially for *S*. Typhimurium. However, in the third round more deviations appeared in the results for both *S*. Typhimurium and *S*. Enteritidis. The AST results were better in the second and the third round compared to the first one. This could be an effect of problematic antimicrobials excluded in the second round. In the third round, fewer antimicrobial were excluded and, to avoid potentially confusing discrepancies, fewer strains with borderline susceptibility were included in the second and third round. Overall, slightly fewer deviations were produced in the third round compared to the first and second rounds.

EQA schemes provide a useful tool for the identification of problematic areas in the typing of *Salmonella* strains in national reference laboratories. The results from the third EQA highlight the continuous need for EQA schemes for *Salmonella* serotyping and the need to develop and implement standard phage typing methodologies, universal AST procedures, and common criteria for the interpretation of antimicrobial susceptibility test results.

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Annex 1. List of participants

Participating laboratories from EU/EEA countries

Country	Institute/city
Austria	AGES, Institute for Medical Microbiology and Hygiene Graz
Belgium	Institute of Public Health Brussels
Cyprus	Nicosia General Hospital Nicosia
Czech Republic	National Institute of Public Health Brno
Denmark	Statens Serum Institute Copenhagen
Finland	National Institute for Health and Welfare Helsinki
France	Institut Pasteur Paris Paris
Germany	Robert Koch Institute, Wernigerode Branch Wernigerode
Greece	Central Public Health Laboratory Vari, Attiki
Hungary	National Centre for Epidemiology Hungary
Iceland	Landspítali – National University Hospital of Iceland Department of Clinical Microbiology Reykjavik
Ireland	Galway UH, Medical Microbiology Department Galway
Italy	Istituto Superiore di Sanità Rome
Latvia	Infectology Center of Latvia Riga
Lithuania	National Public Health Surveillance Laboratory Vilnius
Luxembourg	Laboratoire National de Santé Luxembourg
Malta	Mater Dei Hospital, Pathology Department Malta
Netherlands	RIVM/CVI Bilthoven/Lelystad
Norway	Norwegian Institute of Public Health Oslo
Poland	National Institute of Public Health, National Institute of Hygiene Warsaw
Portugal (No results returned)	Instituto Nacional de Saúde Dr. Ricardo Jorge Lisboa.
Romania	National Institute of Research-Development for Microbiology and Immunology Cantacuzino Bucharest
Slovak Republic	Public Health Authority of the Slovak Republic Bratislava
Slovenia	National Institute of Public Health Ljubljana
Spain	Instituo de Salud Carlos III Madrid
Sweden	Smittskyddsinstitutet (SMI) Solna
United Kingdom – England	Health Protection Agency (HPA) London
United Kingdom – Scotland	Stobhill Hospital, Microbiology Department Glasgow

Participating laboratories from non-EU/EEA countries

Country	Institute/City
Australia	University of Melbourne, Department of Microbiology and Immunology Victoria
Canada	Canadian Science Centre for Human and Animal Health Winnipeg, Manitoba
Japan	National Institute of Infectious Diseases Tokyo
New Zealand	Institute of Environmental Science & Research Limited Wallaceville, Upper Hutt
South Africa	National Institute for Communicable Diseases Johannesburg
Switzerland	Universität Zürich, Institut für Lebensmittelsicherheit und hygiëne Zürich
Turkey (No results returned)	Refik Saydam National Public Health Agency Ankara

Annex 2. Results questionnaire

Table 1: Details on general questions

Lab code	Parcel dam-aged	Date of arrival	Duration transport (days)	Medium for subculture	Manufacturer
F1	no	15-11-2010	7	Nutrient Agar, Bi, Br, Dc Russel	In-house
F2	no	15-11-2010	7	ADCL, Hectoen, Nutrient agar	Merck, Difco
F3	no	10-11-2010	2	Nutrient agar	LAB M
F4	no	15-11-2010	7	Endo-agar	OXOID
F5*	no	18-11-2010	10	Nutrient agar	OXOID
F6	no	16-11-2010	8	XLD, Bacto Peptone, Protease Peptone	OXOID, Difco
F7	no	10-11-2010	2	Nutrient agar	OXOID
F8*	no	11-11-2010	3	Nutrient agar	BD
F9	no	10-11-2010	2	Nutrient Broth No2 CM67	OXOID
F10	no	16-11-2010	8	XLT4	In-house
F11	no	10-11-2010	2	SS, TSA BSA	Becton Dickinson
F12	no	12-11-2010	4	Nutrient agar	Sifin
F13	no	11-11-2010	3	Nutrient agar	OXOID
F14	no	10-11-2010	2	TSA	Becton Dickinson
F15	no	12-11-2010	4	MacConkey	OXOID
F17	no	No info		Blood agar, Nutrient agar, Nutrient Broth	Merck, Difco
F18	no	10-11-2010	2	Nutrient agar and Hektoen Enteric agar	BD, OXOID
F19	no	12-11-2010	4	Nutrient agar	LIP
F20	no	12-11-2011	4	Hektoen agar, Blood agar	OXOID
F22	no	10-11-2010	2	Trypcase soya	Biomerieux
F23	no	11-11-2010	3	Agar L11	OXOID
F24	no	11-11-2010	3	nutrient agar	Immuna pharm
F25*	no	16-11-2010	8	MAC plates, 5% blood	Difco
F26	no	10-11-2010	2	heart infusion broth	Difco
F27	no	10-11-2010	2	Nutrient agar	Karolinska
F28	no	10-11-2010	2	Nutrient agar	SSI diagnostica, Statens Serum Institute
F29	no	12-11-2010	4	Lactose agar, nutrient agar, swarm agar (gard plate)	OXOID
F30	no	11-11-2010	3	TSI	In-house
F31	no	11-11-2010	3	Drigalski-condrad's agar	In-house
F32*	no	16-11-2010	8	Tryptic soya agar	Forth Richard
F33	no	12-11-2010	4	MacConkey agar and nutrient agar	Fluka, Mast
F34*	no	16-11-2010	8	MacConkey agar and Columbia agar	Selecta-media, Diagnostic Media Products
F35	no	10-11-2010	2	MacConkey without Salt	OXOID

** Non-EU/EEA countries*

Table 2: Details on questions regarding serotyping

Lab code	Frequency of serotyping	Number of strains serotyped 2009	Strains EQA tested by
F1	Daily	1066	Own lab
F2	Thrice a week	500	Own lab
F3	Thrice a week	510	Own lab
F4	Daily	No info	Own lab
F5*	Daily	3296	Own lab
F6	Daily	4865	Own lab
F7	Daily	930	Own lab
F8*	On demand	50	Own lab
F9	Daily	6269	Own lab
F10	Daily	7464	Own lab
F11	Daily	752	Own lab
F12	Twice a week	141	Own lab
F13	Daily	200	Own lab
F14	Daily	5733	Own lab
F15	Daily	300	Own lab
F18	Daily	966	Own lab
F19	Daily	768	Own lab
F20	Thrice a week	220	Own lab
F22	Daily	250	Own lab
F23	Daily	5400	Own lab
F24	Daily	717	Own lab
F25*	Daily	1213	Own lab
F26	Once a week	3400	Own lab
F27	Thrice a week	1089	Own lab
F28	Daily	1509	Own lab
F29	Daily	1801	Own lab
F30	Daily	1900	Own lab
F31	Daily	2100	Own lab
F32*	Daily	2258	Own lab
F33	Daily	144	Own lab
F34*	Daily	2208	Own lab
F35	Daily	1700	Own lab

** Non-EU/EEA countries*

Table 3: Details on questions regarding phage typing

Lab code[1]	Number strains phage-typed 2009	Typing systems *Salmonella* Entiritidus	Typing systems *Salmonella* Typhimurium	Phage typing of strains other than SE and STM				
				Typhi	Para-typhi B	Virchow	Hadar	Other
F1	2000	Felix-Callow's scheme and Anderson scheme	Ward scheme and country-specific Scheme	yes	yes			
F2	337	Anderson	Ward	yes	yes			yes
F4	3988	Extended Anderson	Ward	yes	yes	yes	yes	yes
F5*	4819	Colindale	Colindale	yes	yes	yes	yes	yes
F6	1552	HPA	HPA			yes	yes	
F7	1333	Colindale, HPA	Colindale, HPA					
F8*	500	HPA	HPA	yes				yes
F13	180	HPA	HPA					
F14	4041	Anderson et al.	Ward et al. (HPA)	yes		yes	yes	
F17	No info	HPA	HPA					
F19	370	LEP	Colindale					
F23	3600	Colindale	Colindale	yes	yes	yes	yes	
F24	553	Anderson et al.	Ward et al.					
F25*	5900	Colindale	Colindale	yes	yes		yes	yes
F26	500	HPA Colindale	-					
F27	527	Colindale	Colindale					
F31	900	HPA, Colindale	HPA, Colindale	yes				
F32*	1278	Colindale	Colindale	yes				
F35	737	Colindale	Colindale					

[1] *Lab codes of the laboratories that perform phage typing*

** Non-EU/EEA country*

Table 4: Details on questions regarding antimicrobial susceptibility testing (general)

Lab code	Disk/ MIC	Method	Control strains	Agar broth	Concentration	Number of strains tested 2009
F1	Disk	CLSI 2010	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	480
F2	Disk	CLSI -M100-S20; Vol. 30 No 1/Jan 2010	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	500
F3	Disk	CLSI	ATCC 25922	Mueller-Hinton	$1.5*10^8$	500
F6	Disk	CLSI	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	831
F8*	Disk	No info	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	500
F10	Disk	CA-SFM	ATCC 25922	Mueller-Hinton	$1*10^8$	1000-2000
F13	Disk	Agar diffusion test	ATCC 25922	Mueller-Hinton	$1.5*10^8$	350
F14	Disk	Disk diffusion onto Mueller-Hinton agar	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	1904
F15	Disk	No info	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	100
F18	Disk	Disk diffusion	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	966
F20	Disk	CLSI	ATCC 25922, ATCC 35218, *K. pneumoniae* ATCC 700603	Mueller-Hinton	0.5 McFarland standard	230
F22	Disk	CLSI	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	250
F23	Disk	CLSI	ATCC 25922	Mueller-Hinton	10^6/ml	5400
F29	Disk	BD Sensi-Disc, country-specific interpretation	ATCC 25922	Mueller-Hinton	disk 10^5/ml	1639
F30	Disk	Disc diffusion according to CLSI	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	0
F31	Disk	CLSI, FiRe-standard	ATCC 25922	Mueller-Hinton	0.5 McFarland standard	2100
F35	Disk	In-house breakpoint method	ATCC 25922, other *S enterica*	Iso-Sensitest	1/1000 dilution 4 hr culture	2045
F4	MIC	Microbouillon dilution test	ATCC 25922	Mueller-Hinton	$5*10^8$ CFU/ml	4000
F5*	MIC	CLSI (NCCLS) agar dilution	wild strains	DSNB, Mueller-Hinton	0.5 McFarland standard	6446
F9	MIC	In agar breakpoint	*S. typhimurium* 42R500	Iso-Sensitest (OXOID)	10^4-10^5	?
F11	MIC	E-test	ATCC 25922	Mueller-Hinton	$1.5*10^8$	700
F19	MIC	Broth dilution	ATCC 25922	CAMHB	$1*10^8$ CFU/ml, 10 µl added	768
F24	MIC	Microdilution	ATCC 25922*, P. aerigunosa* ATCC 27853	Mueller-Hinton	1-2 * 10^6/ml	900
F25*	MIC	No info	No info	No info	No info	No info
F26	MIC	Broth microdilution with sensititre plates (ISO20776)	ATCC 25922, *E feacalis* ATCC 29212	CAMHB trek diagnostic systems	$5*10^5$/ml	2000
F28	MIC	NCCLS	ATCC 25922	Mueller-Hinton	$5*10^{10}$/ml	2120
F33	MIC	VITEK 2	ATCC25922	Mueller-Hinton	0.5 McFarland standard	144
F34*	MIC	CLSI	ATCC25922 *K.pneumoniae* ATCC 700608	Mueller-Hinton	0.5 McFarland standard	4000

** Non-EU/EEA country*

Table 5: Details on questions regarding antimicrobial susceptibility testing: antibiotics tested; disk load in µg for disk diffusion method, and concentration range tested in mg/L for MIC method

Lab code	Method	Manufacturer	AMP	CTX	CHL	CIP	GEN	NAL	STR	SUL	TET	TMP
F1	Disk	Oxoid/Liofilchem	10	30	30	5	10	30	30	300	30	5
F2	Disk	Oxoid	10	30	30	5	10	30	10	250/300	30	5
F3	Disk	Biorad	10	30	30	5	10	30	10	300	30	5
F6	Disk	Biorad	10	30	30	5	10	30	10 IU	300	30	5
F8*	Disk	BD	10	30	30	5	10	30	10	250	30	-
F10	Disk	Biorad	-	-	30	5	15 (10 IU)	30	10 (UI)	200	30	5
F13	Disk	Becton Dickinson	10	30	30	5	10	10	10	0.25	30	30
F14	Disk	Oxoid	10	30	30	5	10	30	10	300	30	-
F15	Disk	Oxoid	10	30	30	5	10	30	10	300	30	5
F18	Disk	Oxoid	10	30	30	5	10	30	10	300	30	5
F20	Disk	Oxoid	10	30	30	5	10	30			30	5
F22	Disk	i2a/BD	10	30	30	5	10	30	10	200	30	5
F23	Disk	Oxoid	10	30	30	5	10	30	10	300	30	5
F29	Disk	BS sensi-disc	10	-	30	530	-	30	10	250	30	-
F30	Disk	Bio-Merieux/Becton Dickinson/BBL	10	30	30	5	10	30	10	23.75	30	5
F31	Disk	Oxoid	10	30	30	5	10	30	10	300	30	5
F35	Disk	Oxoid	25	5	10	1	10	30	10	100	10	2.5
F4	MIC	No info	1-16	1-16	4-32	0.0625-64	0.5-8	4-32	4-64	n.d.	0.5-8	n.d.
F5*	MIC	MPU	16	1	16	0.06-2	8	16	8, 32	512	8	8
F9	MIC	Sigma	8&128	1	8	0.125&1	4	16	8&128	64	8 &128	2
F11	MIC	No info	10	0.016-256	0.016-256	0.02-32	0.064-1024	-	-	23.75	30	1,25
F19	MIC	Trek	0.5-32	0.06-4	2-64	0.008-8	0.25-32	4-64	2-128	8-1024	1-64	0.5-32
F24	MIC	No info	0.25-32	0.25-32	0.25-32	0.03-4	0.25-32	1-128	1-128	NT	0.125-16	0.5-16
F25*	MIC	No info	No info	No info	No info	No info	No info	No info	No info	No info	No info	No info
F26	MIC	Sensititre (Trek)	0.5-32	0.06-4	2-64	0.08-8	0.25-32	4-64	2-218	8-1024	1-64	0.5-32
F28	MIC	Trek Diagnostics	1-32	0.125-4	2-64	0.015-4	0.5-16	4-64	8-128	64-1024	2-32	1-32
F33	MIC	Vitek 2 (bioMerieux/AB biodisk/n/a	≤2, ≥32	≤1, ≥ 64	0.016-256	≤0.25, ≥4	≤1, ≥16	0.016-256	n/a	n/a	≤1, ≥16	n/a
F34*	MIC	AB bioMérieux	0.016-256	-	0.016-256	0.002-32	-	0.016-256	0.064-1024	0.016-1024	0.016-256	0.02-32

** Non-EU/EEA country*

Annex 3. Evaluation of the detection of O and H antigens and correct serovar names per EU/EEA laboratory

Figure 1: Evaluation of serotyping of O antigens per EU/EEA laboratory

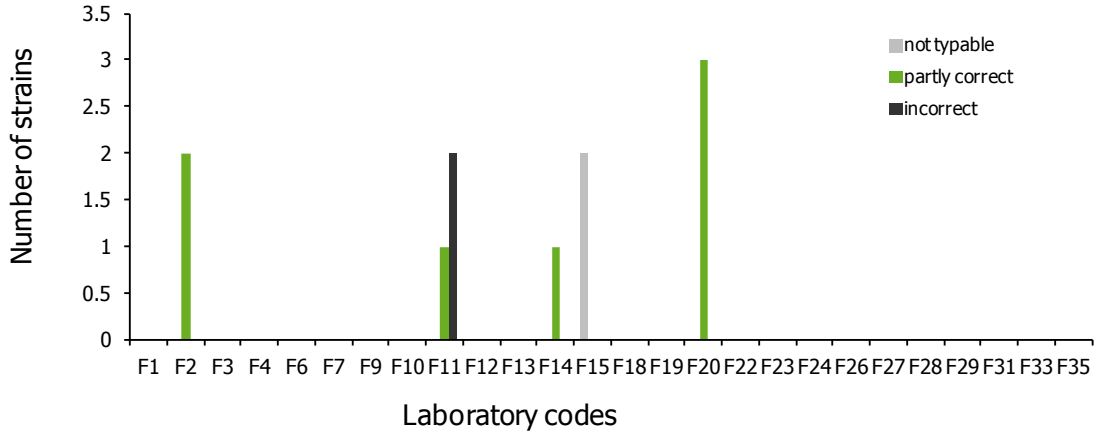


Figure 2: Evaluation of serotyping of H antigens per EU/EEA laboratory

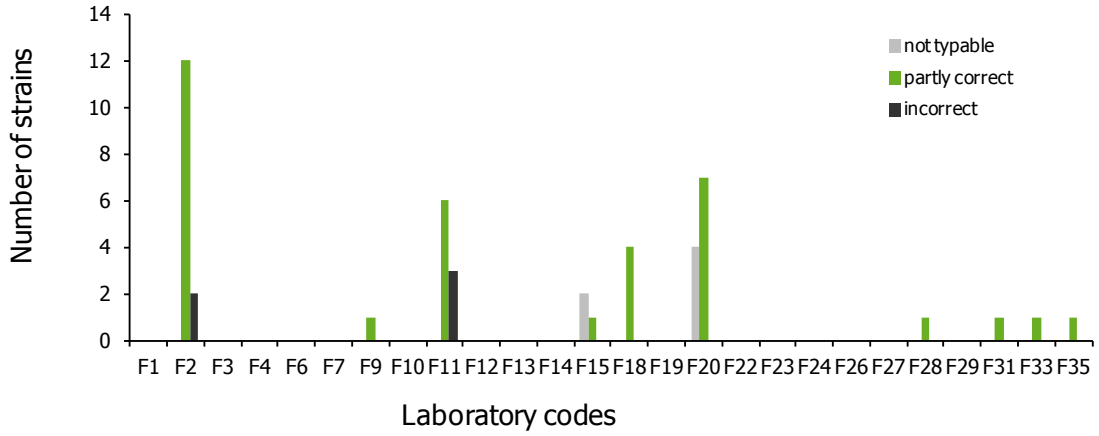
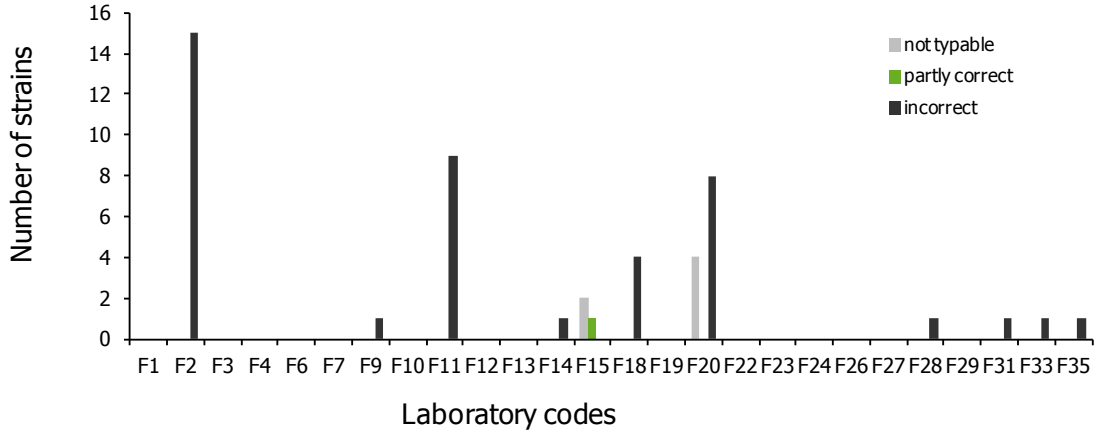


Figure 3: Evaluation of the correct serovar names per EU/EEA laboratory



Annex 4. Evaluation of the detection of O and H antigens and correct serovar names for all participants

Figure 1: Evaluation of serotyping of O antigens per participating laboratory

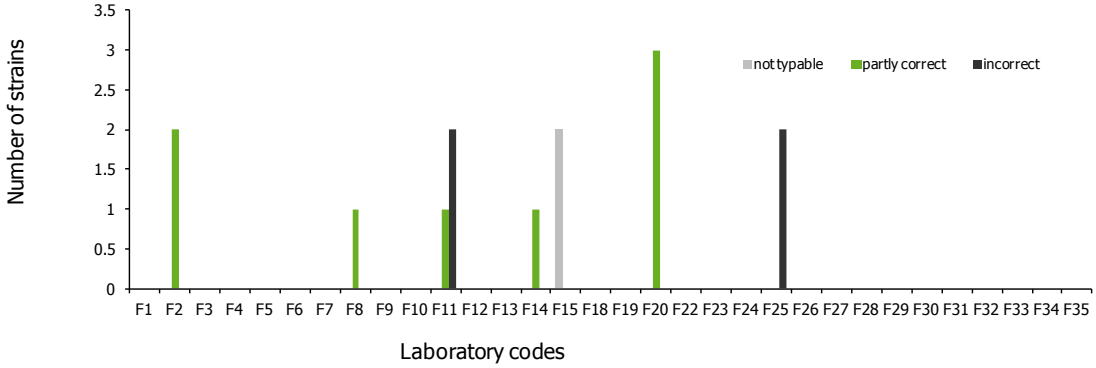


Figure 2: Evaluation of serotyping of H antigens per participating laboratory

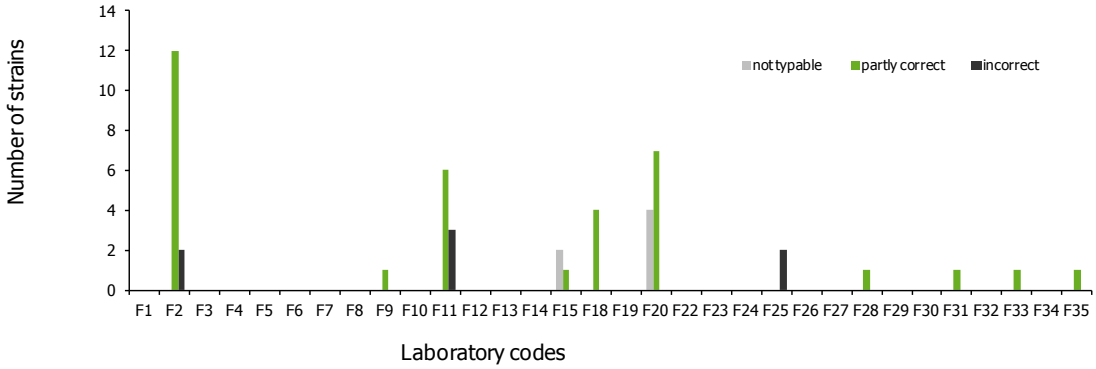
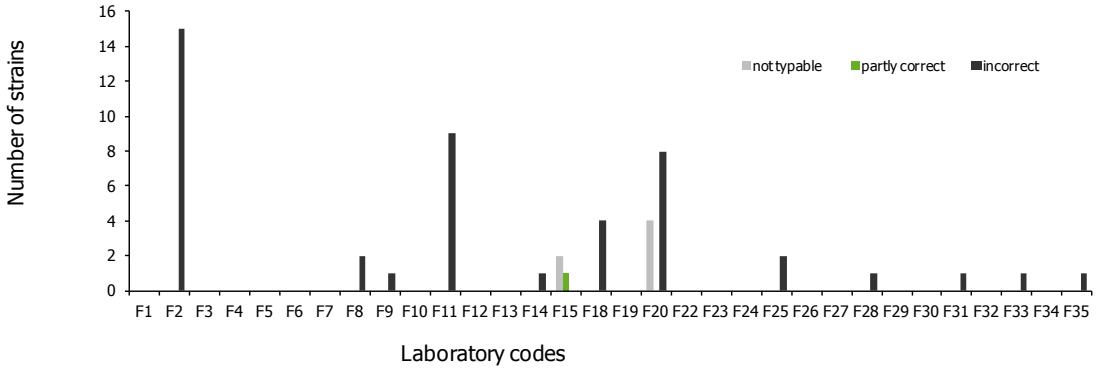


Figure 3: Evaluation of the correct serovar names per participating laboratory



Annex 5. Serovar names reported for strain S18 by FWD laboratories

S18	Lab code
4,5,12:i:-	**REF**
Farsta	F11
Gloucester	F18
Lagos	F33
Tumodi	F2
?	F20
1,4,[5],12 : i : -	F7
4,5,12:i:- monophasic	F30
I. 4,5,12:i:-	F10
Salmonella 4,5,12:i:-	F25
subsp. enterica 4,5,12:i:-	F26
Typhimurium monophasic variant	F22
4,5,12:i:-	F34
4,5,12:i:- (most likely monophasic Typhimurium)	F19
I 4:i:-	F8
monophasic strain Group B (monophasic Typhimurium)	F23
Monophasic Typhimurium	F13
Monophasic Typhimurium	F14
S. enterica ssp. enteric	F1
S. enterica ssp. enterica Gr. O:4 mon.var.	F29
S. enterica subsp. enterica 1,4,5,12 : i : -	F32
S. ssp I	F31
S. subsp. I ser. 4: i: – (Group O:4 monophasic Typhimurium)	F5
S. subspec.I 4,5,12:i:- monophasic variant	F12
S. subspecies I	F27
S. Typhimurium, monophasic	F4
S. ent. subsp.enterica Typhimurium-monophasic var.	F24
Salmonella 4,5:i:-	F6
Salmonella 4:i:- (monophasic strain)	F15
Typhimurium (reported on phage type as DT193)	F35
Unnamed	F9
-	F3
-	F28
No data returned	F21
No data returned	F36
Did not participate	F16
Did not participate	F17

Annex 6. Results: phage typing per strain for all laboratories

Strain E1		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**55**	**-**	**SCL**	**-**	**-**	**-**	**SCL**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F1	55	-	++	-	-	-	+++	-	-	-	-	-	-	-	-	-	-	-
F2	55	-	CL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
F4	55	-	<SCL	-	-	-	<SCL	-	-	-	-	-	-	-	-	-	-	-
F5	55	-	CL	-	-	-	++	-	-	-	-	-	-	-	-		-	±
F6	55	-	SCL	-	-	-	++	-	-	-	-	-	-	-	-	-	-	-
F7	18	-	SCL	CL	-	CL	+++	CL	OL	-	OL	CL	CL	CL	-	-	-	-
F8	55	-	SCL	-	-	-	OL	-	-	-	-	-	-	-	-	-	-	-
F13	55	-	SCL	-	-		SCL	-	-	-	-	-	-	-	-	-	-	-
F14	55	-	CL	-	-	-	<CL	-	-	-	-	-	-	-	-	-	-	-
F17	55	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-		-	-
F19	55	-	+++	-	-	-	+++	-	-	-	-	-	-	-	-	-	-	++
F23	55	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
F24	55	-	<CL	-	-	-	<CL	-	-	-	-	-	-	-	-	-	-	-
F25	55	-	+++	-	-	-	<CL	-	-	-	-	-	-	-	-	-	-	-
F26	55	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
F27	55	-	<CL	-	-	-	SCL	-	-	-	-	-	++	-	-	-	-	-
F31	55	-	+++	-	-	+++	SCL	-	-	-	-	-	++	++	-	-	-	-
F32	55	-	<CL	-	-	-	<CL	-	-	-	-	-	-	-	-	-	-	-
F35	55	-	<CL	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-

Strain E2		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**1b**	**OL**	**SCL**	**CL**	**OL**	**CL**	**SCL**	**CL**	**OL**	**OL**	**SCL**	**CL**	**CL**	**CL**	**SCL**	**OL**	**OL**	**SCL**
F1	1b	+++	SCL	SCL	SCL	SCL	SCL	SCL	+++	SCL	+++	SCL	SCL	SCL	SCL	SCL	SCL	+++
F2	1b	OL	SCL	CL	OL	OL	OL	CL	OL	OL	OL	CL	CL	CL	CL	OL	OL	OL
F4	1b	SCL	SCL	CL	SCL	<CL	SCL	+++	<SCL	<SCL	<SCL	SCL	CL	SCL	<SCL	SCL	<SCL	<OL
F5	1b	SCL	<CL	CL	OL	CL	++	SCL	OL	++	++	CL	CL	<CL	SCL		CL	+++
F6	1b	+++	SCL	SCL	+++	SCL	++	SCL	+++	SCL	+++	SCL	SCL	SCL	SCL	SCL	SCL	+++
F7	1b	OL	SCL	CL	OL	CL	+++	CL	OL	OL	OL	CL	CL	CL	CL	OL	OL	OL
F8	1b	OL	SCL	CL	OL	CL	OL	CL	OL	OL	OL	CL	CL	CL	CL	CL	CL	OL
F13	1b	+++	+++	+	<OL	++	++	SCL	OL	OL	OL	SCL	OL	SCL	SCL	OL	OL	+++
F14	1b	CL	<CL	CL	SCL	CL	<CL	<CL	SCL	SCL	<CL	CL	CL	CL	<CL	CL	<CL	SCL
F17	1d	SCL	SCL	+++	SCL	OL	SCL	++	SCL	OL	OL	++	OL	+++	CL		OL	-
F19	1b	+++	+++	CL	OL	CL	+++	CL	+++	OL	+++	CL	CL	CL	CL	SCL	<CL	OL
F23	1b	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	SCL	<OL	<OL
F24	4a	-	CL	CL	SCL	CL	<CL	CL	-	<CL	-	SCL	CL	CL	-	-	<CL	<OL
F25	1b	OL	<CL	<CL	OL	<CL	<OL	<CL	OL	OL	<OL	<CL	<CL	<CL	OL	OL	OL	OL
F26	1b	OL	SCL	CL	<OL	CL	SCL	CL	OL	<OL	OL	CL	CL	CL	CL	<OL	OL	<OL
F27	1b	OL	<CL	CL	OL	CL	SCL	CL	OL	OL	OL	<CL	CL	CL	OL	SCL	SCL	OL
F31	1b	+++	+++	SCL	+++	SCL	SCL	SCL	+++	+++	+++	SCL	SCL	SCL	+++	+	+++	+++
F32	1b	OL	<CL	CL	<OL	CL	SCL	SCL	<OL	<OL	<CL	<CL	CL	CL	CL	<CL	<CL	OL
F35	1b	OL	<CL	CL	+	CL	+	<CL	OL	<OL	<OL	<CL	CL	<CL	CL	CL	CL	<CL

Strain E3		**Phage reactions at routine test dilution (*S.* Enteritidis)**																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**15a**	**-**	**-**	**++**	**-**	**CL**	**+++**	**-**	**OL**	**-**	**OL**	**-**	**CL**	**CL**	**-**	**-**	**-**	**-**
F1	15a	-	-	++	-	SCL	+++	-	SCL	-	+++	-	SCL	SCL	-	-	-	-
F2	15a	-	-	+++	-	OL	SCL	-	OL	-	OL	-	CL	CL	-	-	-	-
F4	15a	-	-	++	-	OL	<SCL	-	<OL	-	OL	-	CL	SCL	-	-	-	-
F5	15	-	-	CL	-	CL	++	-	OL	±	OL	-	CL	CL	-		++	-
F6	15	-	-	SCL	-	SCL	+++	-	OL	-	OL	-	SCL	SCL	-	-	+++	-
F7	15	-	-	+	-	CL	+++	-	SCL	-	SCL	-	CL	CL	-	-	+++	-
F8	15a	-	-	OL	-	CL	OL	-	OL	-	OL	-	OL	OL	-	-	-	-
F13	15a	-	-	+	-	++	++	-	OL	-	OL	-	+++	SCL	-	-	-	-
F14	15a		-	++	-	CL	<CL	-	<CL	-	OL	±	CL	CL	-	-	-	-
F17	15	-	-	++	-	CL	SCL	-	<SCL	-	SCL	-	CL	CL	-		CL	-
F19	15a	-	-	SCL	-	CL	+++	-	OL	-	SCL	-	CL	CL	-	-	-	-
F23	15a	-	-	++<<	-	CL	<SCL	-	OL	-	OL	-	CL	CL	-	-	-	-
F24	15	-	+	-	-	CL	<CL	-	OL	-	SCL	-	CL	CL	-	-	<CL	
F25	15a	-	-	OL	-	OL	<OL	-	OL	-	OL	-	<CL	<CL	-	-	-	-
F26	15a	-	-	++	-	OL	SCL	-	OL	-	OL	-	CL	CL	-	-	-	-
F27	15a	-	-	SCL	-	CL	SCL	-	OL	-	OL	-	CL	CL	-	-	-	-
F31	15a	±	-	+++	-	SCL	+++	-	OL	-	<OL	-	SCL	CL	-	-	++	-
F32	15a	-	-	<CL		CL.	+++	-	<OL	-	OL	-	CL	CL	-	-	-	-
F35	15a	-	-	<SCL	-	CL	SCL	-	OL	-	OL	-	CL	CL	-	-	-	-

Strain E4		**Phage reactions at routine test dilution (*S.* Enteritidis)**																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**6a**	**-**	**SCL**	**-**	**OL**	**-**	**SCL**	**-**	**-**	**<OL**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**SCL**
F1	6a	-	+++	-	+++	-	SCL	-	-	+++	-	-	-	-	-	-	-	+++
F2	6a	-	<CL	-	SCL	-	OL	-	-	OL	-	-	-	-	-	-	-	OL
F4	6a	-	SCL	-	<SCL	-	CL	-	-	OL	-	-	-	-	-	-	-	<OL
F5	6a	-	SCL	-	+++	-	++	-	-	+	-	-	-	-	-		-	+
F6	6a	-	++	-	+	-	+++	-	-	++	-	-	-	-	-	-	-	+
F7	6b	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
F8	6a	-	+++	-	OL	-	OL	-	-	OL	-	-	-	-	-	-	-	<OL
F13	6a	-	++	-	++	-	++	-	-	++	-	-	-	-	-	-	-	+
F14	6a	-	SCL	-	<CL	-	<CL	-	-	+++	-	-	-	-	-	-	-	<CL
F17	6a	-	SCL	-	SCL	-	SCL	-	-	OL	-	-	-	-	-		-	+++
F19	6a	-	+++	-	<OL	-	+++	-	-	OL	-	-	-	-	-	-	-	OL
F23	6a	-	SCL	-	SCL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	SCL
F24	14c	-	-	-	-	-	CL	-	-	-	-	-	-	-	-	-	-	-
F25	6a	-	+++	-	<OL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	<OL
F26	6a	-	SCL	-	SCL	-	SCL	-	-	<OL	++	-	-	-	-	-	-	<CL
F27	6a	-	SCL	-	SCL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	SCL
F31	6a	-	+++	-	+++	-	SCL	-	-	+++	-	-	-	-	-	-	-	+++
F32	6a	-	CL.	-	SCL	-	<SCL	-	-	<CL	-	-	-	-	-	-	-	OL.
F35	6a	-	<CL	-	<OL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	<CL

Strain E5		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**13a**	**-**	**-**	**-**	**OL**	**-**	**SCL**	**-**	**OL**	**OL**	**SCL**	**-**	**-**	**-**	**-**	**-**	**-**	**SCL**
F1	28	-	-	+	SCL	+++	SCL	6	SCL	SCL	+++	+	+++	-	-	-	-	+++
F2	13a	-	-	-	CL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
F4	13a	-	-	-	SCL	-	<OL	-	-	<OL	SCL	-	-	-	-	-	-	<OL
F5	13a	-	-	-	OL	-	SCL	-	OL	++	<SCL	-	-	-	-		-	+++
F6	13a	-	-	-	+++	-	++	-	SCL	SCL	SCL	-	-	-	-	-	-	+++
F7	28	-	-	+	SCL	SCL	SCL	+	OL	OL	OL	+	SCL	-	-	-	-	OL
F8	13a	-	-	-	OL	-	OL	-	OL	OL	OL	-	-	-	-	-	-	OL
F13	13a	-	-	-	+++	-	++	-	OL	OL	OL	-	-	-	-	-	-	++
F14	13a	-	-	-	SCL	-	<CL	-	<CL	SCL	CL	-	-	-	-	-	-	SCL
F17	19	-	-	-	-	-	+++	-	OL	-	OL	-	-	-	-		-	+++
F19	13a	-	-	-	++	-	+++	-	<OL	OL	+++	-	-	-	-	-	-	OL
F23	13a	-	-	-	SCL	-	<SCL	-	<OL	<OL	<OL	-	-	-	-	-	-	<OL
F24	28	-	-	+	SCL	<CL	SCL	++	SCL	SCL	SCL	+	<CL	-	-	-	-	OL
F25	28	-	-	-	OL	+++	SCL	3	OL	OL	OL	+	+++	-	-	-	-	<OL
F26	13a	-	-	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL
F27	13a	-	-	-	SCL	-	SCL	-	OL	SCL	OL	-	-	-	-	-	-	SCL
F31	13a	-	-	-	+++	-	SCL	-	+++	+++	+++	-	-	-	-	-	-	+++
F32	13a	-	-	-	<SCL	-	SCL	-	<OL	+++	SCL	-	-	-	-	-	-	<OL
F35	13a	-	-	-	<OL	-	SCL	-	OL	<OL	<OL	-	-	-	-	-	-	<CL

Strain E6		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**6**	**-**	**SCL**	**-**	**OL**	**-**	**SCL**	**-**	**OL**	**OL**	**OL**	**-**	**-**	**-**	**-**	**-**	**-**	**SCL**
F1	6	-	SCL	-	SCL	-	+++	-	SCL	SCL	SCL	-	-	-	-	-	-	SCL
F2	6	-	<CL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
F4	6	-	SCL	-	<OL	-	<OL	-	SCL	<OL	<OL	-	-	-	-	-	-	<OL
F5	6	-	CL	-	OL	-	+++	-	OL	SCL	SCL	-	-	-	-		-	<OL
F6	6c	-	SCL	-	SCL	-	++	-	OL	SCL	OL	-	-	-	-	-	+++	SCL
F7	6c	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	OL	OL
F8	6	-	+++	-	OL	-	OL	-	OL	OL	OL	-	-	-	-	-	-	<OL
F13	6	-	++	-	++	-	-	-	OL	<OL	OL	-	-	-	-	-	-	<OL
F14	6		SCL	-	SCL	-	<CL	-	<CL	CL	<CL	-	-	-	-	-	-	SCL
F17	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-		-	+++
F19	6	-	+++	-	<OL	-	+++	-	OL	OL	OL	-	-	-	-	-	-	OL
F23	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL
F24	6	-	CL	-	OL	-	CL	-	<CL	OL	SCL	-	-	-	-	-	-	OL
F25	6	-	+++	-	OL	-	OL	-	OL	OL	OL	-	-	-	-	-	-	OL
F26	6	-	SCL	-	SCL	-	SCL	-	OL	<OL	OL	-	-	-	-	-	-	<OL
F27	6	-	SCL	-	OL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
F31	6	-	+++	-	+++	-	+++	-	+++	+++	+++	-	-	-	-	-	-	+++
F32	6	-	+++	-	SCL	-	SCL	-	+++	+++	<OL	-	-	-	-	-	-	OL
F35	6	-	+++	-	OL	-	++	-	OL	OL	OL	-	-	-	-	-	-	CL

Strain E7		**Phage reactions at routine test dilution (*S.* Enteritidis)**																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**8**	**-**	**-**	**SCL**	**<OL**	**CL**	**SCL**	**<CL**	**OL**	**OL**	**<OL**	**CL**	**CL**	**-**	**-**	**-**	**-**	**SCL**
F1	8	-	-	SCL	+++	SCL	SCL	+++	SCL	+++	SCL	SCL	SCL	-	-	-	-	+++
F2	8	-	-	SCL	SCL	CL	OL	SCL	OL	OL	OL	SCL	SCL	-	-	-	-	OL
F4	8	-	-	<SCL	SCL	OL	SCL	SCL	<OL	SCL	CL	<CL	<CL	-	-	-	-	SCL
F5	8	-	-	<CL	+++	CL	++	+	OL	+++	CL	CL	CL	-	-		-	+++
F6	8	-	-	SCL	+++	++	+++	SCL	+++	SCL	SCL	++	SCL	-	-	-	-	+++
F7	8	-	-	SCL	SCL	CL	SCL	CL	OL	OL	OL	SCL	CL	-	-	-	-	OL
F8	8	-	-	SCL	OL	SCL	OL	SCL	OL	OL	OL	SCL	CL	-	-	-	-	OL
F13	28	-	-	+	+	+	++	+	OL	<OL	OL	++	SCL	-	-	-	-	+
F14	8	±	±	CL	+++	CL	<CL	<CL	OL	SCL	OL	CL	CL	±	±	±	-	SCL
F17	8	-	-	SCL	SCL	CL	SCL	CL	OL	OL	OL	SCL	CL	-	-		-	+++
F19	8	-	-	<SCL	<OL	<SCL	+++	+++	OL	OL	+++	+++	CL	-	-	-	-	OL
F23	8	-	-	SCL	SCL	CL	SCL	SCL	CL	OL	CL	SCL	CL	-	-	-	-	<OL
F24	8	-	-	SCL	SCL	CL	SCL	CL	SCL	SCL	SCL	CL	SCL	-	-	-	-	OL
F25	8	-	-	<CL	OL	CL	<CL	<CL	OL	OL	OL	<CL	CL	-	-	-	-	<OL
F26	8	-	-	SCL	SCL	CL	SCL	SCL	OL	OL	OL	SCL	CL	-	-	-	-	<OL
F27	8	3	-	<CL	OL	<CL	OL	CL	OL	SCL	OL	SCL	CL	-	-	-	-	SCL
F31	8	±	-	SCL	+++	SCL	CL	+++	OL	+++	OL	+++	CL	-	-	-	-	+++
F32	8	-	-	<CL	SCL	CL.	SCL	SCL	OL	+++	OL	SCL	CL.	-	-	-	-	<CL
F35	8	-	-	<SCL	<OL	CL	SCL	<SCL	OL	<OL	OL	SCL	CL	-	-	-	-	<CL

Strain E8		**Phage reactions at routine test dilution (*S.* Enteritidis)**																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**1**	**OL**	**SCL**	**CL**	**OL**	**CL**	**SCL**	**CL**	**OL**	**OL**	**<OL**	**CL**	**CL**	**CL**	**<CL**	**-**	**-**	**SCL**
F1	1b	SCL	+++	SCL	+++	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	+++	+++	+++	+++
F2	1	OL	CL	CL	OL	CL	OL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	<OL
F4	1	OL	SCL	CL	SCL	CL	SCL	SCL	OL	SCL	OL	SCL	CL	SCL	SCL	-	-	<OL
F5	1	OL	CL	CL	OL	CL	++	<CL	OL	CL	<CL	CL	CL	CL	SCL		-	OL
F6	1b	SCL	SCL	SCL	SCL	SCL	+++	SCL	SCL	SCL	+++	SCL	SCL	SCL	SCL	SCL	+++	SCL
F7	1	OL	SCL	CL	OL	CL	+++	CL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
F8	1	OL	SCL	CL	OL	CL	OL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
F13	1	SCL	+++	+	+++	++	+++	+	OL	OL	OL	SCL	SCL	SCL	SCL	-	-	<OL
F14	1	OL	CL	CL	OL	CL	<CL	<CL	OL	SCL	OL	CL	CL	CL	CL	-	-	SCL
F17	1b	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL		OL	+++
F19	1	CL	+++	CL	OL	CL	+++	CL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
F23	1	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
F24	1b	OL	<CL	CL	SCL	CL	CL	CL	OL	OL	SCL	CL	CL	CL	+++	SCL	SCL	<OL
F25	1	OL	OL	<CL	OL	<CL	<CL	<CL	OL	OL	OL	<CL	<CL	<CL	<CL	-	-	OL
F26	1	OL	SCL	CL	<OL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	<OL
F27	1	OL	<CL	CL	OL	CL	OL	CL	OL	SCL	OL	CL	CL	CL	<CL	-	-	OL
F31	1	OL	+++	CL	+++	CL	SCL	SCL	OL	+++	OL	SCL	CL	CL	CL	-	++	+++
F32	1	OL.	CL.	CL	OL.	CL	SCL	SCL	OL	OL	OL.	<CL	CL	CL.	CL	-	-	OL
F35	1	OL	<CL	CL	+	CL	+	CL	OL	<OL	OL	CL	CL	CL	CL	-	-	<CL

Strain E9		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**13**	**-**	**-**	**-**	**SCL**	**-**	**SCL**	**-**	**-**	**SCL**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**++**
F1	14c	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
F2	13	-	-	-	SCL	-	SCL	-	-	OL	-	-	-	-	-	-	-	SCL
F4	13	-	<OL	-	SCL	-	SCL	OL	-	-	-	-	-	-	-	-	-	<OL
F5	13	-	-	-	+++	-	+++	-	-	+	-	-	-	-	-		-	++
F6	14c	-	-	-	-	-	++	-	-	-	-	-	-	-	-	-	-	-
F7	14b	-	-	-	-	-	SCL	-	-	+	-	-	-	-	-	-	-	OL
F8	14c	-	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	-	-
F13	14b	-	-	-	-	-	++	-	-	-	-	-	-	-	-	-	-	++
F14	14b	-	-	-	±	-	<CL	-	-	±	-	-	-	-	-	-	-	++
F17	13	-	-	-	SCL	-	SCL	-	-	OL	-	-	-	-	-		-	+++
F19	13	-	-	-	+++	-	+++	-	-	OL	-	-	-	-	-	-	-	<OL
F23	13	-	-	-	SCL	-	SCL	-	-	OL	-	-	-	-	-	-	-	SCL
F24	13	-	-	-	SCL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	SCL
F25	13	-	-	-	<OL	-	OL	-	-	<OL	-	-	-	-	-	-	-	<OL
F26	13	-	-	-	SCL	-	SCL	-	-	<OL	-	-	-	-	-	-	-	SCL
F27	13	-	-	-	SCL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	SCL
F31	13	-	-	-	+++	-	SCL	-	-	+++	-	-	-	-	-	-	-	+++
F32	14b	-	-	-	+	-	SCL	-	-	+	-	-	-	-	-	-	-	SCL
F35	14b	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	CL

Strain E10		Phage reactions at routine test dilution (*S.* Enteritidis)																
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HPA	**4**	**-**	**SCL**	**CL**	**OL**	**CL**	**SCL**	**CL**	**OL**	**OL**	**<OL**	**CL**	**CL**	**CL**	**-**	**-**	**-**	**SCL**
F1	4	-	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	-	-	-	SCL
F2	4	-	<CL	CL	SCL	CL	SCL	CL	OL	<OL	OL	CL	CL	CL	-	-	-	OL
F4	4	-	SCL	<CL	SCL	<CL	SCL	SCL	OL	SCL	SCL	SCL	CL	SCL	-	-	-	<OL
F5	4	±	CL	OL	OL	CL	++	SCL	OL	SCL	<OL	CL	<CL	<CL	-		**-**	<OL
F6	4b	-	SCL	SCL	OL	SCL	+++	SCL	OL	SCL	OL	SCL	SCL	SCL	-	-	+++	SCL
F7	4b	-	SCL	CL	SCL	SCL	+++	CL	OL	OL	OL	CL	CL	CL	-	-	SCL	OL
F8	4	-	+++	CL	OL	CL	OL	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL
F13	4	-	++	++	++	SCL	++	SCL	OL	OL	OL	SCL	SCL	SCL	-	-	-	++
F14	4	-	CL	<CL	OL	CL	<CL	<CL	OL	SCL	OL	CL	CL	-	-	-	-	OL
F17	45	-	SCL	OL	SCL	CL	OL	++	SCL	OL	SCL	+++	OL	+++	+		-	+++
F19	4	-	+++	CL	OL	CL	+++	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL
F23	4	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
F24	23	-	-	-	OL	-	-	-	-	OL	-	-	-	-	-	-	-	OL
F25	4	-	SCL	<CL	OL	<CL	OL	<CL	OL	OL	OL	<CL	<CL	<CL	-	-	-	OL
F26	4	-	SCL	CL	SCL	CL	SCL	CL	OL	<OL	OL	CL	CL	CL	-	-	-	<OL
F27	4	-	<CL	CL	OL	CL	SCL	CL	OL	OL	OL	<CL	CL	CL	-	-	-	OL
F31	4	-	+++	SCL	+++	SCL	SCL	SCL	OL	+++	+++	SCL	SCL	CL	-	-	-	+++
F32	4	-	CL	<CL	OL	CL.	SCL	<CL	+++	OL	<OL	<CL	CL.	CL.	-	-	-	OL
F35	4	-	<CL	CL	+	CL	+	CL	OL	<OL	OL	CL	CL	CL	-	-	-	<CL

Strain T1		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**U310**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F1	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F2	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F4	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F5	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F6	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F7	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F8	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F13	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F14	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F19	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F23	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F24	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F27	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F31	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F32	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F35	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T1		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**U310**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**±**	**-**
F1	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	2	-
F2	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	±	-
F4	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	<SCL	++	-
F5	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++	-	-
F6	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	SCL	+++	-
F7	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	OL	OL	OL	-
F8	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	±	-
F13	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-	-
F14	U310	-	-	-	-	-	-	-	-	-	-	-	-	±	±	±	+	OL	++	-
F19	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-	-
F23	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	±	SCL	3	-
F24	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-	-
F25	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	OL	±	-
F27	U310	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	OL	+	-
F31	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++	3	OL	+++	-
F32	195	-	-	-	-	-	-	-	-	-	-	-	-	-	±	+++	<OL	OL	<OL	-
F35	U310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	±	<CL	+	-

Strain T2		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**208**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F1	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F2	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F4	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F6	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F7	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F8	U312	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F13	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F14	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F19	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F23	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F24	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F27	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F31	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F32	193a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F35	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T2		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**208**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**SCL**	**SCL**	**SCL**	**OL**
F1	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++	++	+++	++
F2	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	++	-
F4	208	-	-	-	-	-	-	-	-	-	-	-	-							
F5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	++	++
F6	208	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+++	+++	+++	+++
F7	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F8	U312	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F13	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
F14	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	OL	SCL	<CL
F19	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
F23	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	++	++	<SCL
F24	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F25	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	<OL	<OL
F27	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	SCL	SCL	SCL
F31	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
F32	193a	-	-	-	-	-	-	-	±	-	-	-	±	+	+	+++	<OL	OL	<OL	5
F35	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	++

Strain T3		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**46a**	**-**	**SCL**	**OL**	**OL**	**OL**	**OL**	**-**	**-**	**OL**	**OL**	**-**	**-**	**OL**	**OL**	**OL**	**OL**	**-**	**OL**
F1	46a	-	SCL	SCL	SCL	SCL	SCL	-	-	SCL	SCL	-	-	SCL	SCL	SCL	SCL	-	+++
F2	3	-	OL	CL	CL	CL	CL	-	-	CL	CL	-	-	CL	CL	CL	CL	-	CL
F4	46a	-	SCL	SCL	SCL	SCL	<CL	-	-	<CL	SCL	-	-	OL	SCL	<CL	SCL	-	<CL
F5	46a	-	<CL	CL	OL	CL	CL	-	-	<CL	CL	-	-	CL	CL	CL	CL	-	<CL
F6	46a		SCL	SCL	SCL	SCL	SCL			SCL	SCL			SCL	SCL	SCL	SCL		SCL
F7	3	-	+++	CL	CL	CL	CL	-	-	CL	CL	-	-	CL	CL	CL	CL	-	CL
F8	46a	-	-	SCL	CL	CL	CL	-	-	+	CL	-	-	CL	SCL	CL	+	-	-
F13	46	-	SCL	CL	OL	CL	CL	-	-	SCL	SCL	-	-	CL	CL	CL	SCL	-	SCL
F14	46a	-	OL	CL	OL	CL	CL	-	-	CL	OL	-	-	CL	CL	CL	CL	-	CL
F19	46a	-	<SCL	SCL	+++	<CL	CL	-	-	<CL	CL	-	-	CL	SCL	CL	<CL	-	CL
F23	46a	-	<OL	OL	OL	OL	OL	-	-	OL	OL	-	-	OL	OL	OL	OL	-	<OL
F24	46a	-	<CL	CL	OL	<CL	CL	-	-	<CL	<CL	-	-	CL	CL	CL	CL	-	SCL
F25	46a	-	OL	OL	OL	OL	OL	-	-	OL	OL	-	±	OL	OL	<CL	OL	-	<CL
F27	46a	-	SCL	OL	SCL	OL	OL	-	-	OL	OL	-	-	OL	OL	OL	OL	-	OL
F31	46a	-	+++	CL	OL	OL	+++	-	-	+++	CL	-	-	CL	CL	+++	CL	-	++
F32	46a	-	CL.	SCL	SCL	CL	CL	-	-	CL.	CL.	-	-	CL	CL	CL	<CL	-	CL
F35	46a	-	+	CL	OL	CL	CL	-	-	SCL	CL	-	-	CL	CL	CL	CL	-	CL

Strain T3		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**46a**	**SCL**	**OL**	**OL**	**OL**	**OL**	**OL**	**OL**	**OL**	**OL**	**OL**	**OL**	**OL**	**+**	**+**	**+**	**-**	**-**	**-**	**OL**
F1	46a	+++	SCL	SCL	SCL	SCL	SCL	SCL	+++	SCL	SCL	SCL	SCL	SCL	++	+++	-	-	-	SCL
F2	3	CL	CL	OL	CL	CL	CL	OL	CL	+	CL	OL	CL	-	+	-	-	-	-	OL
F4	46a	SCL	OL	SCL	SCL	SCL	<CL	<CL	SCL	OL	<CL	SCL	OL							
F5	46a	SCL	CL	<CL	<CL	CL	CL	<CL	<CL	CL	CL	<CL	CL							
F6	46a	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	+++	+++	+++	+	++	+	SCL
F7	3	CL	CL	SCL	CL	CL	CL	++	CL	+	CL	+++	CL							
F8	46a	SCL	SCL	SCL	SCL	SCL	<SCL	SCL	CL	CL	CL	SCL	CL	-	-	-	-	-	-	CL
F13	46	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	+	+	+	-	-	-	SCL
F14	46a	<CL	OL	<CL	CL	CL	CL	CL	<CL	OL	CL	CL	OL	-	±	±	±	±	±	CL
F19	46a	SCL	<SCL	+++	SCL	SCL	<SCL	SCL	OL	+++	CL	CL	OL	-	+	+	-	-	-	CL
F23	46a	<OL	OL	<OL	<OL	OL	<OL	OL	OL	OL	OL	<OL	OL	+	+++	+	-	-	-	OL
F24	46a	<CL	CL	CL	CL	CL	SCL	CL	<CL	<CL	CL	SCL	CL	-	-	-	-	-	-	<CL
F25	46a	OL	OL	<OL	<OL	<CL	OL	<OL	OL	OL	<CL	OL	OL							
F27	46a	SCL	OL	SCL	SCL	OL	OL	OL	OL	OL	OL	OL	SCL	+	-	++	-	-	-	OL
F31	46a	SCL	SCL	+++	SCL	CL	+++	OL	CL	CL	+	CL	SCL	++	++	+++	-	-	+	OL
F32	46a	<CL	CL	<CL	CL.	SCL	SCL	CL.	CL	CL	CL.	<CL	OL							
F35	46a	SCL	CL	CL	CL	CL	CL	CL	CL	OL	CL	CL	OL							

Strain T4		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**7**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**CL**	**-**
F1	59	-	-	-	-	-	-	+++	-	-	-	-	-	-	-	-	-	SCL	-
F2	7	-	-	-	-	-	-	CL	-	-	-	-	-	-	-	-	-	CL	-
F4	7	-	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-
F5	7	-	-	-	-	-	-	+++	-	-	-	-	-	-	-	-	-	<CL	-
F6	59	-	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	-
F7	7	-	-	-	-	-	-	CL	-	-	-	-	-	-	-	-	-	CL	-
F8	104b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++	-
F13	20a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	-
F14	7	-	-	-	-	-	-	<CL	-	-	-	-	±	-	-	-	-	CL	-
F19	120	-	-	-	-	-	-	++	-	-	-	-	-	-	-	-	-	<CL	-
F23	7	-	-	-	-	-	-	<OL	2	-	-	-	-	-	-	-	-	<CL	-
F24	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	7	-	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	<CL	-
F27	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-
F31	7	-	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	CL	-
F32	7	-	-	-	-	-	-	<SCL	±	-	-	-	-	-	-	-	-	<CL	-
F35	104b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<CL	-

Strain T4		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**7**	**+**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**-**	**+**	**+**	**+**	**SCL**	**OL**	**OL**	**-**
F1	59	++	-	-	-	-	-	-	-	-	-	+++	-	±	±	+	+++	+++	+++	-
F2	7	OL	-	-	-	-	-	-	-	-	-	OL	±	+	+	+	OL	OL	-	-
F4	7	++	-	-	-	-	-	-	-	-	-	+++	-							
F5	7	++	-	-	-	-	-	-	-	-	-	++	-							
F6	59	+++	-	-	-	-	-	-	-	-	-	SCL	-	+++	+++	+++	OL	OL	OL	-
F7	7	++	-	-	-	-	-	-	-	-	-	+++	+							
F8	104b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	<OL	OL	-
F13	20a	++	-	-	-	-	-	-	-	-	-	OL	-	+	+	+++	OL	OL	OL	-
F14	7	+++	-	-	-	-	-	-	-	-	-	<CL	-	±	±	++	<OL	<OL	<OL	-
F19	120	++	-	-	-	-	-	-	-	-	-	++	-	+++	+++	+++	OL	OL	OL	-
F23	7	++	-	-	-	-	-	-	-	-	-	++	-	±	++	+	OL	SCL	SCL	-
F24	20	OL	-	-	-	-	-	-	-	-	-	OL	-	-	-	-	<OL	<OL	<OL	-
F25	7	SCL	-	-	-	-	-	-	-	-	-	<CL	-							
F27	120	-	-	-	-	-	-	-	-	-	-	-	-	+	+	++	-	-	-	-
F31	7	SCL	-	-	-	-	-	-	-	-	-	SCL	-	+	++	+++	OL	OL	OL	-
F32	7	+	-	-	-	-	-	-	-	-	-	+	-							
F35	104b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-

Strain T5		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**15a**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**CL**	**CL**	**-**	**OL**	**-**	**OL**	**-**	**SCL**
F1	75	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-	SCL	-	SCL	-	SCL
F2	15a	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	OL	-	OL	-	OL
F4	15a	-	-	-	-	-	-	-	-	-	OL	SCL	<OL	-	OL	-	OL	-	SCL
F5	15a	-	-	-	-	-	-	-	-	-	OL	CL	<CL	-	OL	-	OL	-	<OL
F6	15a	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-	SCL	-	SCL	-	SCL
F7	15a	-	-	-	-	-	-	-	-	-	SCL	CL	CL	-	OL	-	OL	-	OL
F8	75	-	-	-	-	-	-	-	-	-	OL	SCL	CL	-	+	-	+	-	-
F13	U289	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-	OL	-	SCL	-	SCL
F14	15a	-	-	-	-	-	-	-	-	-	OL	CL	CL	-	<CL	-	OL	-	OL
F19	75	-	-	-	-	-	-	-	-	-	SCL	CL	CL	-	-	-	<CL	-	OL
F23	15a	-	-	-	-	-	-	-	-	-	OL	<CL	<CL	-	OL	-	CL	-	<OL
F24	15a	-	-	-	-	-	-	-	-	-	CL	CL	CL	-	CL	-	<CL	-	OL
F25	15a	-	-	-	-	-	-	-	-	-	OL	<CL	<CL	-	OL	-	OL	-	OL
F27	15a	-	-	-	-	-	-	-	-	-	<CL	<CL	<CL	-	OL	-	SCL	-	SCL
F31	15a	-	-	-	-	-	-	-	-	-	SCL	CL	CL	-	SCL	-	OL	-	SCL
F32	15a	-	-	-	-	-	-	-	-	-	OL	CL.	CL.	-	OL.	-	<OL	-	<SCL
F35	15a	-	-	-	-	-	-	-	-	-	CL	CL	CL	-	CL	-	CL	-	+

Strain T5		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**15a**	**SCL**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**-**	**+**	**+**	**+**	**OL**	**OL**	**OL**	**+**
F1	75	+++	-	-	-	-	-	-	3	-	-	SCL	-	-	2	±	+++	+++	+++	3
F2	15a	OL	-	-	-	-	-	-	+	-	-	OL	++	-	±	-	-	OL	OL	-
F4	15a	OL	-	-	-	-	-	-	±	-	-	<OL	-							
F5	15a	SCL	-	-	-	-	-	-	-	-	-	<OL	-							
F6	15a	SCL	-	-	-	-	-	-	+	-	-	SCL	-	+++	++	++	SCL	SCL	SCL	-
F7	15a	OL	-	-	-	-	-	-	++	-	-	OL	+++							
F8	75	SCL	-	-	-	-	-	-	+	-	-	+	-	-	-	-	OL	<OL	OL	-
F13	U289	SCL	-	-	-	-	-	-	-	-	-	OL	-	-	-	+	OL	OL	OL	-
F14	15a	SCL	-	-	-	-	-	-	-	-	-	OL	-	+++	+++	+++	OL	OL	OL	-
F19	75	OL	-	-	-	-	-	-	-	-	-	OL	-	+	+	+	<SCL	OL	OL	+
F23	15a	OL	-	-	-	-	-	-	±<<	-	-	<OL	1	++	+++	++	<OL	SCL	SCL	5
F24	15a	SCL	-	-	-	-	-	-	+	-	-	SCL	+++	-	-	-	OL	OL	OL	-
F25	15a	OL	-	-	-	-	-	-	1	-	-	OL	2							
F27	15a	SCL	-	-	-	-	-	-	+	-	-	SCL	-	+	-	++	OL	SCL	SCL	-
F31	15a	SCL	-	-	-	-	-	-	+	-	-	OL	-	-	-	-	OL	OL	OL	5
F32	15a	<OL	-	-	-	-	-	-	-	-	-	SCL	5							
F35	15a	<CL	-	-	-	-	-	-	-	-	-	OL	-							

Strain T6		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**24**	**-**	**-**	**SCL**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**CL**	**-**	**-**	**-**	**-**	**-**
F1	24	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
F2	24	-	-	+++	-	-	-	-	-	-	-	-	-	CL	-	+	-	-	-
F4	24	-	-	<SCL	-	-	-	-	-	-	-	-	-	<CL	-	-	-	-	-
F5	24	-	-	+++	-	-	-	-	-	-	-	-	-	+++	-	-	-	-	-
F6	24	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
F7	24	-	-	+++	-	-	-	-	-	-	-	-	-	CL	-	++	-	-	-
F8	24	-	-	++	-	-	-	-	-	-	-	-	-	<OL	-	-	-	-	-
F13	24	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
F14	24	-	-	CL	-	-	-	-	-	-	-	-	-	CL	-	-	-	-	-
F19	24	-	-	+++	-	-	-	-	-	-	-	-	-	<CL	-	-	-	-	-
F23	24	-	-	<SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
F24	24	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
F25	24	-	-	<CL	-	-	-	-	-	-	-	-	-	<CL	-	-	-	-	-
F27	24	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
F31	24	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-
F32	24	-	-	++	-	-	-	-	-	-	-	-	-	+++	-	-	-	-	-
F35	24	-	-	+++	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	-

Strain T6		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**24**	**-**	**-**	**-**	**-**	**CL**	**-**	**CL**	**-**	**-**	**-**	**-**	**-**	**+**	**+**	**+**	**SCL**	**OL**	**OL**	**±**
F1	24	-	-	-	-	+++	-	+++	-	-	-	-	-	±	±	±	+++	+++	+++	-
F2	24	-	-	-	-	CL	-	OL	-	-	-	-	-	-	-	-	-	OL	OL	-
F4	24	-	-	-	-	SCL	-	SCL	-	-	-	-	-							
F5	24	-	-	-	-	+++	-	+++	-	+	-	-	-							
F6	24	-	-	-	-	SCL	-	SCL	-	-	-	-	-	+	+	+	SCL	SCL	SCL	-
F7	24	-	-	-	-	CL	-	++	-	-	-	-	-							
F8	24	-	-	-	-	++	-	++	-	-	-	-	-	-	-	-	OL	<OL	OL	-
F13	24	-	-	-	-	SCL	-	SCL	-	-	-	-	-	-	+	++	OL	OL	OL	-
F14	24	-	-	-	-	CL	-	SCL	-	-	-	-	-	-	-	-	CL	OL	OL	-
F19	24	-	-	-	-	++	-	+++	-	-	-	-	-	-	-	-	SCL	OL	OL	<OL
F23	24	-	-	-	-	SCL	-	CL	-	-	-	-	-	+	+++	++	OL	SCL	SCL	-
F24	24	-	-	-	-	SCL	-	SCL	-	-	-	-	-	-	-	-	<OL	<OL	<OL	-
F25	24	-	-	-	-	SCL	-	SCL	-	-	-	-	-							
F27	24	-	-	-	-	SCL	-	OL	-	-	-	-	-	+	+	++	OL	OL	SCL	-
F31	24	-	-	-	-	SCL	-	+++	-	-	-	-	-	+	+	+++	OL	OL	OL	-
F32	24	-	-	-	-	+	-	+++	-	-	-	-	-							
F35	24	-	-	-	-	+++	-	+++	-	-	-	-	-							

Strain T7		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**15**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**CL**	**CL**	**-**	**OL**	**-**	**OL**	**CL**	**++**
F1	15	-	-	-	-	-	-	-	-	-	-	SCL	SCL	+++	-	SCL	-	+++	SCL
F2	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	-
F4	15	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-	SCL	-	++	<OL	SCL
F5	15	-	-	-	-	-	-	-	-	-	SCL	SCL	++	-	<OL	-	SCL	CL	+++
F6	15a	-	-	-	-	-	-	-	-	-	SCL	+++	+++	-	SCL	-	SCL	-	SCL
F7	15	-	-	-	-	-	-	-	-	-	+++	SCL	SCL	-	+++	-	SCL	CL	CL
F8	11	-	-	-	-	-	-	-	-	-	OL	<OL	<OL	-	-	-	++	++	-
F13	15	-	-	-	-		-	-	-	-	OL	OL	OL	-	OL	-	<SCL	CL	OL
F14	15	-	-	-	-	-	-	-	-	-	OL	OL	OL	-	SCL	-	<CL	CL	SCL
F19	11	-	-	-	-	-	-	-	-	-	<OL	SCL	SCL	-	-	-	+++	<CL	<OL
F23	15	-	-	-	-	-	-	-	-	-	<OL	SCL	SCL	-	OL	-	<OL	SCL	++
F24	75	-	-	-	-	-	-	-	-	-	SCL	SCL	<CL	-	-	-	OL	-	SCL
F25	15	-	-	-	-	-	-	-	3	-	OL	<CL	<CL	-	OL	-	OL	CL	OL
F27	15	-	-	-	-	-	-	-	-	-	OL	OL	OL	-	OL	-	SCL	SCL	SCL
F31	15	-	-	-	-	-	-	-	-	-	OL	+	OL	-	OL	-	OL	CL	OL
F32	15	-	-	-	-	-	-	-	-	-	<OL	SCL	SCL	-	<OL	-	SCL	<OL	SCL
F35	15	-	-	-	-	-	-	-	-	-	CL	++	++	-	OL	-	CL	SCL	+

Strain T7		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**15**	**SCL**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**-**	**±**	**±**	**±**	**OL**	**OL**	**OL**	**±**
F1	15	+++	+++	-	-	-	-	-	+	1	-	SCL	±	2	±	±	+++	+++	+++	-
F2	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F4	15	++	-	-	-	-	-	-	±	2	-	SCL	-							
F5	15	++	-	-	-	-	-	-	-	-	-	SCL	-							
F6	15a	+++	-	-	-	-	-	-	+	-	-	SCL	+	+	+	++	SCL	SCL	SCL	+
F7	15	SCL	-	-	-	-	-	-	++	+	-	SCL	+							
F8	11	+++	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	<OL	OL	-
F13	15	OL	-	-	-	-	-	-	-	-	-	SCL	+	-	-	++	OL	OL	OL	-
F14	15	<CL	-	-	-	-	-	-	-	-	-	<CL	-	+++	+++	+++	OL	OL	OL	-
F19	11	+++	-	-	-	-	-	-	-	-	-	SCL	-	++	+	++	<OL	OL	OL	-
F23	15	<SCL	-	-	-	-	-	-	+	3	-	SOL	5	+n	+++	++	<OL	SCL	SCL	-
F24	75	CL	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	OL	OL	OL	-
F25	15	OL	-	-	-	-	-	-	2	-	-	OL	-							
F27	15	SCL	-	-	-	-	-	-	+	-	-	OL	- 2	+	-	++	OL	OL	SCL	-
F31	15	OL	-	-	-	-	-	-	+	-	-	OL	-	+	++	+++	-	-	-	-
F32	15	SCL	-	-	-	-	-	-	-	-	-	<OL	±							
F35	15	++	-	-	-	-	-	-	-	-	-	OL	-							

Strain T8		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**193**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
F1	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F2	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F4	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F5	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F6	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F7	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F8	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F13	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F14	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F19	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F23	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F24	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F27	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F31	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F32	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F35	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T8		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**193**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**+++**	**+++**	**+++**	**-**	**-**	**-**	**-**
F1	193	-	-	-	-	-	-	-	-	-	-	-	-	++	SCL	SCL	-	-	-	-
F2	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	+++	-	-	-	-
F4	193	-	-	-	-	-	-	-	-	-	-	-	-	±	±	++	-	-	-	-
F5	193	-	-	-	-	-	-	-	-	-	-	-	-	+	+	SCL	-	-	-	-
F6	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
F7	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	+++	-	-	-	-
F8	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	-	-	-	-
F13	193	-	-	-	-	-	-	-	-	-	-	-	-	+	+	++	-	-	-	-
F14	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
F19	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+	+++	-	-	-	-
F23	193	-	-	-	-	-	-	-	-	-	-	-	-	++	SCL	++	-	-	-	-
F24	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	193	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	<SCL	<SCL	-	-	-	-
F27	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	++	+++	-	-	-	-
F31	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	++	+++	-	-	-	-
F32	193	-	-	-	-	-	-	-	-	-	-	-	-	++	SCL	SCL	-	-	-	-
F35	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-

Strain T9		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**104**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**SCL**	**SCL**	**-**	**-**	**-**	**-**	**+++**	**-**
F1	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+++	-
F2	110	-	-	-	-	-	-	-	-	-	-	-	CL	-	-	-	-	CL	-
F4	104	-	-	-	-	-	-	-	-	-	-	±	++	-	-	-	-	++	-
F5	104	-	-	-	-	-	-	-	-	-	-	<CL	<CL	-	-	-	-	+++	-
F6	12	-	-	-	-	-	-	-	-	-	-	++	+++	-	-	-	-	-	-
F7	104	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	SCL	-
F8	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+	-
F13	104	-	-	-	-	-	-	-	-	-	-	+	+++	-	-	-	-	SCL	-
F14	104	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	+++	-
F19	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+++	-
F23	104	-	-	-	-	-	-	-	-	-	-	+<<	+<<	-	-	-	-	+ns	-
F24	12	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	-	-
F25	104	-	-	-	-	-	-	-	-	-	-	<CL	<CL	-	-	-	-	SCL	-
F27	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	SCL	-
F31	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	SCL	-
F32	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	++	-
F35	104	-	-	-	-	-	-	-	-	-	-	++	SCL	-	-	-	-	+	-

Strain T9		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**104**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**OL**	**OL**	**OL**	**-**
F1	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-
F2	110	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	OL	OL	-
F4	104	-	-	-	-	-	-	-	-	-	-	-	-							
F5	104	-	-	-	-	-	-	-	-	-	-	-	-							
F6	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-
F7	104	-	-	-	-	-	-	-	-	-	-	-	-							
F8	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	<OL	OL	-
F13	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F14	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL	OL	OL	-
F19	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F23	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	SCL	SCL	-
F24	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	OL	<OL	-
F25	104	-	-	-	-	-	-	-	-	-	-	-	-							
F27	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	SCL	-
F31	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F32	104	-	-	-	-	-	-	-	-	-	-	-	-							
F35	104	-	-	-	-	-	-	-	-	-	-	-	-							

Strain T10		Phage reactions at routine test dilution (*S.* Typhimurium)																	
Lab code	**Phage type**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
HPA	**36**	**CL**	**CL**	**CL**	**OL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**	**CL**
F1	36	SCL	SCL	SCL	SCL	SCL	SCL	+++	+++	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL
F2	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	CL	CL
F4	36	<SCL	SCL	<CL	SCL	SCL	<CL	SCL	SCL	<CL	SCL	SCL	SCL	<CL	<CL	<CL	SCL	SCL	SCL
F5	36	SCL	<CL	<CL	CL	CL	CL	CL	CL	<CL	CL	CL	SCL	CL	CL	CL	<CL	CL	CL
F6	36	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL
F7	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	CL	CL
F8	36	SCL	+	SCL	SCL	CL	CL	CL	CL	++	CL	SCL	SCL	CL	SCL	CL	SCL	SCL	SCL
F13	36	SCL	SCL	SCL	OL	SCL	SCL	SCL	CL	SCL	SCL	++	SCL	CL	SCL	SCL	SCL	CL	SCL
F14	36	<CL	CL	CL	OL	CL	CL	CL	<CL	<CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
F19	36	<CL	SCL	SCL	SCL	SCL	OL	SCL	CL	CL	CL	OL	CL	CL	CL	CL	CL	CL	OL
F23	36	CL	<CL	CL	CL	CL	CL	CL	CL	CL	CL	SCL	SCL	CL	CL	CL	CL	CL	<CL
F24	36	SCL	SCL	<CL	OL	SCL	<CL	SCL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	SCL	SCL
F25	36	OL	OL	OL	OL	CL	CL	CL	CL	OL	OL	<CL	<CL	CL	CL	OL	OL	OL	OL
F27	36	<CL	SCL	CL	CL	CL	CL	CL	CL	<CL	CL	SCL	SCL	CL	CL	CL	CL	CL	<CL
F31	36	SCL	SCL	CL	CL	SCL	SCL	CL	SCL	<SCL	SCL	SCL	SCL	CL	CL	CL	CL	CL	SCL
F32	36	SCL	CL	SCL	SCL	CL	CL	<CL	CL	CL.	CL.	<CL	<CL	CL.	CL	CL	<CL	CL	CL.
F35	36	CL	SCL	CL	OL	CL	CL	<CL	<CL	CL	CL	SCL	SCL	CL	CL	CL	CL	SCL	<CL

Strain T10		Phage reactions at routine test dilution (*S.* Typhimurium)												Additional phages						
Lab code	**Phage type**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**32**	**35**	**1**	**2**	**3**	**10**	**10VAR2**	**10VAR3**	**18**
HPA	**36**	**CL**	**OL**	**OL**	**CL**	**CL**	**CL**	**CL**	**CL**	**OL**	**CL**	**CL**	**OL**	**++**	**++**	**++**	**OL**	**OL**	**OL**	**CL**
F1	36	+++	SCL	SCL	+++	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	+	+++	+++	+++	SCL	+++	SCL
F2	36	CL	CL	CL	CL	CL	CL	OL	CL	CL	CL	CL	CL	-	-	-	-	OL	OL	OL
F4	36	SCL	SCL	SCL	<SCL	CL	SCL	SCL	OL	OL	<SCL	OL	OL							
F5	36	SCL	CL	<CL	<CL	<CL	CL	CL	<CL	CL	CL	CL	CL							
F6	36	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	+++	++	++	OL	OL	OL	OL
F7	36	CL	CL	CL	CL	CL	CL	SCL	CL	CL	CL	SCL	CL							
F8	36	SCL	SCL	SCL	SCL	<SCL	<SCL	SCL	CL	CL	CL	SCL	CL	++	+++	+++	OL	<OL	OL	OL
F13	36	SCL	SCL	SCL	SCL	SCL	CL	SCL	SCL	SCL	CL	SCL	SCL	+	++	+++	OL	OL	OL	OL
F14	36	<CL	CL	<CL	CL	CL	CL	<CL	<CL	OL	CL	CL	OL	±	±	±	OL	OL	OL	CL
F19	36	SCL	SCL	+++	SCL	SCL	+++	+++	OL	SCL	CL	OL	OL	+++	+	+++	OL	OL	OL	CL
F23	36	<CL	CL	CL	CL	CL	<CL	CL	CL	CL	CL	<CL	CL	+	+++	+	OL	SCL	SCL	CL
F24	36	CL	CL	CL	CL	CL	<CL	<CL	CL	CL	CL	CL	<CL	-	-	-	OL	OL	OL	SCL
F25	36	OL	OL	<OL	OL	OL	<OL	<CL	OL	OL	CL	CL	OL							
F27	36	SCL	CL	<CL	CL	CL	CL	CL	CL	CL	CL	CL	<CL	++	-	++	SCL	SCL	SCL	<CL
F31	36	<CL	CL	SCL	SCL	CL	SCL	SCL	CL	CL	++	CL	SCL	+++	+++	SCL	OL	OL	OL	OL
F32	36	<CL	CL	<CL	CL.	SCL	<CL	<CL	CL	CL	CL	<CL	OL.							
F35	36	SCL	CL	CL	SCL	CL	CL	SCL	SCL	CL	CL	CL	OL							

Annex 7. Results: antimicrobial susceptibility testing per antibiotic for all laboratories

Ampicillin			Strain number										Evaluation		
Lab code	Method	criteria used	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10	N	Minor	Major
REF	MIC	2-8	<= 0.5	> 32	> 32	> 32	1	2	> 32	2	1	> 32			
REF	MIC		S	R	R	R	S	S	R	S	S	R			
F4	MIC	2	2	>16	>16	>16	2	2	>16	2	2	>16			
F4	MIC	S	s	R	R	R	s	s	R	s	s	R	10	0	0
F5	MIC														
F5	MIC		S	R	R	R	S	S	R	S	S	R	10	0	0
F9	MIC		<8	>128	>128	>128	<8	<8	>128	<8	<8	>128			
F9	MIC		S	R	R	R	S	S	R	S	S	R	10	0	0
F11	MIC	8	0,094	>8	≥32	≥32	≤2	≤2	>8	<4	<2	32			
F11	MIC	S	S	R	R	R	S	S	R	S	S	R	10	0	0
F19	MIC	2	1	>32	>32	>32	1	1	>32	2	1	>32			
F19	MIC		S	R	R	R	S	S	R	S	S	R	10	0	0
F24	MIC	4	2	>32	>32	>32	2	2	>32	2	2	>32			
F24	MIC		S	R	R	R	S	S	R	S	S	R	10	0	0
F25	MIC	4	<=1	>32	>32	>32	<=1	<=1	>32	<=1	<=1	>32			
F25	MIC	in range	S	R	R	R	S	S	R	S	S	R	10	0	0
F26	MIC	4	1	> 32	> 32	> 32	1	2	> 32	2	2	> 32			
F26	MIC		S	R	R	R	S	S	R	S	S	R	10	0	0
F28	MIC	8	<=1	>32	>32	>32	2	<=1	>32	2	2	>32			
F28	MIC	S	S	R	R	R	S	S	R	S	S	R	10	0	0
F33	MIC	>256	<=2	>=32	>=32	>=32	<=2	<=2	>=32	<=2	<=2	>=32			
F33	MIC		s	r	r	r	s	s	r	s	s	r	10	0	0
F34	MIC	4	0.5	256	256	256	1	1	256	1	0.5	256			
F34	MIC	S	S	R	R	R	S	S	R	S	S	R	10	0	0
F1	Disk	16	23	6	18	6	24	23	6	25	23	6			
F1	Disk		S	R	S	R	S	S	R	S	S	R	10	0	1
F2	Disk	19	24	6	6	6	24	24	6	24	25	6			
F2	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F3	Disk	21	29	6	6	6	29	26	6	27	30	6			
F3	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F6	Disk	20	26	7	7	7	24	25	7	24	25	7			
F6	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F8	Disk	19	22	6	6	6	23	22	6	21	22	6			
F8	Disk		S	R	R	R	S	S	S	S	S	S	10	0	2
F13	Disk	19	24	6	6	6	25	23	6	22	24	6			
F13	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F14	Disk	16.39	28.31	0	0	0	29.09	26.87	0	26.03	27.41	0			
F14	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F15	Disk	17	28	6	6	6	27	25	6	25	26	6			
F15	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F18	Disk	19	25	6	6	6	25	24	6	24	24	6			
F18	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F20	Disk	16	25	6	6	6	22	23	6	22	23	6			
F20	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F22	Disk	21	30	6	6	6	32	25	6	27	28	6			
F22	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F23	Disk	19	27	6	6	6	27	25	6	23	27	6			
F23	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F29	Disk	21	27	6	6	6	26	25	25	26	25	6			
F29	Disk		I	R	R	R	I	I	I	I	I	R	10	6	0
F30	Disk	19	25	6	6	6	25	22	6	22	25	6			
F30	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F31	Disk	17	24	0	0	0	25	22	0	20	22	0			
F31	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F35	Disk	24	25.5	0	0	0	25	25	0	23.5	24	0			
F35	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
F10	Disk	26	33	6	6	6	31	30	6	33	30	6			
F10	Disk		S	R	R	R	S	S	R	S	S	R	10	0	0
													280	6	3

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation. MIC: in mg/L, disk: in mm

Cefotaxime			Strain number									Evaluation		
Lab code	**Method**	**criteria used**	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**N**	**Minor**	**Major**
REF	**MIC**	**0.03-0.12**	**<= 0.06**	**<= 0.06**	**0.12**	**> 4**	**0.12**	**0.25**	**> 4**	**0.12**	**0.12**	**0.12**			
REF	**MIC**		**S**	**S**	**S**	**R**	**S**	**S**	**R**	**S**	**S**	**S**			
F4	MIC	<=1	</=1	</=1	</=1	>16	</=1	</=1	>16	</=1	</=1	</=1			
F4	MIC	S	s	s	s	R	s	s	R	s	s	s	10	0	0
F5	MIC														
F5	MIC		S	S	S	R	S	S	R	S	S	S	10	0	0
F9	MIC		<1	<1	<1	>1	<1	<1	>1	<1	<1	<1			
F9	MIC		S	S	S	R	S	S	R	S	S	S	10	0	0
F11	MIC	0,064	0,023	0,047	0,032	8	0,023	0,032	32	0,64	0,016	0,016			
F11	MIC	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F19	MIC	0.06	0.06	0.06	0.12	>4	0.12	0.12	>4	0.12	0.06	0.06			
F19	MIC		S	S	S	R	S	S	R	S	S	S	10	0	0
F24	MIC	<=0.5	<=0.5	<=0.5	<=0.5	32	<=0.5	<=0.5	>64	<=0.5	<=0.5	<=0.5			
F24	MIC		S	S	S	**R**	S	S	R	S	S	S	10	0	0
F25	MIC														
F25	MIC														
F26	MIC	<= 0.06	<= 0.06	<= 0.06	0.12	> 4	0.12	0.12	> 4	0.12	0.12	<= 0.06			
F26	MIC		S	S	S	R	S	S	R	S	S	S	10	0	0
F28	MIC	<=0.125	0.25	<=0.125	<=0.125	>4	<=0.125	0.25	>4	<=0.125	<=0.125	<=0.125			
F28	MIC	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F33	MIC	0.064	<=1	<=1	<=1	16	<=1	<=1	>=64	<=1	<=1	<=1			
F33	MIC	s	s	s	r	r	s	s	r	s	s	s	10	0	1
F34	MIC														
F34	MIC														
F1	Disk	30	32	36	31	14	32	32	6	33	30	32			
F1	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F2	Disk	32	32	33	30	13	32	31	10	30	30	31			
F2	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F3	Disk	34	34	36	33	18	37	38	13	36	34	38			
F3	Disk		S	S	S	I	S	S	R	S	S	S	10	1	0
F6	Disk	31	31	32	30	15,84	30	32	11,94	31	32	32			
F6	Disk	S	S	S	S	I	S	S	R	S	S	S	10	1	0
F8	Disk	30	31	32	31	15	33	30	6	27	31	30			
F8	Disk	S	S	S	S	I	S	S	S	S	S	S	10	1	1
F13	Disk	31	32	31	30	10	30	30	7	30	31	30			
F13	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F14	Disk	34.65	34.15	38.8	37.42	16.61	38.47	34.65	7.35	36.9	37.44	38.78			
F14	Disk	S	S	S	S	I	S	S	S	S	S	S	10	1	1
F15	Disk	32	37	36	34	16	36	36	8	34	35	35			
F15	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F18	Disk	33	33	35	31	13	34	32	6	32	34	32			
F18	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F20	Disk	30	35	36	33	14	34	31	10	34	34	32			
F20	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F22	Disk	34	37	37	34	14	37	34	6	34	36	33			
F22	Disk		S	S	S	R	S	S	R	S	S	S	10	0	0
F23	Disk	34	36	25	33	15	37	34	10	32	35	34			
F23	Disk	S	S	S	S	I	S	S	R	S	S	S	10	1	0
F29	Disk														
F29	Disk														
F30	Disk	32	32	34	31	18	32	29	10	30	32	33			
F30	Disk	S	S	S	S	I	S	S	R	S	S	S	10	1	0
F31	Disk	32	32	31	25	18	32	32	12	30	30	34			
F31	Disk	S	S	S	S	I	S	S	R	S	S	S	10	1	0
F35	Disk	30	30	30	27	0	28	29	0	25	28	30			
F35	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
F10	Disk	37	35	35	33	16	35	35	10	35	34	34			
F10	Disk	S	S	S	S	R	S	S	R	S	S	S	10	0	0
													250	7	3

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation.

MIC: in mg/L, disk: in mm

Chloramphenicol			Strain number										Evaluation		
Lab code	Method	Criteria used	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10	N	Minor	Major
REF	**MIC**	**2-8**	**8**	**8**	**8**	**16**	**8**	**> 64**	**8**	**8**	**8**	**> 64**			
REF	**MIC**		**S**	**S**	**S**	**R**	**S**	**R**	**S**	**S**	**S**	**R**			
F4	MIC	<=4	</=4	</=4	</=4	16	</=4	>32	8	8	</=4	>32			
F4	MIC	S	s	s	s	R	s	R	s	s	s	R	9	0	0
F5	MIC														
F5	MIC		S	S	S	S	S	R	S	S	S	R	9	0	0
F9	MIC		<8	<8	<8	>8	<8	>8	<8	<8	<8	>8			
F9	MIC		S	S	S	R	S	R	S	S	S	R	9	0	0
F11	MIC	1,5	1	1,5	1,5	6	1	>256	1,5	1	1,5	>256			
F11	MIC	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F19	MIC	4	4	4	8	8	4	>64	8	8	4	>64			
F19	MIC		S	S	S	S	S	R	S	S	S	R	9	0	0
F24	MIC	4	4	4	4	8	4	>32	4	4	4	>32			
F24	MIC		S	S	S	S	S	R	S	S	S	R	9	0	0
F25	MIC	4	4	4	8	16	4	>32	8	8	8	>32			
F25	MIC	in range	S	S	S		S	R	S	S	S	R	9	0	0
F26	MIC	4	4	8	8	16	8	> 64	8	8	8	> 64			
F26	MIC		S	S	S	S	S	R	S	S	S	R	9	0	0
F28	MIC	8	8	4	8	16	8	>64	8	8	8	>64			
F28	MIC	S	S	S	S		S	R	S	S	S	R	9	0	0
F33	MIC	3	3	2	4	12	2	>256	4	3	3	>256			
F33	MIC	s	s	s	s	r	s	r	s	s	s	r	9	0	0
F34	MIC	4	4	2	4	8	4	256	4	4	4	256			
F34	MIC	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F1	Disk	25	29	27	28	21	25	6	24	26	26	6			
F1	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F2	Disk	24	24	25	24	18	24	6	22	24	22	6			
F2	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F3	Disk	24	29	27	27	23	29	6	26	28	26	6			
F3	Disk		S	S	S	S	S	R	S	S	S	R	9	0	0
F6	Disk	24	24	24	24	18	23	7	23	23	25	7			
F6	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F8	Disk	24	26	25	25	20	26	6	24	25	26	6			
F8	Disk	S	S	S	S	S	S	R	S	S	S	S	9	0	1
F10	Disk	28	29	30	28	20	28	6	25	27	27	6			
F10	Disk	S	S	S	S	R	S	R	S	S	S	R	9	0	0
F13	Disk	22	22	25	22	15	23	6	21	23	22	6			
F13	Disk	S	S	S	S		S	R	S	S	S	R	9	0	0
F14	Disk	23.64	27.32	29.09	29.06	19.37	30.31	0	26.16	28.81	26.28	0			
F14	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F15	Disk	25	28	28	27	20	29	6	26	26	26	6			
F15	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F18	Disk	37	27	29	26	20	28	6	24	26	26	6			
F18	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F20	Disk	21	26	27	27	20	25	6	24	24	24	6			
F20	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F22	Disk	24	24	25	24	16	25	6	23	23	26	6			
F22	Disk		S	S	S		S	R	S	S	S	R	9	0	0
F23	Disk	24	25	26	26	18	25	6	23	24	25	6			
F23	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F29	Disk	24	28	28	26	21	27	6	25	25	25	6			
F29	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F30	Disk	24	23	26	27	21	26	6	26	25	26	16			
F30	Disk	S	S	S	S	S	S	R	S	S	S	I	9	0	0
F31	Disk	27	29	28	25	23	28	0	26	25	27	0			
F31	Disk	S	S	S	S	S	S	R	S	S	S	R	9	0	0
F35	Disk	17	22	21	19.5	11	22	0	17	18	18	0			
F35	Disk	S	S	S	S	R	S	R	S	S	S	R	9	0	0
													252	0	1

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation.

MIC: in mg/L, disk: in mm

Ciprofloxacin			Strain number										Evaluation		
Lab code	Method	Criteria used	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10	N	Minor	Major
REF	**MIC**	**0.004-0.015**	**0.03**	**0.03**	**8**	**2**	**0.03**	**0.03**	**0.03**	**0.5**	**0.03**	**0.25**			
REF	**MIC**		**S**	**S**	**R**	R	**S**	**S**	**S**	S	**S**	S			
F4	MIC	<=0,06	</=0,06	</=0,06	16	2	</=0,06	</=0,06	</=0,06	0,5	</=0,06	0,25			
F4	MIC	S	s	s	R	i	s	s	s	s	s	s	7	0	0
F5	MIC														
F5	MIC		S	S	R	I	S	S	S	I	S	I	7	0	0
F9	MIC		<0.125	<0.125	>1	>0.125, <1	<0.125	<0125	<0.125	>0.125,<1	<0.125	>0.125,<1			
F9	MIC		S	S	R	I	S	S	S	I	S	I	7	0	0
F11	MIC	0,004	0,004	0,032	2	0,25	0,004	0,006	0,006	0,16	0,004	0,047			
F11	MIC	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F19	MIC	0.008	0.015	0.03	8	2	0.015	0.06	0.015	0.5	0.03	0.25			
F19	MIC		S	S	R	R	S	S	S	S	S	S	7	0	0
F24	MIC	<0.03	<0.03	<0.03	>4	1	<0.03	<0.03	<0.03	0.5	<0.03	0.25			
F24	MIC		S	S	R	I	S	S	S	S	S	S	7	0	0
F25	MIC	<=0.015	<=0.015	<=0.015	>4	1	<=0.015	<=0.015	<=0.015	0.5	<=0.015	0.12			
F25	MIC	in range	S	S	R	S	S	S	S	S	S	S	7	0	0
F26	MIC	<= 0.008	0.015	0.03	> 8	2	0.015	0.03	0.03	0.5	0.03	0.25			
F26	MIC		S	S	R	R	S	S	S	R	S	R	7	0	0
F28	MIC	<=0.01	<=0.01	0.03	>4	2	0.03	0.03	0.03	0.5	0.03	0.25			
F28	MIC	S	S	S	R	R	S	S	S	R	S	R	7	0	0
F33	MIC	0.016	<=0.25	<=0.25	>=4	1	<=0.25	<=0.25	<=0.25	0.5	<=0.25	<=0.25			
F33	MIC	s	s	s	r	r	s	s	s	r	s	r	7	0	0
F34	MIC	0.008	0.015	0.031	8	0.5	0.015	0.031	0.015	0.25	0.031	0.125			
F34	MIC	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F1	Disk	34 (0,004)	34	32	12 (4)	23 (0,38)	34	32	29	30	30	30 (0,047)			
F1	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F2	Disk	32	29	30	11	21	29	29	30	25	30	26			
F2	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F3	Disk	36	32	33	10	23	42	35	33	30	35	31			
F3	Disk		S	S	R	S	S	S	S	S	S	S	7	0	0
F6	Disk	32	31	31	10.35	21	31	31	30	23	32	26			
F6	Disk	S	S	S	R	I	S	S	S	I	S	I	7	0	0
F8	Disk	32	30	34	10	23	37	32	31	23	32	26			
F8	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F10	Disk	39	36	39	11	26	40	38	37	30	36	30			
F10	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F13	Disk	31	30 (0,008)	30 (0,015)	8(4)	20 (0,5)	31 (0,015)	30 (0,015)	30 (0,015)	22 (0,25)	30 (0,015)	25 (0,25)			
F13	Disk	S	S	S	R	R	S	S	S	R	S	R	7	0	0
F14	Disk	36.04	35.39	35.94	14.1	24.4	37.43	36.92	33.91	26.71	36.87	31.71			
F14	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F15	Disk	37	34	35	13	24	42	38	36	28	37	32			
F15	Disk	S	S	S	R	R	S	S	S	S	S	R	7	0	0
F18	Disk	37	35	37	11	24	40	33	32	27	32	28			
F18	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F20	Disk	33	33	34	13	23	32	34	34	24	33	30			
F20	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F22	Disk	33	31	32	6	18	37	31	31	22	32	25			
F22	Disk		S	S	R	R	S	S	S	R	S	R	7	0	0
F23	Disk	33	33	33	10	19	35	34	31	24	35	27			
F23	Disk	S	S	S	R	I	S	S	S	S	S	S	7	0	0
F29	Disk	41	36	37	11	24	38	34	36	27	34	31			
F29	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F30	Disk	35	27	31	11	22	38	28	29	25	34	29			
F30	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F31	Disk	33	30	30	13*	21**	34	31	31	23***	29	28****			
F31	Disk	S	S	S	R	S	S	S	S	S	S	S	7	0	0
F35	Disk	28	28	28.5	0	16	30	30	28	16.5	30	23			
F35	Disk	S	S	S	R	R	S	S	S	R	S	S	7	0	0
													196	0	0

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation.

MIC: in mg/L, disk: in mm

Gentamicin			Strain number										Evaluation		
Lab code	**Method**	**criteria used**	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**N**	**Minor**	**Major**
REF	**MIC**	**0.25-1**	**0.5**	**1**	**16**	**<= 0.25**	**0.5**	**<= 0.25**	**0.5**	**0.5**	**1**	**0.5**			
REF	**MIC**		**S**	**S**	**R**	**S**	**S**	**S**	**S**	**S**	**S**	**S**			
F4	MIC	<=0,5	</=0,5	1	>8	</=0,5	</=0,5	</=0,5	</=0,5	</=0,5	1	</=0,5			
F4	MIC	S	s	s	R	s	s	s	s	s	s	s	10	0	0
F5	MIC														
F5	MIC		S	S	S	S	S	S	S	S	S	S	10	0	1
F9	MIC		<4	<4	>4	<4	<4	<4	<4	<4	<4	<4			
F9	MIC		S	S	R	S	S	S	S	S	S	S	10	0	0
F11	MIC	0,19	0,094	0,064	6	<0,064	0,064	<0,064	0,064	0,064	0,064	0,064			
F11	MIC	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F19	MIC	0.5	0.25	0.5	16	0.5	0.25	0.5	0.5	0.5	0.5	0.5			
F19	MIC		S	S	R	S	S	S	S	S	S	S	10	0	0
F24	MIC	0,5	0,5	0,5	32	0.25	0.25	0,5	0,5	0.25	0,5	0.5			
F24	MIC		S	S	R	S	S	S	S	S	S	S	10	0	0
F25	MIC	0.5	<=0.25	1	16	<=0.25	0.5	<=0.25	<=0.25	<=0.25	0.5	0.5			
F25	MIC	in range	S	S	R	S	S	S	S	S	S	S	10	0	0
F26	MIC	0.5	<= 0.25	0.5	16	<= 0.25	0.5	<= 0.25	<= 0.25	1	1	<= 0.25			
F26	MIC		S	S	R	S	S	S	S	S	S	S	10	0	0
F28	MIC	<=0.5	<=0.5	<=0.5	8	<=0.5	<=0.5	<=0.5	<=0.5	<=0.5	<=0.5	<=0.5			
F28	MIC	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F33	MIC	1.5	<=1	<=1	>=16	<=1	<=1	<=1	<=1	<=1	<=1	<=1			
F33	MIC	s	s	s	r	s	s	s	s	s	s	s	10	0	0
F34	MIC														
F34	MIC														
F1	Disk	19	19	18	11	20	19	18	20	19	18	18			
F1	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F2	Disk	24	18	21	10	20	20	20	20	20	18	19			
F2	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F3	Disk	20	21	20	10	25	23	22	18	22	22	21			
F3	Disk		S	S	R	S	S	S	S	S	S	S	10	0	0
F6	Disk	21	23	22	10.68	26	23	22	24	22	24	22			
F6	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F8	Disk	22	21	22	11	25	22	23	22	21	22	22			
F8	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F10	Disk	28	28	28	15	32	28	28	27	27	29	27			
F10	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F13	Disk	19	18	18	9	20	18	19	19	18	18	17			
F13	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F14	Disk	19.92	21.37	20.07	9.77	24.34	20.54	22.49	22.24	20.03	19.58	20.93			
F14	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F15	Disk	23	21	1	10	23	22	21	21	22	22	22			
F15	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F18	Disk	23	20	22	11	25	24	23	20	19	19	22			
F18	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F20	Disk	19	20	20	10	21	20	21	19	20	20	15			
F20	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F22	Disk	20	21	21	10	24	22	21	21	21	23	21			
F22	Disk		S	S	R	S	S	S	S	S	S	S	10	0	0
F23	Disk	20	23	22	11	22	25	23	22	22	23	23			
F23	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F29	Disk														
F29	Disk														
F30	Disk	23	17	18	14	23	21	20	20	20	20	21			
F30	Disk	S	S	S	I	S	S	S	S	S	S	S	10	1	0
F31	Disk	23	22	22	10	25	22	22	23	21	22	23			
F31	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
F35	Disk	23	22	21.5	13	27	24	23	22	20	21.5	21.5			
F35	Disk	S	S	S	R	S	S	S	S	S	S	S	10	0	0
													260	1	1

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation.

MIC: in mg/L, disk: in mm

Nalidixic acid			Strain number										Evaluation		
Lab code	**Method**	**criteria used**	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**N**	**Minor**	**Major**
REF	**MIC**	**1-4**	**<= 4**	**<= 4**	**> 64**	**> 64**	**<= 4**	**<= 4**	**<= 4**	**8**	**<= 4**	**> 64**			
REF	**MIC**		**S**	**S**	**R**	**R**	**S**	**S**	**S**	**S**	**S**	**R**			
F4	MIC	<=4	</=4	8	>32	>32	8	8	8	>32	8	>32			
F4	MIC	S	s	s	R	R	s	s	s	R	s	R	10	0	1
F5	MIC														
F5	MIC		S	S	R	R	S	S	S	S	S	R	10	0	0
F9	MIC		<16	<16	>16	>16	<16	<16	<16	<16	<16	>16			
F9	MIC		S	S	R	R	S	S	S	S	S	R	10	0	0
F11	MIC														
F11	MIC														
F19	MIC	4	4	4	>64	>64	4	4	4	8	4	>64			
F19	MIC		S	S	R	R	S	S	S	S	S	R	10	0	0
F24	MIC	8	8	4	>128	>128	4	8	4	32	4	>128			
F24	MIC		S	S	R	R	S	S	S	R	S	R	10	0	1
F25	MIC	1	4	4	>32	>32	4	4	4	16	4	>32			
F25	MIC	in range	S	S	R	R	S	S	S	S	S	R	10	0	0
F26	MIC	<= 4	<= 4	<= 4	> 64	> 64	<= 4	<= 4	<= 4	8	<= 4	> 64			
F26	MIC		S	S	R	R	S	S	S	S	S	R	10	0	0
F28	MIC	<=4	<=4	<=4	>64	>64	<=4	<=4	<=4	8	<=4	>64			
F28	MIC	S	S	S	R	R	S	S	S	S	S	R	10	0	0
F33	MIC	2	3	4	>256	>256	2	3	3	12	4	>256			
F33	MIC	s	s	s	r	r	s	s	s	s	s	r	10	0	0
F34	MIC	2	2	2	256	256	2	2	2	4	2	256			
F34	MIC	S	S	S	R	R	S	S	S	S	S	R	10	0	0
F1	Disk	26	32	25	6	6	27	24	24	21	25	6			
F1	Disk	S	S	S	R	R	S	S	S	S	S	R	10	0	0
F2	Disk	25	23	23	6	6	25	23	24	17	23	6			
F2	Disk	S	S	S	R	R	S	S	S	I	S	R	10	1	0
F3	Disk	26	24	21	6	6	26	23	24	20	22	6			
F3	Disk		S	S	R	R	S	S	S	S	S	R	10	0	0
F6	Disk	23	21	15.95	7	7	21	18.46	19	13.83	19	7			
F6	Disk	S	S	I	R	R	S	S	S	I	S	R	10	2	0
F8	Disk	23	20	20	6	6	22	22	21	18	20	6			
F8	Disk	S	S	S	R	R	S	S	S	S	S	S	10	0	1
F10	Disk	31	28	28	6	6	30	27	29	19	28	6			
F10	Disk	S	S	28	R	R	S	S	S	I	S	R	10	1	0
F13	Disk	23	22	21	6	6	24	22	23	17	22	6			
F13	Disk	S	S	S	R	R	S	S	S	I	S	R	10	1	0
F14	Disk	26.86	24.48	24.88	0	0	29.57	25.97	24.16	21.15	24.51	0			
F14	Disk	S	S	S	R	R	S	S	S	S	S	R	10	0	0
F15	Disk	25	23	4	6	6	26	25	24	18	24	6			
F15	Disk	S	S	S	R	R	S	S	S	S	S	R	10	0	0
F18	Disk	26	22	21	6	6	23	21	22	6	21	6			
F18	Disk	S	S	S	R	R	S	S	S	R	S	R	10	0	1
F20	Disk	26	25	22	6	6	25	22	24	17	22	6			
F20	Disk	S	S	S	R	R	S	S	S	I	S	R	10	1	0
F22	Disk	28	25	24	6	6	28	23	23	17	23	6			
F22	Disk		S	S	R	R	S	S	S	I	S	R	10	1	0
F23	Disk	27	26	23	6	6	26	24	24	16	23	6			
F23	Disk	S	S	S	R	R	S	S	S	I	S	R	10	1	0
F29	Disk	30	26	26	6	6	28	24	25	20	24	6			
F29	Disk	S	S	S	R	R	S	S	S	S	S	R	10	0	0
F30	Disk	27	22	22	6	6	26	22	23	20	25	12			
F30	Disk	S	S	S	R	R	S	S	S	S	S	R	10	0	0
F31	Disk	26	23	21	0	0	26	23	22	16	20	0			
F31	Disk	S	S	S	R	R	S	S	S	I	S	R	10	1	0
F35	Disk	26	25	26	0	0	28	25	23	18	22	0			
F35	Disk	S	S	S	R	R	S	S	S	S	S	R	10	0	0
													270	9	4

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation.

MIC: in mg/L, disk: in mm

Streptomycin			Strain number										Evaluation		
Lab code	**Method**	**criteria used**	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**N**	**Minor**	**Major**
REF	**MIC**	**No criteria**	**16**	**> 128**	**> 128**	**64**	**8**	**64**	**32**	**16**	**128**	**128**			
REF	**MIC**		**S**	**R**	**R**	**R**	**S**	**R**	**S**	**S**	**R**	**R**			
F4	MIC	<=4	8	>64	>64	64	8	>64	32	16	>64	>64			
F4	MIC	S	s	R	R	R	s	R	R	i	R	R	8	0	0
F5	MIC														
F5	MIC		S	R	R	I	S	R	I	S	R	R	8	1	0
F9	MIC		<8	>128	>128	<8	<8	>8,<128	<8	<8	>8,<128	>8,<128			
F9	MIC		S	R	R	S	S	I	S	S	I	I	8	3	1
F11	MIC														
F11	MIC														
F19	MIC	8	8	>128	>128	64	8	64	16	16	64	64			
F19	MIC		S	R	R	R	S	R	S	S	R	R	8	0	0
F24	MIC	8	16	>128	128	64	16	128	64	32	>128	>128			
F24	MIC		S	R	R	R	S	R	R	S	R	R	8	0	0
F25	MIC	<=32	<=32	>64	>64	64	<=32	64	<=32	<=32	64	>64			
F25	MIC	No rule	S	R	R	R	S	R	S	S	R	R	8	0	0
F26	MIC	4	8	> 128	> 128	32	4	128	32	16	128	64			
F26	MIC		S	R	R	S	S	R	S	S	R	R	8	0	0
F28	MIC	<=8	<=8	>128	>128	32	<=8	64	32	16	64	64			
F28	MIC	S	S	R	R	R	S	R	R	I	R	R	8	0	0
F33	MIC	/	/	/	/	/	/	/	/	/	/	/			
F33	MIC	/	/	/	/	/	/	/	/	/	/	/			
F34	MIC	4	8	1024	256	16	4	32	8	8	32	32			
F34	MIC	S	S	R	R	S	S	S	S	S	S	S	8	0	4
F1	Disk	15	15	6	6	11	17	6	6	13	6	6			
F1	Disk	S	S	R	R	R	S	R	R	I	R	R	8	0	0
F2	Disk	15	15	6	6	10	18	8	13*	14	6	6			
F2	Disk	S	S	R	R	R	S	R	R	I	R	R	8	0	0
F3	Disk	16	16	6	6	10	19	7	15	15	7	8			
F3	Disk		S	R	R	R	S	R	S	S	R	R	8	0	0
F6	Disk	16	15	7	7	7	16	7	12.08	15	7	7			
F6	Disk	S	S	R	R	R	S	R	I	S	R	R	8	0	0
F8	Disk	14	14	6	6	10	18	7	13	13	6	6			
F8	Disk	I	I	R	R	R	S	R	S	S	S	S	8	1	2
F10	Disk	20	16	6	6	9	18	6	16	16	6	6			
F10	Disk	S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			
F13	Disk	16	15	6	6	8	17	6	8	13	7	7			
F13	Disk	S	S	R	R	R	S	R	R	I	R	R	8	0	0
F14	Disk	18.44	15.17	0	0	7.35	18.04	0	15.28	12.52	0	0			
F14	Disk	S	S	R	R	R	S	R	S	I	R	R	8	0	0
F15	Disk	15	13	6	6	6	16	6	10	12	6	6			
F15	Disk	S	I	R	R	R	S	R	R	I	R	R	8	1	0
F18	Disk	17	15	6	6	9	18	6	6	14	6	6			
F18	Disk	S	S	R	R	R	S	R	R	I	R	R	8	0	0
F20	Disk	14	14	6	6	8	15	6	10	13	6	6			
F20	Disk	I	I	R	R	R	S	R	R	I	R	R	8	1	0
F22	Disk	15	15	6	6	9	17	6	13	13	9	6			
F22	Disk		S	R	R	R	S	R	I	I	R	R	8	0	0
F23	Disk	15	15	6	6	7	18	6	14	14	6	6			
F23	Disk	S	S	R	R	R	S	R	I	I	R	R	8	0	0
F29	Disk	18	18	6	6	9	20	6	18	15	6	6			
F29	Disk	S	S	R	R	R	S	R	S	S	R	R	8	0	0
F30	Disk	18	15	6	6	11	17	7	10	15	6	8			
F30	Disk	S	S	R	R	R	S	R	R	S	R	R	8	0	0
F31	Disk	16	15	0	0	0	17	0	0	9	0	0			
F31	Disk	S	S	R	R	R	S	R	R	R	R	R	8	0	0
F35	Disk	21	19.5	0	0	17	22	14	19.5	17	13	13			
F35	Disk	S	S	R	R	S	S	R	S	S	R	R	8	0	1
													200	7	8

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation.

MIC: in mg/L, disk: in mm

Sulfonamides			Strain number										Evaluation		
Lab code	**Method**	**Criteria used**	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**N**	**Minor**	**Major**
REF	**MIC**	**8-32**	**<= 8**	**> 1024**	**> 1024**	**<= 8**	**> 1024**	**> 1024**	**> 1024**	**> 1024**	**<= 8**	**> 1024**			
REF	**MIC**		**S**	**R**	**R**	**S**	**R**	**R**	**R**	**R**	**S**	**R**			
F4	MIC	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.			
F4	MIC														
F5	MIC														
F5	MIC		S	R	R	S	R	R	R	R	S	R	10	0	0
F9	MIC		<64	>64	>64	<64	>64	>64	>64	>64	<64	>64			
F9	MIC		S	R	R	S	R	R	R	R	S	R	10	0	0
F11	MIC	<20	<256	>256	<256	>256	<256	>256	>256	>256	>256	<256			
F11	MIC	S	S	R	S	R	S	R	R	R	R	S			
F19	MIC	64	16	>1024	>1024	16	>1024	>1024	>1024	>1024	32	>1024			
F19	MIC		S	R	R	S	R	R	R	R	S	R	10	0	0
F24	MIC	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT			
F24	MIC		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT			
F25	MIC	64	32	>256	>256	64	>256	>256	>256	>256	64	>256			
F25	MIC	in range	S	R	R	S	R	R	R	R	S	R	10	0	0
F26	MIC	<= 8	<= 8	> 1024	> 1024	<= 8	> 1024	> 1024	> 1024	> 1024	<= 8	> 1024			
F26	MIC		S	R	R	S	R	R	R	R	S	R	10	0	0
F28	MIC	<=64	<=64	>1024	>1024	<=64	>1024	>1024	>1024	>1024	<=64	>1024			
F28	MIC	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F33	MIC	/	/	/	/	/	/	/	/	/	/	/			
F33	MIC	/	/	/	/	/	/	/	/	/	/	/			
F34	MIC	32	32	1024	1024	128	1024	1024	1024	1024	64	1024			
F34	MIC	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F1	Disk	21	30	6	6	15	6	6	6	6	20	6			
F1	Disk	S	S	R	R	I	R	R	R	R	S	R	10	1	0
F2	Disk	22	24	6	6	22	6	6	6	6	23	6			
F2	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F3	Disk	24	30	6	6	28	6	6	6	6	27	6			
F3	Disk		S	R	R	S	R	R	R	R	S	R	10	0	0
F6	Disk	21	28	7	7	27	7	7	7	7	22	7			
F6	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F8	Disk	18	25	6	6	22	6	6	6	6	24	6			
F8	Disk	S	S	R	R	S	R	R	S	S	S	S	10	0	3
F10	Disk	24	30	6	6	31	6	6	6	6	30	6			
F10	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F13	Disk	20	24	6	6	14	6	6	6	6	19	6			
F13	Disk	S	S	R	R	I	R	R	R	R	S	R	10	1	0
F15	Disk	23	27	6	6	25	6	6	6	6	25	6			
F15	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F18	Disk	20	25	6	6	29	6	6	6	6	20	6			
F18	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F22	Disk	21	28	6	6	22	6	6	6	6	19	6			
F22	Disk		S	R	R	S	R	R	R	R	S	R	10	0	0
F23	Disk	23	29	6	6	20	6	6	6	6	23	6			
F23	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F29	Disk	22	27	6	6	24	6	6	18	6	24	6			
F29	Disk	S	S	R	R	S	R	R	I	R	S	R	10	1	0
F30	Disk	23	17	6	6	9	6	6	6	6	13	6			
F30	Disk	S	S	R	R	R	R	R	R	R	I	R	10	1	1
F31	Disk	21	28	0	0	29	0	0	0	0	26	0			
F31	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F35	Disk	18	19	0	0	15	0	0	0	0	22	0			
F35	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F14	Disk	24.16	29.44	0	0	27.63	0	0	0	0	26.29	0			
F14	Disk	S	S	R	R	S	R	R	R	R	S	R	10	0	0
F20	Disk	26	29	6	24	6	19	6	6	6	6	24			
F20	Disk	S	S	R	S	R	S	R	R	R	R	S			
													230	4	4

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation. Pink results are outliers.

MIC: in mg/L, disk: in mm.

** Outlier results*

Tetracycline			Strain number										Evaluation		
Lab code	**Method**	**criteria used**	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**N**	**Minor**	**Major**
REF	**MIC**	**0.5-2**	**2**	**> 64**	**> 64**	**4**	**> 64**	**2**	**2**	**2**	**2**	**32**			
REF	**MIC**		**S**	**R**	**R**	**S**	**R**	**S**	**S**	**S**	**S**	**R**			
F4	MIC	<=1	2	>8	>8	4	>8	2	2	2	2	>8			
F4	MIC	S	i	R	R	i	R	i	i	i	i	R	10	6	0
F5	MIC														
F5	MIC		S	R	R	S	R	S	S	S	S	R	10	0	0
F9	MIC		<8	>8,<128	>8,<128	<8	>8,<128	<8	<8	<8	<8	>8,<128			
F9	MIC		S	I	I	S	I	S	S	S	S	I	10	4	0
F11	MIC	<1	≤1	≥16	>8	4	≥16	≤1	≤1	<4	≤1	16			
F11	MIC	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F19	MIC	1	2	>64	>64	4	>64	2	2	2	1	>64			
F19	MIC		S	R	R	S	R	S	S	S	S	R	10	0	0
F24	MIC	1	2	>16	>16	2	>16	2	1	2	2	>16			
F24	MIC		S	R	R	S	R	S	S	S	S	R	10	0	0
F25	MIC	<=4	<=4	>32	>32	<=4	>32	<=4	<=4	<=4	<=4	32			
F25	MIC	in range	S	R	R	S	R	S	S	S	S	R	10	0	0
F26	MIC	<= 1	2	> 64	> 64	4	> 64	2	2	<= 1	2	64			
F26	MIC		S	R	R	S	R	S	S	S	S	R	10	0	0
F28	MIC	<=2	<=2	>32	>32	4	>32	<=2	<=2	<=2	<=2	32			
F28	MIC	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F33	MIC	/	<=1	>=16	8	4	>=16	<=1	<=1	<=1	<=1	>=16			
F33	MIC	/	s	r	i	s	r	s	s	s	s	r	10	1	0
F34	MIC	1	1	64	32	2	32	0.5	1	1	1	8			
F34	MIC	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F1	Disk	23	29	6	6	15	6	22	21	22	23	6			
F1	Disk	S	S	R	R	S	R	S	R	S	S	R	10	0	1
F2	Disk	24	20	6	6	16	6	20	17	18	18	10			
F2	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F3	Disk	22	20	6	6	17	6	20	17	20	18	9			
F3	Disk		S	R	R	S	R	S	S	S	S	R	10	0	0
F6	Disk	20	21	7	7	12.14	7	20	17.47	17.1	21	7			
F6	Disk	S	S	R	R	I	R	S	S	S	S	R	10	1	0
F8	Disk	21	20	6	6	17	6	21	20	20	20	10			
F8	Disk	S	S	R	R	S	R	S	S	S	S	S	10	0	1
F10	Disk	27	25	6	6	22	6	24	23	23	23	10			
F10	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F13	Disk	19	19	6	6	15	6	19	19	19	19	7			
F13	Disk	S	S	R	R	I	R	S	S	S	S	R	10	1	0
F14	Disk	25.64	23.06	0	0	20.94	0	23.65	24.86	23.9	25.97	11.29			
F14	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F15	Disk	24	22	6	6	16	6	22	22	22	22	10			
F15	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F18	Disk	24	23	6	6	18	6	21	21	22	20	9			
F18	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F20	Disk	21	22	6	6	18	6	21	21	21	21	11			
F20	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F22	Disk	21	19	6	6	19	6	18	19	20	19	8			
F22	Disk		S	R	R	S	R	S	S	S	S	R	10	0	0
F23	Disk	24	24	6	6	19	6	20	21	18	21	9			
F23	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F29	Disk	24	23	6	6	22	7	20	23	23	22	9			
F29	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F30	Disk	23	21	6	6	17	6	17	18	19	18	10			
F30	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F31	Disk	25	24	0	0	23	0	23	22	22	21	11			
F31	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
F35	Disk	18	21	0	0	18	0	20	20	18	19	8			
F35	Disk	S	S	R	R	S	R	S	S	S	S	R	10	0	0
													280	13	2

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation.

MIC: in mg/L, disk: in mm

Trimetroprim			Strain number										Evaluation		
Lab code	**Method**	**criteria used**	**A-1**	**A-2**	**A-3**	**A-4**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**N**	**Minor**	**Major**
REF	**MIC**	**0.5-2**	**<= 0.5**	**> 32**	**<= 0.5**	**> 32**	**<= 0.5**	**> 32**	**> 32**	**> 32**	**> 32**	**<= 0.5**			
REF	**MIC**		**S**	**R**	**S**	**R**	**S**	**R**	**R**	**R**	**R**	**S**			
F4	MIC	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.			
F4	MIC														
F5	MIC														
F5	MIC		S	R	S	R	S	R	R	R	R	S	10	0	0
F9	MIC		<2	>2	<2	>2	<2	>2	>2	>2	>2	<2			
F9	MIC		S	R	S	R	S	R	R	R	R	S	10	0	0
F11	MIC	<2	≤2	>4	<2	>4	<2	>4	>4	>4	>4	<2			
F11	MIC	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F19	MIC	0.5	0.5	>32	0.5	>32	0.5	>32	>32	>32	>32	0.5			
F19	MIC		S	R	S	R	S	R	R	R	R	S	10	0	0
F24	MIC	1	1	>16	0.5	>16	1	>16	>16	>16	>16	1			
F24	MIC		S	R	S	R	S	R	R	R	R	S	10	0	0
F25	MIC	<=0.012	<=0.12	>4	<=0.12	>4	<=0.12	>4	>4	>4	>4	<=0.12			
F25	MIC	in range	S	R	S	R	S	R	R	R	R	S	10	0	0
F26	MIC	<= 0.5	<= 0.5	> 32	<= 0.5	> 32	<= 0.5	> 32	> 32	> 32	> 32	<= 0.5			
F26	MIC		S	R	S	R	S	R	R	R	R	S	10	0	0
F28	MIC	<=1	<=1	>32	<=1	>32	<=1	>32	>32	>32	>32	<=1			
F28	MIC	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F33	MIC	/	/	/	/	/	/	/	/	/	/	/			
F33	MIC	/	/	/	/	/	/	/	/	/	/	/			
F34	MIC	0.5	0.125	32	0.125	32	0.125	32	32	32	32	0.125			
F34	MIC	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F1	Disk	21	25	6	25	6	20	6	6	6	6	23			
F1	Disk												10	0	0
F2	Disk	25	25	6	26	6	25	6	6	6	6	27			
F2	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F3	Disk	26	27	6	25	6	30	6	6	6	6	29			
F3	Disk		S	R	S	R	S	R	R	R	R	S	10	0	0
F6	Disk	23	26	7	27	7	26	7	7	7	7	27			
F6	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F8	Disk														
F8	Disk														
F10	Disk	28	30	6	29	6	31	6	6	6	6	28			
F10	Disk	S	S	R	S	R	S	S	R	R	R	S	10	0	1
F13	Disk	24	26	6	28	6	26	6	6	6	6	28			
F13	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F14	Disk	-	-	-	-	-	-	-	-	-	-	-			
F14	Disk	-	-	-	-	-	-	-	-	-	-	-			
F15	Disk	25	28	6	31	6	30	6	6	6	6	30			
F15	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F18	Disk	25	26	6	28	6	25	6	6	6	6	25			
F18	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F20	Disk	25	29	6	29	6	29	6	6	6	6	28			
F20	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F22	Disk	27	29	6	32	6	32	6	6	6	6	30			
F22	Disk		S	R	S	R	S	R	R	R	R	S	10	0	0
F23	Disk	28	32	6	32	6	32	6	6	6	6	32			
F23	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F29	Disk														
F29	Disk														
F30	Disk	22	28	6	29	6	28	6	6	6	6	29			
F30	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F31	Disk	25	29	0	28	0	32	0	0	0	0	30			
F31	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
F35	Disk	22	27	0	25.5	0	27	0	0	0	0	26			
F35	Disk	S	S	R	S	R	S	R	R	R	R	S	10	0	0
													230	0	1
													2438	41	27

Dark grey cells = resistant (R), light grey cells = intermediate (I), white cells = susceptible (S).
Text in grey: excluded from evaluation. Pink results are outliers.

*MIC: in mg/L, disk: in mm. * Outlier results*

Annex 8. Protocol

PROTOCOL OF THE THIRD EQA SCHEME (NOVEMBER 2010) ON SEROTYPING, PHAGE TYPING AND ANTIMICROBIAL SUSCEPTIBILITY TYPING OF *SALMONELLA* SPP. FOR FWD LABORATORIES

Introduction

This External Quality Assurance (EQA) scheme on the typing of *Salmonella* strains is organised for the laboratories belonging to the Food and Waterborne Diseases Network (FWD-Net) of the European Centre for Disease Control (ECDC). The study is organised by the Laboratory for Zoonoses and Environmental Microbiology (LZO) of the National Institute of Public Health and the Environment (RIVM, Bilthoven, Netherlands), in close cooperation with the Health Protection Agency (HPA, London, United Kingdom), and the Central Veterinary Institute of Wageningen UR (CVI, Lelystad, Netherlands).

The objective of this typing study is to test the performance of the participating laboratories for serotyping, phage typing and antimicrobial susceptibility testing of *Salmonella* spp.

The study will take place in week 46 (starting on 15 November 2010). The timetable can be found on the last page of this protocol.

All data have to be reported in the test report, sent to RIVM-LZO, and will be used for analysis.

Transportation of the *Salmonella* strains to the laboratories.

RIVM-LZO will transport the strains for each part of the study in a separate parcel. The strains will be sent as Biological Substance Category B (UN 3373) with a door-to-door courier to your laboratory.

Serotyping

A total of 20 *Salmonella* strains (coded S-1 to S-20) have to be serotyped. The method routinely performed in your laboratory can be used in this study. Each laboratory is allowed to send strains for serotyping to another reference laboratory in their country if this is part of the normal routine procedure.

IN THE TEST REPORT OF THIS STUDY, TWO EXTRA TABLES ARE ADDED. PLEASE INDICATE THE REACTIONS FOR EVERY STRAIN-ANTISERUM COMBINATION USED. THIS SUPPLIES RIVM WITH MORE INFORMATION IN CASE OF ANY DEVIATING RESULTS.

The results for each strain have to be reported with the full formula for the O antigens and H antigens and the serovar names according to the White-Kauffman-le Minor scheme of 2007 (http://www.pasteur.fr/sante/clre/cadrecnr/salmoms/WKLM_2007.pdf).

Definite conclusions can only be based on agglutination with mono-specific antisera. Otherwise it is better to identify the strains by giving the antigenic formula as far as detected. The evaluation of the serotyping results will be performed by the Laboratory for Zoonoses and Environmental Microbiology (LZO) and the Laboratory for Infectious Diseases and Perinatal Screening (LIS) of the RIVM according to Table 1.

Table 1. Evaluation of serotyping results

Results	Evaluation	Abbreviation
Auto-agglutination or Incomplete set of antisera (outside range of antisera)	Not typable	NT
Partly typable due to incomplete set of antisera or Part of the formula (for the name of the serovar) or No name serovar	Partly correct	+/-
Wrong serovar or mixed sera formula	Incorrect	-

Recent information revealed that colonial form variation my occur with the expression of the O:61 antigen by some serogroup C_2 serovars (Hendriksen et al., J Clin Microbiol 47(9): 2729-36). Also, for this third EQA scheme on serotyping it was decided to consider the serovar pairs concerned (e.g. Newport/*S.* Bardo and *S.* Hadar/*S.* Istanbul in the second EQA) not as distinct serovars.

Phage typing

A total of 20 *Salmonella* strains have to be phage-typed:

- 10 strains of *S*. Enteritidis numbered E1–E10
- 10 strains of *S*. Typhimurium numbered T11–T20

The evaluation of the phage-typing results will be done in collaboration with the *Salmonella* Reference Unit of the HPA.

Antimicrobial susceptibility testing

A total of 10 *Salmonella* strains (different from the ones used for sero- and phage typing) have to be tested for antimicrobial susceptibility. The 10 test strains are coded A-1 to A-10. These strains are to be tested for susceptibility to a list of antibiotics with the method routinely used in your laboratory.

The control strain LMG 8223 (= *E. coli* ATCC 25922) is provided for this second EQA scheme, but will probably also be needed in subsequent EQA schemes. The strain will only be provided once, therefore take care to store this strain in an appropriate way, e.g. in cryotubes at -70 °C.

For the list of antibiotics to be tested, the advices are followed as described in the EFSA Report of the Task Force on Zoonoses Data Collection which was published in 2007 (The EFSA Journal (2007), 96, 1-46). This report includes a proposal for a harmonised monitoring scheme of antimicrobial resistance in *Salmonella* in fowl (*Gallus gallus*), turkeys, and pigs and *Campylobacter jejuni* and *C. coli* in broilers. This EFSA report indicates a list of 10 antibiotics that should be included in the antimicrobial resistance monitoring for *Salmonella*.

All strains should be tested against the following antibiotics:

1. Ampicillin
2. Cefotaxime
3. Chloramphenicol
4. Ciprofloxacin
5. Gentamicin

6. Nalidixic Acid
7. Streptomycin
8. Sulphonamides
9. Tetracycline
10. Trimethoprim

If the method routinely used in your laboratory is a disk diffusion method, please use disks with concentrations of the antibiotics according to CLSI or EUCAST.

The evaluation of the antimicrobial susceptibility testing results will be done in collaboration with the Dutch National Reference Laboratory on Antimicrobial Resistance at CVI.

All 10 isolates have been tested as CVI in duplicate by the international reference method broth microdilution according to ISO-20776–1:2006. EUCAST clinical breakpoints (www.eucast.org) will be used for interpretation of the results:

EUCAST clinical breakpoint table v.1.1, 2010-04-27

Antibiotic	Abbreviation	MIC breakpoint (mg/L)	
		S ≤	R >
Ampicillin	AMP	4	8
Cefotaxime	CEX/FOT	1	2
Chloramphenicol	CHL	8	8
Ciprofloxacin	CIP	0,5	1
Gentamicin	GEN	2	4
Nalidixic acid	NAL	8	16
Streptomycin*	STR	32	32
Sulphamethoxazole**	SUL/SMX	256	256
Tetracycline**	TET	4	8
Trimethoprim	TMP	2	4

** EFSA; ** CLSI M2100–S20*

A check-up by the participants of the submitted results is no longer necessary when the results are sent by e-mail in the provided file format. This will save time, but participants need to ensure that they fill in the correct results at once.

If you have questions or remarks about this EQA scheme, please contact:

Wilma Jacobs

P.O. Box 1

3720 BA Bilthoven

tel. number: +31-30-2744290

fax number: +31-30-2744434

e-mail: wilma.jacobs@rivm.nl

Timetable for the third EQA scheme (November 2010) on serotyping, phage typing and antimicrobial susceptibility typing of Salmonella spp. for FWD laboratories

Week	Date	Topic
43	25–29 Oct	Protocols and test report forms for the third EQU mailed.
45	8–12 Nov	Parcels mailed to participants by door-to-door courier service as 'diagnostic specimen'. After arrival at the laboratory, the strains need to be sub-cultured and stored until typing is carried out. If you do not receive the parcel by 12 November, contact RIVM-LZO immediately.
46	15–19 Nov	Identification of strains.
49	6–10 Dec	Send the electronically completed test report to RIVM by e-mail. Deadline: 10 Dec 2010
50	13–17 Dec	Data input at the RIVM-LZO. A check-up by the participants of the submitted results is no longer necessary when the results are sent by e-mail in the provided file format. This will save time, but participants need to ensure that they fill in the correct results at once.
	Jan 2011	Reporting of individual laboratory results.
	Mar 2011	Interim summary report.
	Summer 2011	Final report issued by ECDC.

Annex 9. Test report

THIRD EQA SCHEME (2010) ON SEROTYPING, PHAGE TYPING AND ANTIMICROBIAL SUSCEPTIBILITY TESTING OF *SALMONELLA* SPP. FOR FWD LABORATORIES.

Laboratory code	
Name contact person	
Email address contact person	
Name of laboratory or institute	
Country	

Please enter your remarks and comments on page 14 of the test report.

GENERAL QUESTIONS

Shipment of the strains	
Was your parcel damaged at arrival?	
Date of receipt at your laboratory:	

Sub-culturing	
Medium used for sub-culturing the strains	Name: Manufacturer:

REMARKS CONCERNING THE ADDITIONAL TABLES FOR SEROTYPING
Two **optional** tables are included this test report, to give the RIVM more information about the antisera used. The tables on pages 4 and 5 concern reactions obtained with O antisera and the tables on pages 6 and 7 with H antisera. At the bottom of the table space is left to fill in other antisera than mentioned in the table. Please mention the manufacturer of the antisera used in the column next to the antisera. Indicate for each combination of strain and antiserum if there was agglutination (+) or not (-). If the cell remains empty this indicates that the agglutination was not determined for the specific combination of antiserum and strain. **Please note that in case of deviating results you will be asked to fill in these tables retrospectively!**

QUESTIONS SEROTYPING

What was the frequency of serotyping of *Salmonella* at your laboratory in 2009?	q Daily q Once a week q Twice a week q Thrice a week q Weekly q Monthly q Other:
How many *Salmonella* strains did your laboratory (approximately) serotype in 2009?	Number of strains:
What kind of sera do you use?	q Prepared in own laboratory q Commercial sera Manufacturer(s):
The strains in this EQA scheme were serotyped by:	q Own laboratory, q Other laboratory, namely: Strains:

		Strains																			
O antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Group B																					
1, 4, 12, 27																					
1, 4, 5, 12																					
4, 5, 12																					
4, 5, 27																					
4, 5																					
4																					
5																					
Group C																					
7, 8																					
6, 7, 8																					
6, 7																					
6_1, 6_2, 7																					
6, 8																					
8, 20																					
6_1																					
6																					
7																					
8																					
14																					
20																					
Group D																					
9																					
9, 12																					
1, 9, 12																					
12																					
9, 46																					
46																					
Group E																					
1, 3, 10, 15, 19, 34																					
3, 10, 15, 19, 34																					
(3), (15), 34																					
3, 10, 15																					
3, 10																					
3, 15																					

		Strains																			
O antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
10																					
15																					
1, 3, 19																					
19																					
Group G																					
13																					
13, 22, 23																					
22																					
23																					
Other O antisera																					

		Strains																			
H antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
b																					
d																					
E (complex)																					
e, h																					
e, n																					
e, n, x																					
e, n, z_{15}																					
h																					
x																					
x (z_{16})																					
z_{15}																					
G (complex)																					
g, p																					
g, m																					
f																					
m																					
p																					
q																					
s																					
t																					
u																					
q, s, t, p, u																					
i																					
k																					
L (complex)																					
l, v																					
l, w																					
v																					
w																					
r																					
y																					
z																					
z_6																					
z_{10}																					

		Strains																			
H antisera	**Manufacturer**	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
1 (complex)																					
2																					
5																					
6																					
7																					
Other H antisera																					

TEST RESULTS SEROTYPING

Lab code:	Starting date of serotyping:	Finishing date of serotyping:

Strain no.	**O antigens**	**H antigens (phase 1)**	**H antigens (phase 2)**	**Serovar name**
S-1				
S-2				
S-3				
S-4				
S-5				
S-6				
S-7				
S-8				
S-9				
S-10				
S-11				
S-12				
S-13				
S-14				
S-15				
S-16				
S-17				
S-18				
S-19				
S-20				

QUESTIONS PHAGE TYPING

Does your laboratory perform phage typing?	q Yes q No
If yes, which *Salmonella* strains do you phage type?	q *Salmonella* Typhimurium q *Salmonella* Enteritidis q Other(s):
Which typing system is used for:	*Salmonella* Typhimurium: *Salmonella* Enteritidis:
How many strains did your laboratory (approximately) phage type in 2009?	Number of strains:

TEST RESULTS PHAGETYPING

Lab code:	Starting date of phage typing:	Finishing date of phage typing:

Notations:	-:	no reaction	O*:	O pooled
	+:	5-20 plaques	(<) CL:	Clear Lysis
	+:	21-40 plaques	(<) OL:	Opaque Lysis
	++:	41-80 plaques	SCL:	Semi Confluent Lysis
	+++:	81-100 plaques	<< :	Merging plaques towards semi-confluent lysis

Phage reactions at Routine Test Dilution (*S.* Enteritidis)

Strain number	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
E1																		
E2																		
E3																		
E4																		
E5																		
E6																		
E7																		
E8																		
E9																		
E10																		

TEST RESULTS PHAGE TYPING

Lab code:	Starting date of phage typing:	Finishing date of phage typing:

Phage reactions at Routine Test Dilution (*S.* Typhimurium)

Strain number	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
T1																			
T2																			
T3																			
T4																			
T5																			
T6																			
T7																			
T8																			
T9																			
T10																			

		Phage reactions at Routine Test Dilution (*S.* Typhimurium)												Additional phages						
Strain number	Phage type	20	21	22	23	24	25	26	27	28	29	32	35	1	2	3	10	10 var 2	10 var 3	18
T1																				
T2																				
T3																				
T4																				
T5																				
T6																				
T7																				
T8																				
T9																				
T10																				

QUESTIONS ANTIMICROBIAL SUSCEPTIBILITY TESTING (AST)

What method do you use for antimicrobial susceptibility testing?	Disk:	MIC:
Which control strain(s) do you use with routine analysis?	Disk:	MIC:
Which agar/broth medium do you use?	Disk:	MIC:
What is the concentration of the inoculum in bacteria per ml?	Disk:	MIC:
How many strains were (approximately) tested for antimicrobial susceptibility in your lab in 2009?	Number of strains:	

Details on the antibiotics that you used in this EQA scheme

Antibiotic	Abbreviation	Disk load (µg)	Manufacturer	Interpretive criteria used in Disk Diffusion	Concentration range used in MIC determination	Interpretive criteria used in MIC
Ampicillin	**AMP**					
Cefotaxime	**CTX**					
Chloramphenicol	**CHL**					
Ciprofloxacin	**CIP**					
Gentamicin	**GEN**					
Nalidixic Acid	**NAL**					
Streptomycin	**STR**					
Sulphonamides	**SUL**					
Tetracycline	**TET**					
Trimethoprim	**TMP**					

RESULTS ANTIMICROBIAL SUSCEPTIBILITY TESTING (AST)

Lab code	
Starting date of AST	
Finishing date of AST	

Please fill in the MIC-value in µg/ml if your method of choice is the Minimal Inhibition Concentration or the diameter of the inhibition zones in mm if your method is Disk Diffusion and also include the interpretation according to your criteria as either Resistant, Intermediate or Susceptible.

	AMP	**AMP**	**CTX**	**CTX**	**CHL**	**CHL**	**CIP**	**CIP**	**GEN**	**GEN**	**NAL**	**NAL**	**STR**	**STR**	**SUL**	**SUL**	**TET**	**TET**	**TMP**	**TMP**
Strain nr.	Result	S/I/R	Result	S/I/R	Result	S/I/R	Result	S/I/R	Result	S/I/R	Result	S/I/R	Result	S/I/R	Result	S/I/R	Result	S/I/R	Result	S/I/R
A-1																				
A-2																				
A-3																				
A-4																				
A-5																				
A-6																				
A-7																				
A-8																				
A-9																				
A-10																				
E. coli																				

REMARKS AND COMMENTS

Name of person(s) carrying out the typing:	
Date:	

Name of person in charge:	
Date:	