TECHNICAL REPORT

External quality assurance scheme for Salmonella typing

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ECDC TECHNICAL REPORT

External quality assurance scheme for *Salmonella* typing

As part of the European Food- and Waterborne Diseases and Zoonoses network, March 2009

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Table of contents

Abbreviations

AMC	Amoxicillin and clavanulate
AMP	Ampicillin
AST	Antimicrobial Susceptibility Testing
ATCC	American Type Culture Collection
BGA	Brilliant Green Agar
CHL	Chloramphenicol
CIP	Ciprofloxacin
CLSI	Clinical and Laboratory Standards Institute
CRL-*Salmonella*	Community Reference Laboratory for *Salmonella*
CTX	Cefotaxime
CVI	Central Veterinary Institute
DD	Disk diffusion
EEA	European Economic Area
ECDC	European Centre for Disease Prevention and Control
ESBL	Extended Spectrum Beta-lactamase
EFSA	European Food Safety Authority
ENRO	Enrofloxacin
EQA	External Quality Assurance
EU	European Union
EUCAST	European committee on Antimicrobial Susceptibility Testing
EU-RL	European Union Reference Laboratory
FLO	Florfenicol
FWD-Net	Food and Waterborne Diseases and Zoonoses Network
GEN	Gentamicin
HPA	Health Protection Agency
I	Intermediate
KAN	Kanamycin
LGP	Laboratory of Gastrointestinal Pathogens
LZO	Laboratory for Zoonoses and Environmental Microbiology
MH agar	Mueller Hinton agar
MIC	Minimal Inhibition Concentration
NAL	Nalidixic acid
NCCLS	National Committee for Clinical Laboratory Standards
NEO	Neomycin
NI	Not indicated
NRLs-*Salmonella*	National Reference Laboratories for *Salmonella*
NT	Not typable
PT	Phage type
R	Resistant
RDNC	Reacts but does not conform
RIVM	National Institute for Public Health and the Environment
S	Susceptible
SE	*Salmonella* Enteritidis
STM	*Salmonella* Typhimurium
STR	Streptomycin
SUL	Sulfonamides
SXT	Sulfamethoxazole + Trimethoprim
TET	Tetracycline
TMP	Trimethoprim
UK	United Kingdom
XLD	Xylose Lysine Desoxycholate

Symbols

-	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

List of tables

List of figures

Executive summary

Main findings:

- Thirty-four laboratories of the Food- and Waterborne Diseases and Zoonoses network (FWD-Net) participated in the first international external quality assurance scheme by ECDC on typing of *Salmonella.* Twenty-eight laboratories were from EU/EEA countries.
- The serotyping results for EU/EEA laboratories showed that almost 75% correctly typed the O-antigens. The H-antigens were typed correctly by 68% of the laboratories. Fifty-four per cent typed all antigens correctly, and 57% were able to assign the correct serovar names.
- The phage typing results for EU/EEA laboratories showed that 88% of the *S.* Enteritidis strains and 80% of the *S.* Typhimurium strains were phage typed correctly by all laboratories. Laboratories faced more problems phage typing *S.* Typhimurium strains compared to *S.* Enteritidis strains. Only 25% of the laboratories phage typed all *S.* Enteritidis correctly compared to 13% of *S.* Typhimurium.
- The results of the antimicrobial susceptibility testing showed minor deviations for 25% of all results for the interpretation of the susceptibility tests. Nineteen per cent of all results showed major deviations. If a quality limit of 90% accuracy is used, all laboratories would be approved. Errors were primarily made on a number of strains with borderline susceptibility.

In March 2009, the first external quality assurance (EQA) scheme on typing of *Salmonella* subspecies was organised for the laboratories of the Food- and Waterborne Diseases and Zoonoses network co-ordinated by the European Centre for Disease Prevention and Control. The study was organised by the laboratory for Zoonoses and Environmental Microbiology of the National Institute for Public Health and the Environment (RIVM, the Netherlands) in collaboration with the *Salmonella* reference unit of the laboratory of Gastrointestinal Pathogens of the Health Protection Agency (HPA) in London and the Central Veterinary Institute (CVI) of Wageningen University and Research Centre, Department of Bacteriology and TSEs (the Netherlands). In the EQA scheme, three procedures for typing of *Salmonella* subspecies were tested: serotyping, phage typing and antimicrobial susceptibility testing (AST). The main objective of this EQA scheme was to evaluate whether typing of *Salmonella* strains by different laboratories within and outside the European Union (EU) and the European Economic Area (EEA) was carried out uniformly and whether comparable results were obtained.

In total, thirty-four laboratories participated in this study. Twenty-eight laboratories were situated in the EU/EEA Member States and six laboratories were from countries outside the EU/EEA. One laboratory in a European country received all strains for the study but did not report results. In total, 20 strains of the species *Salmonella enterica* subspecies *enterica* were selected for serotyping by RIVM. All participants performed serotyping of the strains. The strains had to be typed with the method routinely used in each laboratory. For the reporting of the full formulas and serovar, names according to the White-Kauffmann-Le Minor scheme had to be given. The laboratories were allowed to send strains for serotyping to another specialised laboratory in their country. Most problems were encountered when typing the H-antigens. The serotyping results for EU/EEA laboratories showed that almost 75% correctly typed the O-antigens. The H-antigens were typed correctly by 68% of the laboratories. Only 54% typed all antigens correctly, while 57% were able to assign the correct serovar names.

The HPA selected 20 strains for phage typing, 10 of which were of the serovar *Salmonella* Enteritidis and 10 of the serovar *Salmonella* Typhimurium. Twenty participants performed phage typing on *Salmonella* Enteritidis strains, 16 of which were from EU/EEA laboratories. One laboratory did not perform phage typing on *Salmonella* Typhimurium strains, therefore only nineteen participants performed phage typing on *S.* Typhimurium (15 EU/EEA laboratories). Overall, 88% of the *S.* Enteritidis strains were phage typed correctly by EU/EEA laboratories. The phage typing of the *S.* Typhimurium caused more problems for the participating laboratories. Here, 80 % of the *S.* Typhimurium strains were phage typed correctly by EU/EEA laboratories. Only four of the *S.* Enteritidis strains and two of the *S.* Typhimurium strains were correctly phage typed by the participating EU/EEA laboratories.

Ten strains of various *Salmonella* serotypes were selected for AST by CVI. These ten strains were tested by the participants for their susceptibility to a panel of fourteen antibiotics. Thirty-one laboratories participated with a quantitative method producing minimum inhibitory concentration (MIC) values or a qualitative disk diffusion test producing zone diameters. Twenty-six laboratories were situated in the EU/EEA.

The laboratories categorised the results as susceptible (S), intermediate (I) or resistant (R) based on their own interpretive criteria. The results were compared with those produced with the reference method. The results showed for 25% of all results minor deviations for the interpretation of the susceptibility tests. Nineteen per cent of all results showed major deviations. Errors were mainly made on a number of strains with borderline susceptibility.

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'*.

External quality assurance (EQA) is the part of the quality management system that evaluates the performance of laboratories by an outside agency on material that is supplied especially for the purpose. The European Centre for Disease Prevention and Control's disease specific networks organise a series of EQA schemes for EU/EEA countries. In some specific networks, non-EU/EEA countries are also involved in the EQA activities organised by ECDC. The aim of the EQA is to identify improvement needs in laboratory diagnostic capacities relevant to surveillance of diseases listed in Decision No 2119/98/EC†. The main purposes of EQA schemes include the following:

- 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;
- providing continuing education; and
- identifying training activity needs.

For many years the European Commission funded Enter-net, an international surveillance network for national reference laboratories and surveillance centres on selected human gastrointestinal infections. Custodianship of Enter-net migrated to ECDC in October of 2007. In 2008, a framework contract on external quality assurance for *Salmonella* and verocytotoxin-producing *E. coli* (VTEC) was put in place for the years 2008–2011. The *Salmonella* EQA was won by the laboratory for Zoonoses and Environmental Microbiology (LZO) of the National Institute for Public Health and the Environment (RIVM, the 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 Central Veterinary Institute (CVI) of Wageningen University and Research Centre, Department of Bacteriology and TSEs (the Netherlands). This consortium now arranges annual EQA rounds for the national reference laboratories in the EU/EEA countries on serotyping, phage-typing and antimicrobial resistance testing for *Salmonella*. European Union candidate countries were also invited to participate at the cost of ECDC and non-EU/EEA countries could participate at their own cost.

* 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

†For further information about the decision, click here:
http://eur-lex.europa.eu/pri/en/oj/dat/1998/l_268/l_26819981003en00010006.pdf

2 Introduction

This report describes the first international EQA scheme on typing of *Salmonella* subspecies (spp.) organised by order and for the ECDC. The study was organised by the laboratory for Zoonoses and Environmental Microbiology (LZO) of the Dutch National Institute for Public Health and the Environment (RIVM) in Bilthoven—where the EU Reference Laboratory (EU-RL) for *Salmonella* is situated—in close cooperation with the *Salmonella* reference unit of the laboratory of Gastrointestinal enteric Pathogens (LGP) of the Health Protection Agency (HPA) in London, UK and the Department of Bacteriology and TSE of the Central Veterinary Institute (CVI) of Wageningen University and Research Centre in Lelystad, the Netherlands. Participants in this EQA scheme were the laboratories of the Food- and Waterborne Diseases and Zoonoses network (FWD-net). Before this study was organised, the group of laboratories participated in the interlaboratory comparison study on typing of *Salmonella* spp. since 1999, which was organised by the EU-RL—then called Community Reference Laboratory (CRL)—for *Salmonella* (the Netherlands).

The main objective of the EQA scheme was to provide laboratories the opportunity to evaluate their own performance in common typing methods for *Salmonella*, and to generally assess whether typing of *Salmonella* strains by different laboratories within and outside Europe produced comparable results. In addition, it enabled ECDC to identify where the major problems in commonly used typing methods and procedures are experienced.

3 Materials and methods

An invitation letter was sent out to national reference laboratories in EU/EEA countries and EU candidate countries on serotyping, phage-typing and antimicrobial resistance testing for *Salmonella*. Non-European Union/European Economic Area countries were invited to participate at their own cost. Laboratories were given the choice to participate in all or some of the methods.

The selection of strains for phage typing and interpretation of the results was performed in close cooperation with the HPA. With the help of the CVI of Wageningen University and Research Centre in the Netherlands, strains of various *Salmonella* serotypes were selected for AST. The Food- and Waterborne Diseases and Zoonoses Network laboratories and other participants were assigned a laboratory code F1–F35 by RIVM. Four weeks before the start of the study, the laboratories received the protocol and a test report via e-mail. The protocol and test report can be found in Annexes 2 and 3. All samples were packed and transported as biological substances and transported by door-to-door courier service. The parcels containing strains for serotyping, phage typing and AST were sent by RIVM in week 8/2009. A questionnaire was incorporated in the test report of the EQA scheme (see Annex 3).

3.1 Salmonella strains for serotyping

Twenty strains for serotyping were sent to the participants. The *Salmonella* strains used for the interlaboratory comparison study on serotyping originated from the National *Salmonella* Centre's collection. The strains were typed once again by LZO before mailing. The complete antigenic formulae according to the most recent White-Kauffmann-Le Minor scheme [1] of the 20 serovars are shown in Table 1.

Table 1: Antigenic formulas of the 20 selected *Salmonella* strains according to the White-Kauffmann-Le Minor scheme determined by the National *Salmonella* Centre, the Netherlands

No.	Serovar	O-antigens	H-antigens
S1	*S.* Paratyphi B var.Java	1,4,[5],12	b : 1,2
S2	*S.* Dublin	1,9,12	g,p : -
S3	*S.* Mbandaka	6,7,14	z_{10} : e,n,z_{15}
S4	*S.* Give	3,{10}{15}{15,34}	l,v : 1,7
S5	*S.* Plymouth	9,46	d : z_6
S6	*S.* Senftenberg	1,3,19	g,[s],t : -
S7	*S.* Heidelberg	1,4,[5],12	r : 1,2
S8	*S.* Virchow	6,7,14	r : 1,2
S9	*S.* Hadar	6,8	z_{10} : e,n,x
S10	*S.* Infantis	6,7,14	r : 1,5
S11	*S.* Enteritidis	1,9,12	g,m : -
S12	*S.* Kottbus	6,8	e,h : 1,5
S13	*S.* Coeln	1,4,[5],12	y : 1,2
S14	*S.* Brandenburg	4,[5],12	l,v : e,n,z_{15}
S15	*S.* Typhimurium	1,4,[5],12	i : 1,2
S16	*S.* Bredeney	1,4,12,27	l,v : 1,7
S17	*S.* Blockley	6,8	k : 1,5
S18	*S.* Colindale	6,7	r : 1,7
S19	*S.* Derby	1,4,[5],12	f,g : -
S20	*S.* Worthington	1,13,23	z : l,w

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**

3.2 *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 at the HPA. Ten strains of *S.* Enteritidis and 10 strains of *S.* Typhimurium were selected.

Table 3: Phage reactions of the *S.* Enteritidis strains determined by HPA

		Phages reactions at Routine Test Dilution																
Strain no.	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
E1	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	OL
E2	6	-	SCL	-	OL	-	<OL	-	OL	<OL	OL	-	-	-	-	-	-	<OL
E3	60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	CL	CL	CL	-	-	-
E4	47	-	SCL	-	-	-	<OL	-	-	-	-	-	-	-	CL	-	-	-
E5	1b	OL	SCL	CL	OL	CL	<OL	<CL	OL	<OL	<OL	CL	CL	CL	CL	SCL	CL	<OL
E6	8	-	-	<SCL	<OL	CL	<OL	SCL	OL	<OL	OL	SCL	CL	-	-	-	-	<OL
E7	6c	-	SCL	-	SCL	-	<OL	-	SCL	<OL	<OL	-	-	-	-	-	CL	<OL
E8	4	-	SCL	CL	OL	CL	<OL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
E9	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
E10	1	OL	SCL	CL	OL	CL	<OL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	SCL

Table 4a: Phage reactions of the *S.* Typhimurium strains determined by HPA, phages 1-19

		Phages reactions at Routine Test Dilution																
Strain no	Phage type	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18	19
T11	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T12	36	CL	CL	CL	OL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
T13	104	-	-	-	-	-	-	-	-	-	-	++	SCL	-	-	-	-	++	-
T14	18	-	-	-	-	-	-	-	-	-	<OL	-	-	-	SCL	-	<OL	SCL	SCL
T15	2	-	CL	CL	OL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
T16	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T17	12a	-	-	-	-	-	-	-	±	-	-	OL	OL	-	-	-	-	<CL	-
T18	136	-	-	-	OL	CL	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
T19	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T20	12	-	-	-	-	-	-	-	-	-	-	SCL	<CL	-	-	-	-	-	-

Table 4b: Phage reactions of the *S.* Typhimurium strains determined by HPA, phages 20-35 plus additional phages

		Phages at Routine Test Dilution												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
T11	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	+++	+	OL
T12	36	CL	CL	CL	CL	C	CL	CL	CL	CL	CL	CL	CL	+++	++	+++	OL	OL	++	OL
T13	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	+++	-
T14	18	SCL	-	-	-	-	-	-	+	-	-	OL	±	+++	++	+++	OL	<OL	+	-
T15	2	CL	OL	OL	CL	CL	CL	<CL	CL	-	CL	CL	OL	+++	+	++	OL	OL	SCL	OL

		Phages at Routine Test Dilution												Additional phages						
T16	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-
T17	12a	-	±	-	-	-	-	-	++	-	-	-	OL	++	+	++	OL	OL	++	±
T18	136	+	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	SCL	SCL	++	-
T19	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
T20	12	-	-	-	-	-	-	-	-	-	-	-	-	+++	++	+++	OL	OL	++	-

- = *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*

3.4 Strains and antibiotics for antimicrobial susceptibility testing

The *Salmonella* strains used for the AST originated from the collection at the CVI in the Netherlands. The panel of 14 antibiotics tested were amoxicillin and clavulanate, ampicillin, cefotaxime, chloramphenicol, ciprofloxacin, florfenicol, gentamicin, kanamycin, nalidixic acid, neomycin, streptomycin, sulphamethoxazole and trimethoprim, sulphonamide (e.g., sulfoxizole), and trimethoprim. The ten strains were numbered A-1 to A-10. The strains were selected for their resistance phenotype. Strain A1, *S.* Corvallis, showed a quinolone resistance phenotype (reduced susceptibility for ciprofloxacin and susceptible for nalidixic acid), which is typical for the expression of the qnr-gene. This serovar has been detected occasionally in the last years. Moreover, several Extended-Spectrum ß-lactamase ESBL, or AmpC-type beta-lactamase producing isolates were included.

A summary of the serotypes and their sources are given in Table 5.

Table 5: *Salmonella* strains used for antimicrobial susceptibility testing

Strain	Source	Serotype
A1	Human faeces	*S.* Corvallis
A2	Poultry meat	*S.* Paratyphi B var. Java
A3	Human faeces	*S.* Paratyphi B var. Java
A4	Food products	*S.* Typhimurium
A5	Poultry meat	*S.* Paratyphi B var. Java
A6	Meat products	*S.* Blockley
A7	Animal feed	*S.* Mbandaka
A8	Human blood	*S.* Enteritidis Pt 1
A9	Meat products	*S.* subsp. enterica 4,[5],12:i:-
A10	Meat products	*S.* Saintpaul

The strains were tested, in duplicate at CVI, for their susceptibility by broth microdilution method using Sensititre plates according to ISO-20776-1 [2].

The control strain that was used was *E. coli* ATCC 25922. The MIC values determined for the prescribed panel of antibiotics and the categories—resistant, intermediate and susceptible—were based on Clinical and Laboratory Standards Institute (CLSI) breakpoints [3, 4] and are shown in Table 6.

The participating laboratories were asked to use their standard method for susceptibility testing. If the disk diffusion test was used, it was requested to use the following disks: amoxicillin and clavanulate (30 µg), ampicillin (10 µg), cefotaxime (30 µg), chloramphenicol (30 µg), ciprofloxacin (5 µg), florfenicol (30 µg), gentamicin (10 µg), kanamycin (30 µg), nalidixic acid (30 µg), neomycin (30 µg), streptomycin (10 µg), sulfamethoxazole and trimethoprim (25 µg), sulfonamides (250 or 300 µg) and 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.

If an MIC test was used, the participants were asked to test the same antibiotics as required for the diffusion tests. Those participants that used a quantitative method were asked to record the MIC values determined. Moreover, all participants were asked to categorise their results as susceptible (S), intermediate (I) or resistant (R) according to their own breakpoint criteria used. The deviations from the categories determined by CVI were classified as minor or major deviations. An R–I or an S–I deviation was called a minor deviation and S-R or R-S deviations were

classified as major deviations. The CLSI breakpoints for MIC values according to guideline M100-S17 and interpretive criteria for disk diffusion according to guideline M100-S17/M31-A3 are shown in Table 7.

Table 6: Minimal inhibition concentration results (in mg/L) of selected AST-strains and of control strain *Escherichia coli* ATCC 25922 determined with the prescribed panel of antibiotics by CVI

	Antibiotics							
Strains	**AMC**	**AMP**	**CTX**	**CTD**	**CHL**	**CIP**	**FLO**	**GEN**
A1	1/0.5	1	≤ 0.06	≤ 0.25	8	0.5	4	0.5
A2	4/23	> 32	0.5	1	> 64	0.25	16	> 32
A3	6/33	> 32	> 4	16	16	2	16	0.5
A4	8/43	> 32	0.5	0.5	> 64	1	> 64	0.5
A5	32/163	> 32	> 4	> 16	16	2	8	≤ 0.25
A6	1/0.5	1	0.12	≤ 0.25	4	0.5	4	1
A7	1/0.5	1	0.12	0.5	8	≤ 0.03	8	1
A8	2/1	2	0.12	0.5	8	0.25	4	1
A9	3/1.53	> 32	≤ 0.06	≤ 0.25	8	≤ 0.03	8	0.5
A10	8/43	> 32	1	2	> 64	1	16	16
E. coli (MIC)	2/1-8/4	2-8	0.03 – 0.12	0.06 – 0.5	2-8	0.004-0.015	2-8	0.25-1
E. coli (disc)2	(20/10) 18-24	(10) 16-22	(30) 29-35	(30) 25-32	(30) 21-27	(5) 30-40	(30) 22-28	(10) 19-26

	Antibiotics							
Strains	**KAN**	**NAL**	**NEO**	**STR**	**SXT[1]**	**SUL**	**TET**	**TMP**
A1	≤ 4	16	1	4	≤ 0.12/2.38	16	≤ 1	≤ 0.5
A2	> 128	> 64	> 16	> 128	> 16/304	> 1024	> 64	> 32
A3	≤ 4	> 64	1	128	> 16/304	> 1024	> 64	> 32
A4	≤ 4	> 64	1	128	0.25/4.75	> 1024	> 64	≤ 0.5
A5	≤ 4	> 64	0.5	32	1/19	≤ 8	4	> 32
A6	> 128	> 64	> 16	> 128	≤ 0.12/2.38	≤ 8	64	≤ 0.5
A7	≤ 4	≤ 4	1	16	≤ 0.12/2.38	≤ 8	4	≤ 0.5
A8	≤ 4	> 64	1	4	≤ 0.12/2.38	32	2	≤ 0.5
A9	≤ 4	8	1	> 128	≤ 0.12/2.38	> 1024	> 64	≤ 0.5
A10	128	> 64	1	128	> 16/304	> 1024	> 64	> 32
E. coli (MIC)	1-4	1-4	NA	NA	≤ 0.5/9.5	8-32	0.5–2	0.5-2
E. coli (disc)[2]	(10) 17-25	(30) 22-28	(30) 17-23	(10) 12-20	(1.25/23.75) 23-29	(300) 15-23	(30) 18-25	(5) 21-28

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S);
1: Sulfamethoxazole results displayed; 2: Disc load in µg between brackets, zone diameter in mm 3: determined by E-test; NA = not applicable

Table 7: Clinical and Laboratory Standards Institute interpretive criteria in mg/L for MIC and in mm for disk diffusion

	MIC (M100-S17) (mg/L)		Disc diffusion (M100-S17/M31-A3) (mm)	
Antibiotics	**Susceptible**	**Resistant**	**Susceptible**	**Resistant**
Amoxicillin + Clavanulate (AMC)	≤ 8/4	≥ 32/16	≥ 18	≤ 13
Ampicillin (AMP)	≤ 8	≥ 32	≥ 17	≤ 13
Cefotaxime (CTX)	≤ 8	≥ 64	≥ 23	≤ 14
Cefotaxime (ESBL)	-	≥ 2	-	≤ 27
Chloramphenicol (CHL)	≤ 8	≥ 32	≥ 18	≤ 12
Ciprofloxacin (CIP)	≤ 1	≥ 4	≥ 21	≤ 15
Florfenicol* (FLO)	≤ 16	≥ 32	-	-
Gentamicin (GEN)	≤ 4	≥ 16	≥ 15	≤ 12

	MIC (M100-S17) (mg/L)		Disc diffusion (M100-S17/M31-A3) (mm)	
Antibiotics	**Susceptible**	**Resistant**	**Susceptible**	**Resistant**
Kanamycin (KAN)	≤ 16	≥ 64	≥ 18	≤ 13
Nalidixic Acid (NAL)	≤ 16	≥ 32	≥ 19	≤ 13
Neomycin* (NEO)	≤ 16	≥ 32	-	-
Streptomycin (STR)	≤ 16	≥ 32[#]	≥ 15	≤ 11
Trimethoprim + Sulphamethoxazole (1:19) (SXT)	≤ 2 / 38	≥ 4 / 76	≥ 16	≤ 10
Sulfonamides** (SUL)	≤ 256	≥ 512	≥ 17	≤ 12
Trimethoprim (TMP)	≤ 8	≥ 16	≥ 16	≤ 10

** No CLSI breakpoint available, EUCAST cut off values used (http://www.eucast.org) [#]*
Streptomycin: no breakpoint or cut-off available, Source EFSA (EFSA journal 2007, 2008) and previous RIVM ring trials;
***CLSI breakpoints for sulfisoxazole used*

4 Questionnaire results

In this chapter the questions and answers of this questionnaire are summarised.

4.1 General questions

Question 1: **Was your parcel damaged at arrival?**
All packages were received in a perfect state and no damage occurred during transport.

Question 2: **What was the date of receipt at the laboratory?**
Almost all participants received their parcel within the same week as the samples were sent (week 8/2009). Most laboratories (27) received the parcel within one week (four days). For five laboratories (F20 and F25, F8, F32, F34), the parcel took more than four days to arrive; 8, 11, 24, 25 days respectively. Most of these laboratories were from outside the EU/EEA. One laboratory did not provide information (F22). The average transport time for the participants was 2.3 days for countries within the EU/EEA, and 4.2 days for all participants.

Question 3: **What kind of medium did you use for subculturing the strains?**
The laboratories used a variety of media from various manufacturers for the subculturing of the *Salmonella* strains (see Table 8). This varied from non-selective nutrient agar to selective media like XLD or BGA.

Table 8: Selection of media and manufacturer for subculturing

Labcode	Medium	Manufacturer
F1	Nutrient Agar	Home made
F2	ADCL, Nutrient Agar	Merck/Difco
F3	Nutrient Agar	ALBM
F4	Endo-Agar	Oxoid
F5	Nutrient Agar	Oxoid
F6	XLD, Lab Lemco + bactopeptone + protease peptone	International Medical/Oxoid/Difco
F7	Nutrient Agar	Oxoid
F8	Nutrient Agar	BD
F9	Nutrient Broth No2	Oxoid
F10	XLT4	Home made
F11	TSA	BD
F12	Nutrient Agar	Sifin
F13	Nutrient Agar	Oxoid
F14	TSA	Oxoid
F15	McConkey Agar	Oxoid
F16	Endo-Agar	Lab M
F17	Blood Agar/TSI	Merck/BioMerieux
F18	BHA, SS, TSI, SwenGard	Oxoid, Biorad
F19	Nutrient Agar	Oxoid
F20	Hektoen Agar & Blood Agar	Oxoid
F22	TSA	BioMerieux
F23	Agar L11	Oxoid
F24	Broth No 2/Nutrient Agar/XLD/Rambach	Imuna/Merck
F25	MacConkey & Nutrient Agars	BD
F26	Heart Infusion Agar with Sheep blood	Difco
F27	No info	No info
F28	Nutrient plate agar	SSI
F29	Lactose, Nutrient, Swarm-agar	Biolife, Oxoid, SSI
F30	TSI Agar	BioMerieux
F31	Drigalski-Condrad's Agar	Home made
F32	TSA	fort Richard

Labcode	Medium	Manufacturer
F33	MacConkey & Nutrient Agars	Lab M & Oxoid
F34	5% Columbia Blood agar	Diagnostic Media Products, National Health Laboratory Services
F35	MacConkey Agar without salt	Oxoid

4.2 Questions regarding serotyping

Question 4: **What was the frequency of serotyping at your laboratory in 2007?**

Question 5: **How many strains did your laboratory serotype in 2007?**

Question 6: **How many of these typings considered a rough strain?**

Table 9: Frequency and number of strains serotyped in 2007

Labcode NRLs	Typing frequency	Number of strains serotyped in 2007	Number of rough strains	Laboratory
F1	Daily	1970	2	Own
F2	Thrice a week	829	3	Own
F3	Thrice a week	880	1	Own
F4	Daily	5893	231	Own
F5	Daily	7400	64	Own
F6	Daily	4746	nd	Own
F7	Daily	970	20	Own
F8	Monthly	200	1	Own
F9	Daily	7000	130	Own
F10	Daily	5967	33	Own
F11	Daily	359	no info	Own
F12	Twice a week	167	0	Own
F13	Weekly	300	0	Own
F14	Daily	5166	3	Own
F15	Daily	250	1	Own
F16	Twice a week	197	0	Own
F17	Weekly	60	0	Own
F18	Thrice a week	1018	2	Own
F19	Daily	1110	25	Own
F20	Thrice a week	120	nd	Own
F22	Daily	301	0	Own
F23	Daily	6180	18	Own
F24	Daily	543	0	Own
F25	Daily	1025	28	Own
F26	Once a week	4284	50	Own
F27	Thrice a week	1613	4	Own
F28	Daily	1118	0	Own
F29	Daily	2474	<10	Own
F30	Daily	1739	10	Own
F31	Daily	2840	4	Own
F32	Daily	2555	3	Own
F33	Daily	241	0	Own
F34	Daily	2471	2	Own
F35	Daily	1878	8	Own

nd= not determined

Question 7: **What kind of sera do you use (commercially available or prepared in own laboratory)?**

Table 10: Number of laboratories using sera from one or more manufacturers and/or in-house prepared sera

Number of manufacturers where sera are obtained	Number of labs (n = 34)	Number of EU/EEA labs (n = 28)
From 1 manufacturer	10	9
From 2 manufacturers	5	4
From 3 manufacturers	7	6
From 4 manufacturers	8	7
From 5 manufacturers or more	3	2
Preparation in own laboratory	2	
No information	1	

Table 11: Number of laboratories using sera from different manufacturers

Name manufacturer	Number of labs (n = 34)	Number of EU/EEA labs (n = 28)
Biomed	1	1
Biorad	12	11
Bio-trading	1	1
Dade Behring	3	3
Denka Seiken	6	3
Difco	2	2
Eurobio	1	1
Immunolab	1	1
Institute Immunology Zagreb	1	1
Lucron	1	1
Mast assure	1	1
Murex	1	0
Prolab	4	3
Oxoid	1	1
Reagensia AB	4	4
Remel	3	1
Serobact	1	0
Sifin	15	13
SMI	1	1
Statens Serum Institute	23	20
Own laboratory	6	6

Question 8: **Were the strains in the collaborative study typed in your own laboratory?**
All strains were typed in their own labs; two non-EU laboratories did not send in information on this subject.

4.3 Questions regarding phage typing

Question 9: **Does your laboratory perform phage typing of *S.* Enteritidis, *S.* Typhimurium and/or of other strains?**
Nineteen participants performed phage typing of *S.* Typhimurium and twenty participants performed phage typing of *S.* Enteritidis strains. One laboratory indicated to use a national scheme for phage typing of *S. Typhimurium*. For routine purposes, 11 participants also phage typed other strains like *S.* Agona, *S.* Bovismorbificans, *S.* Hadar, *S.* Heidelberg, *S.* Infantis, *S.* Oranienburg, *S.* Paratyphi A, *S.* Paratyphi B, *S.* Thompson, *S.* Typhimurium, *S.* Virchow., *S.* Gallinarum, *S.* Derby, *S.* Newport, *S.* Panama.

Question 10: **How many strains did your laboratory phage type in 2007?**

Table 12: Number of phage typings in 2007

Laboratory codes	Number of strains phage typed in 2007
F1	1880
F2	365
F4	4313
F5	5404
F6	1506
F7	786
F8	700
F13	100
F14	3620
F17	No information
F19	552
F21	No information
F23	4800
F24	No information
F25	4926
F26	670
F27	572
F29	449
F31	1390
F32	No information
F35	814

4.4 Questions regarding antimicrobial susceptibility testing

Question 11: **Do you use a standard method for susceptibility testing; e.g., CLSI?**
Most laboratories (19) used the CLSI as their standard method for susceptibility testing. A few other alternatives were mentioned: Breakpoint method, E-test, EUCAST, NCCLS, CA SFM, DIN ISO, and BD sensi-Disc. Six laboratories did not provide information on this topic.

Question 12: **What is/are the name(s) of your control strain(s)?**
Twenty-eight laboratories used *E. coli* (ATCC 25922) as their control strain except for laboratories F5 and F9. Some laboratories used more than one control strain. Results are shown in Table 13.

Table 13: Control strains used by the different laboratories

Lab	Control strains	Lab	Control strains
F1	*E.coli* ATCC 25922	**F20**	*E.coli* ATCC 25922 and ATCC 35218, *K. pneumoniae* ATCC 70603
F2	*E.coli* ATCC 25922	**F21**	
F3	*E.coli* ATCC 25922	**F22**	*E.coli* ATCC 25922
F4	*E.coli* ATCC 25922	**F23**	*E.coli* ATCC 25922
F5	In house wild strains	**F24**	*E.coli* ATCC 25922
F6	*E.coli* ATCC 25922	**F25**	*E.coli* ATCC 25922
F7	*E. coli* ATCC 25922 and ATCC 35218	**F26**	*E. coli* ATCC 25922, *E faecalis* ATCC 29212
F8	*E. coli* ATCC 25922	**F28**	*E.coli* ATCC 25922
F9	*E. coli* K12m / *S. Typhimurium*	**F29**	*E.coli* ATCC 25922
F10	*E. coli* ATCC 25922	**F30**	*E.coli* ATCC 25922
F11	*E. coli* ATCC 25922	**F31**	*E.coli* ATCC 25922

Lab	Control strains	Lab	Control strains
F12	*E. coli* ATCC 25922 and ATCC 35218, *S.aureus* ATCC 29213, ATCC 29212, *E. faecalis* ATCC 51299, *Pseudomonas aeruginosa* ATCC 27853		
F13	*E. coli* ATCC 25922	**F33**	*E.coli* ATCC 25922
F14	*E. coli* ATCC 25922	**F34**	*E coli* ATCC 25922
F15	*E. coli* ATCC 25922 and ATCC 35218, *E. faecalis* ATCC 29212	**F35**	*E.coli* ATCC 25922
F17	*E. coli* ATCC 25922		
F18	*E. coli* ATCC 25922		
F19	*E. coli* ATCC 25922		

Question 13: **What is the concentration of the AST inoculum in bacteria per ml?**

Table 14: Concentration of the inoculum of the laboratories using the disc diffusion test

Laboratory code	Inoculum	Laboratory code	Inoculum
F1	0,5McF	**F17**	0,5McF
F2	0,5McF	**F18**	0,5McF
F3	1,50E+08	**F19**	0,5McF
F7	0,5McF	**F20**	0,5McF
F9	1,00E+07	**F22**	0,5McF
F10	1,00E+08	**F23**	1,00E+07
F11	0,5McF	**F24**	0,5McF
F12	1,50E+08	**F29**	1,00E+05
F13	1,00E+08	**F30**	0,5McF
F14	0,5McF	**F31**	1,00E+08
F15	0,5McF	**F35**	1/1000

McF=MacFarland

Table 15: Concentration of inoculum in bacteria per ml of the laboratories using MIC test

Laboratory code	Density
F3	1,80E+08
F10	0,5McF
F13	1,80E+08
F26	5,00E+05
F28	5,00E+05
F31	1,00E+08
F33	0,5McF
F34	1-2 x 10^8

Question 14: **For how many strains was the antimicrobial susceptibility tested in your laboratory in 2007?**

Table 16: Number of strains tested for their antimicrobial susceptibility in 2007 and relevant method used

Labcode	Number	Method	Labcode	Number	Method
F1	7365	Disk Diffusion	**F17**	7365	Disk Diffusion
F2	657	Disk Diffusion	**F18**	657	Disk Diffusion
F3	4200	MIC	**F19**	4200	Disk Diffusion
F4	400	Disk Diffusion	**F20**	400	Disk Diffusion
F5	20480	Disk Diffusion	**F22**	301	Disk Diffusion
F6	1000	Disk Diffusion	**F23**	6300	Disk Diffusion
F7	359	Disk Diffusion	**F24**	543	Disk Diffusion
F8	168	Disk Diffusion	**F25**	3338	Disk Diffusion

Labcode	Number	Method	Labcode	Number	Method
F9	350	Disk Diffusion	**F26**	2152	MIC
F10	1432	MIC	**F28**	2033	MIC
F11	No info	Disk Diffusion	**F29**	2113	Disk Diffusion
F12	90	Disk Diffusion	**F30**	0	Disk Diffusion
F13	988	MIC	**F31**	2900	MIC
F14	1110	Disk Diffusion	**F33**	241	MIC
F15	120	Disk Diffusion	**F34**	No info	Disk Diffusion
F17	7365	Disk Diffusion	**F35**	1878	Disk Diffusion
F18	657	Disk Diffusion			

Question 15: **Which antibiotics did you use in this study?**

Table 17: Antibiotics tested and their manufacturers

Lab	company	AMC	AMP	CEF	CHL	CIP	FLO	GEN	KAN	NAL	NEO	STR	SXT	SUL	TMP
F1	Oxoid	+	+	+	+	+	+	+	+	+	+	+	+	+	+
F2	Oxoid	+	+	+	+	+	-	+	+	+	-	+	+	+	+
F3	Biorad	+	+	+	+	+	-	+	+	+	+	+	+	-	+
F4	No info														
F5	No info														
F6	Biorad	+	+	+	+	+	-	+	+	+	+	+	+	+	+
F7	Adatab	Oxoid	+	+	Oxoid	+	-	+	Oxoid	+	Oxoid	powder	+	Oxoid	powder
F8	BD	-	+	+	+	+	-	+	+	+	-	+	+	+	-
F9	Sigma	-	+	+	+	+	-	+	+	+	+	+	-	+	+
F10	Biorad	+	-	-	+	+	-	+	+	+	-	+	+	+	+
F11	Biorad	+	+	+	+	+	-	+	+	-	-	-	+	-	-
F12	Biorad*	+	+	+	-	+	-	+	-	Oxoid	-	-	+	-	-
F13	BD	-	+	+	+	+	+	+	+	+	+	+	+	+	+
F14	Oxoid	+	+	+	+	+	-	+	+	+	+	+	+	+	-
F15	Oxoid	+	+	+	+	+	-	+	+	+	+	+	+	+	+
F17	BBL	+	+	+	+	+	KRKA	+	+	+	Oxoid	+	+	Oxoid	+
F18	Oxoid	+	+	+	+	+	-	+	+	+	-	+	+	+	+
F19	Oxoid	-	+	+	+	+	-	+	+	+	-	+	-	+	+
F20	Oxoid	+	+	+	+	+	-	+	-	+	-	-	+	-	+
F22	12A	+	+	+	+	+	-	B-D	+	+	-	+	+	+	B-D
F23	Oxoid	-	+	+	+	+	-	+	+	+	-	+	-	+	+
F24	BD	-	+	-	+	+	-	+	+	+	-	+	+	+	+
F25	Sensititre	+	+	-	+	+	-	+	+	+	-	+	+	+	-
F26	Sensititre	-	+	+	+	+	+	+	+	+	-	+	-	-	-
F28	Trek Diagnostic systems Ltd.	+	+	-	+	+	+	+	-	+	+	+	-	-	+
F29	BD Sensi-disc ™	-	+	-	+	+	-	-	-	+	-	+	+	+	-
F30	Biomerieux	+	+	+	Oxoid	+	-	+	+	+	+	Oxoid	+	-	-
F31	Oxoid	-	+	+	+	+	-	+	-	+	-	+	-	+	+
F33	AB Biodisk	+	+	+	+	+	-	+	-	+	-	-	+	-	-
F34	AB biomerieux Sweden	+	+	+	+	+	-	-	+	+	-	+	+	+	+
F35	In house	-	+	+	+	+	+	+	+	+	+	-	-	+	+

+= tested
-= not tested
**= and Vitek2-compact of Biomerieux*
B-D = Becton and Dickinson

5 Results of external quality assurance

5.1 Overview of results

Thirty-four laboratories participated in this study, 28 from EU/EEA countries and six from countries outside of Europe. One EU laboratory received all strains but did not send in a completed test report.

All participants performed serotyping of the *Salmonella* strains. Twenty participants performed phage typing on 10 *S.* Enteritidis strains and 19 participants performed phage typing on *S.* Typhimurium. Thirty-one laboratories participated using a quantitative method producing MIC values or a qualitative disk diffusion test producing zone diameters. For an overview of the number of participating laboratories per methods and number of laboratories with all results according to intended results, see Table 18.

Table 18: 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	
Serotyping (20 strains)	**All correct**	**Participating**	**All correct**	**Participating**
O-antigens	21	28	25	34
H-antigens	19	28	25	34
Serovar name	16	28	20	34
Phage typing				
S. Enteritidis (10 strains)	4	16	7	19
S. Typhimurium (10 strains)	2	15	3	20
Antimicrobial susceptibility testing (14 antimicrobials)	2	26	2	31

5.2 Serotyping

5.2.1 Results serotyping for EU and EEA laboratories

Twenty-eight EU/EEA laboratories participated in this EQA Scheme. The evaluation of the detection of O- and H-antigens and the correctness of the serovar names are shown in Figures 1, 2 and 3 and the percentages correctness in Figure 4.

Twenty-one laboratories (75% of participating EU/EEA laboratories) typed all O-antigens correct. Nineteen laboratories (68% of participating EU/EEA laboratories) identified all H-antigens correctly and 16 laboratories (57% of the participating EU/EEA laboratories) identified all serovar names correctly.

Figure 1: Deviations from correct results for serotyping of O-antigens for EU/EEA laboratories

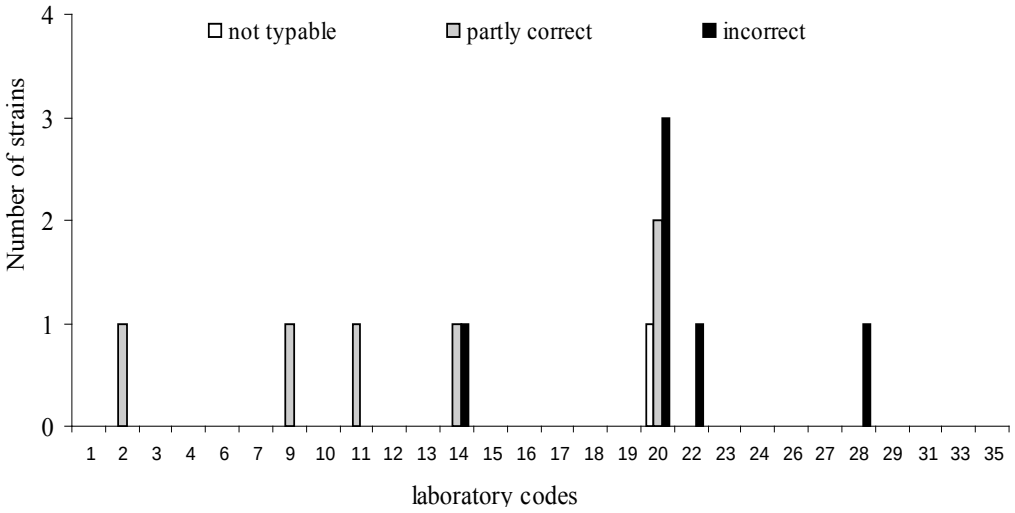


Figure 2: Deviations from correct results for serotyping of H-antigens for EU/EEA laboratories

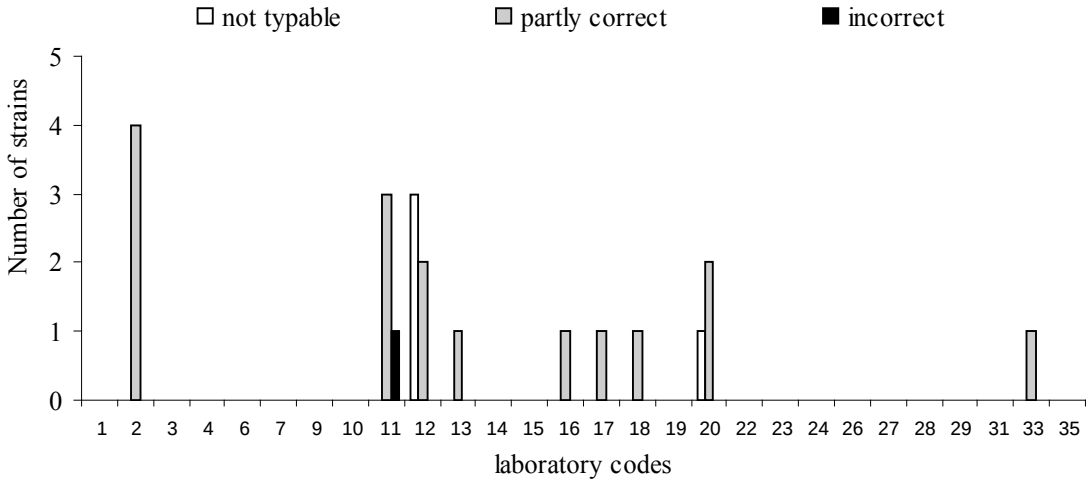


Figure 3: Deviations from correct results for serotyping of serovar names for EU laboratories

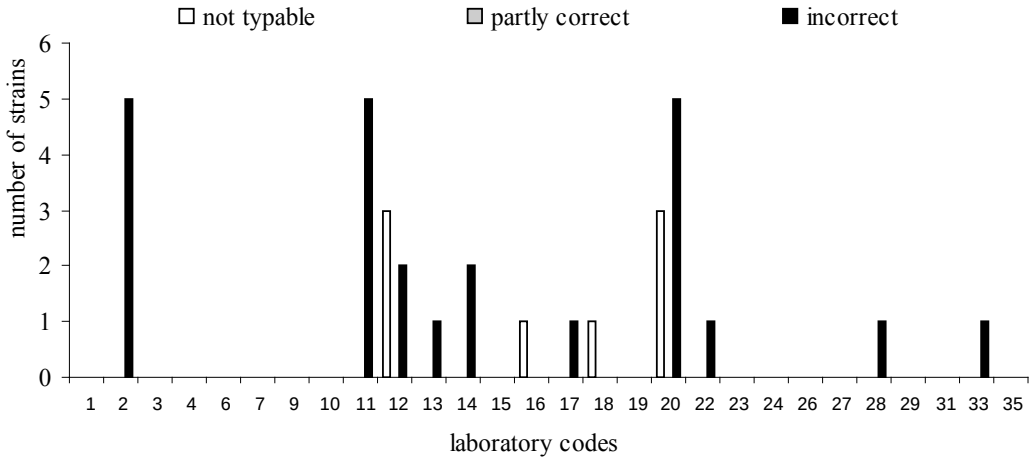
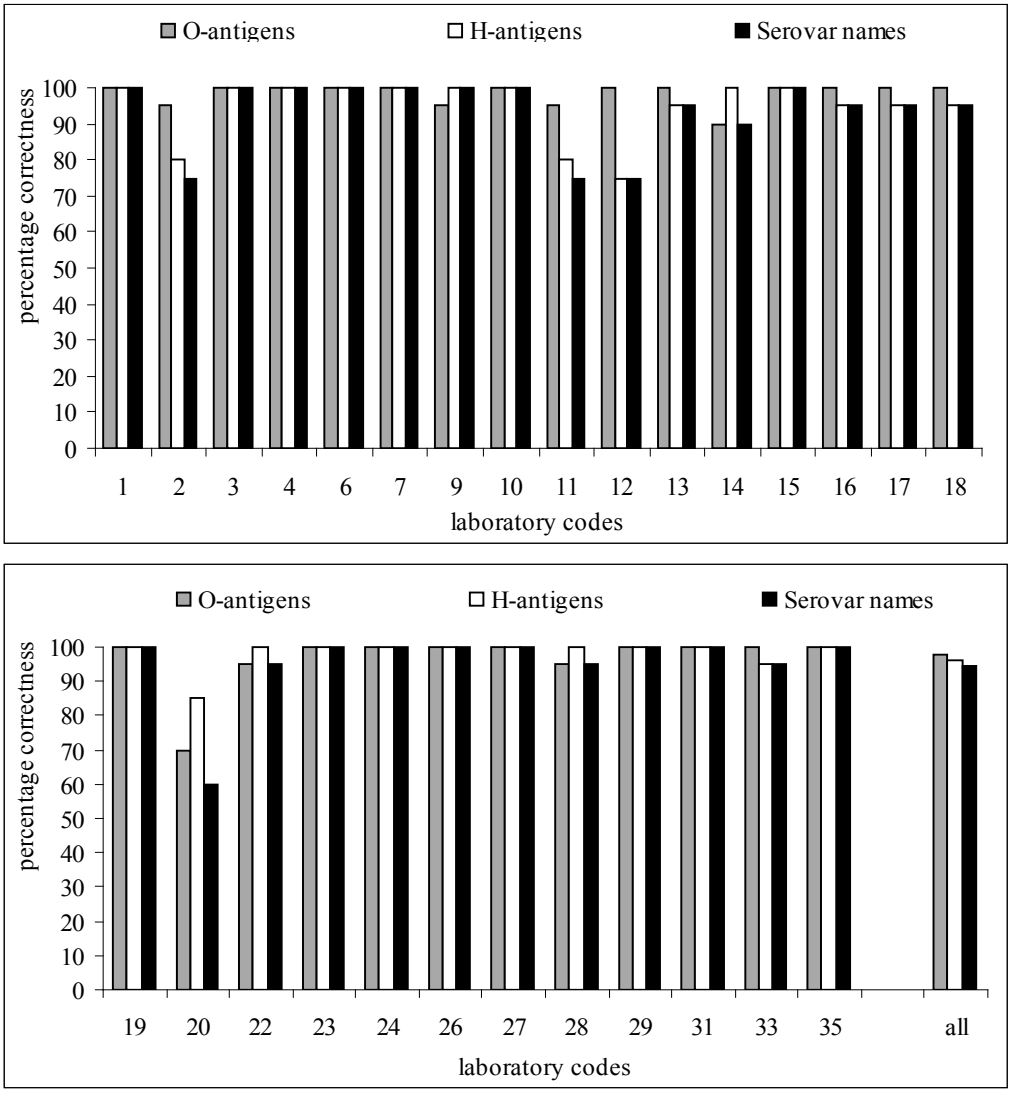


Figure 4: Achievements in percentages that were correct by EU/EEA laboratories



5.2.2 Evaluation per strain

The evaluation of the detection of O- and H-antigens and identification of the serovar names per strain are shown in Table 19. The pattern for the group of EU/EEA laboratories correctly typing the O- and H- antigens and serovar names are identical compared to the whole group of participants. The O-antigens of 12 strains and the H-antigens for 11 strains were typed correctly by the EU/EEA laboratories. A total correct identification was obtained for nine strains: *S.* Dublin (strain 2), *S.* Heidelberg (strain 7), *S.* Virchow (strain 8), *S.* Infantis (strain 10), *S.* Enteritidis (strain 11), *S.* Coeln (strain 13), *S.* Brandenburg (strain 14), *S.* Typhimurium (strain 15) and *S.* Bredeney (strain 16). Problems arose with strains *S.* Paratyphi B var.Java (strain 1), *S.* Mbandaka (strain 3), *S.* Give (strain 4), *S.* Plymouth (strain 5), *S.* Senftenberg (strain 6), *S.* Hadar (strain 9) and *S.* Kottbus (strain 12), *S.* Blockley (strain 17), *S.* Colindale (strain 18), *S.* Derby (strains 19) and *S.* Worthington (strain 20).

Table 19: Evaluation of the serotyping of strains by the EU/EEA laboratories.

Strain		O antigen detected*				H antigen detected*				Name serovar*			
No.	Serotype	+	nt	+/-	-	+	nt	+/-	-	+	nt	+/-	--
S1	*S.* Paratyphi B var.Java	27	0	0	**1**	28	0	0	0	27	0	0	**1**
S2	*S.* Dublin	28	0	0	0	28	0	0	0	28	0	0	0
S3	*S.* Mbandaka	26	**2**	0	0	22	**2**	**3**	**1**	22	**3**	0	**3**
S4	*S.* Give	28	0	0	0	25	0	**3**	0	25	0	0	**3**
S5	*S.* Plymouth	25	0	**3**	0	25	0	**3**	0	23	**1**	0	**4**
S6	*S.* Senftenberg	24	0	**2**	**2**	28	0	0	0	24	0	0	4

Strain		O antigen detected*				H antigen detected*				Name serovar*			
No.	Serotype	+	nt	+/-	-	+	nt	+/-	-	+	nt	+/-	--
S7	*S.* Heidelberg	28	0	0	0	28	0	0	0	28	0	0	0
S8	*S.* Virchow	28	0	0	0	28	0	0	0	28	0	0	0
S9	*S.* Hadar	27	0	0	**1**	26	**1**	**1**	0	25	**1**	0	**2**
S10	*S.* Infantis	28	0	0	0	28	0	0	0	28	0	0	0
S11	*S.* Enteritidis	28	0	0	0	28	0	0	0	28	0	0	0
S12	*S.* Kottbus	27	0	0	**1**	27	0	**1**	0	26	0	0	**2**
S13	*S.* Coeln	28	0	0	0	28	0	0	0	28	0	0	0
S14	*S.* Brandenburg	28	0	0	0	28	0	0	0	28	0	0	0
S15	*S.* Typhimurium	28	0	0	0	28	0	0	0	28	0	0	0
S16	*S.* Bredeney	28	0	0	0	28	0	0	0	28	0	0	0
S17	*S.* Blockley	27	0	0	**1**	27	0	**1**	0	25	0	0	**3**
S18	*S.* Colindale	28	0	0	0	27	0	**1**	0	27	**1**	0	0
S19	*S.* Derby	28	0	0	0	27	0	**1**	0	27	0	0	**1**
S20	*S.* Worthington	26	0	**1**	**1**	25	**1**	**2**	0	25	**2**	0	**1**

+ = correct; nt = not typable ; +/- = partly correct ; - = incorrect
** = The figures indicate the number of laboratories finding the relevant results (total number of labs = 28)*

The characterisations that caused major problems (strains 1, 3 and 9) for some laboratories are shown in Table 20. The empty cells indicate that strains were typed correctly by the laboratories mentioned.

Table 20: Identifications per strain that caused major problems in serotyping by EU/EEA laboratories

	Strain 1	Strain 3	strain 4	strain 5	strain 6	strain 9	strain 12	Strain 17	Strain 18	Strain 19	Strain 20
	S. Paratyphi B var.Java 1,4,[5],12; b:1,2	S. Mbandaka 6,7,14;z10 : e,n,z15	S. Give 3,{10}{15}{15,34};l,v:1, 7	S. Plymouth 9,46; d : z6	S. Senftenberg 1,3,19; g,[s],t : -	S. Hadar 6,8;z10 : e,n,x	S. Kottbus 6,8;e,h : 1,5	S. Blockley 6,8;k : 1,5	S. Colindale 6,7;r : 1,7	S. Derby 1,4,[5],12;f,g : -	S. Worthington 1,13,23;z : l,w
F2		*S.* Jerusalem 6,7,14;z10 ; l,w		*S.* Sontheim 9,46;d ; z35	*S.* Westhampton 3,15,34;g,s,t; -		*S.* Tshiongwe 6,8;e,h; e,n,z15				*S.* Poona 1,13,22,23;z;1,6
F9											S. Worthington 13,**22**;z:l,w
F11		S. Thompson 6,7,14; k,5	S. London 3,10,[15];l,v, 6	S. Typhi 9,12,[Vi];d				S. Zerifin 6,8;k,5		S. Essen 4,12;g,m	
F12		Not typable 6,7	S. Mokola 3,10;y:1,7			Not typable 6,8;NT		S. Kallo 6,8;k:1,2			Not typable 13,23;NT
F13		S. Mikawasima 7,14;y: z15									
F14	S. Hull 16; b:2			S. Zega 9;d : z6							
F16		- 6,7;z10 : e, n, z15, 1,2									
F17						S. Cleveland 6,8;z10:1,7					
F18				? 9,46; d:-							
F20		*Salmonella* sp. Autoaggl		S. Zega 9;d : z6	S. Westhampton 3,10;g,s,t	S. Istanbul or Hadar 6,8;z10:e,n,x	S. Ferruch or Kottbus 6,8;h:1,5	S. Haardt or Blockley 6,8;k:1,5	*Salmonella* sp. 6,7; r		*Salmonella* sp. 13,23;l,w
F22					S. Kingston 4,5;g,t,s						
F28					S. Kingston 4,5,12;g,t,s						
F33			S. London 10;lv : 1,6								

5.2.3 Results serotyping for all participants

The evaluation of the detection of O- and H-antigens and identification of the strains per laboratory are shown in Figures 5, 6 and 7 and the percentages which were correct in Figure 8.

Twenty-five typed all O-antigens correctly. Twenty-five laboratories identified all H-antigens correctly and twenty laboratories identified all serovar names correctly.

Figure 5: Deviations from correct results for serotyping of O-antigens per participant

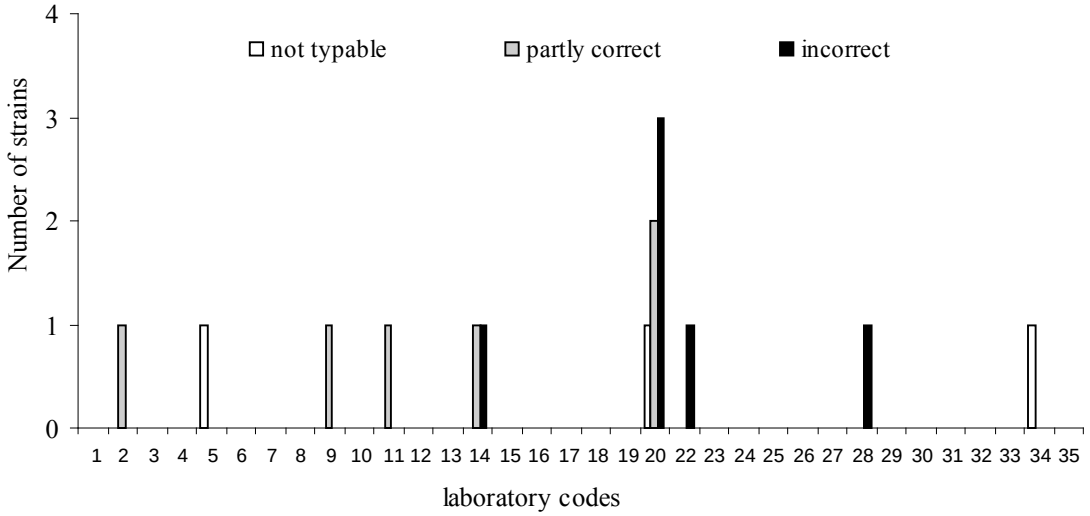


Figure 6: Deviations from correct results for serotyping of H- antigens per participant

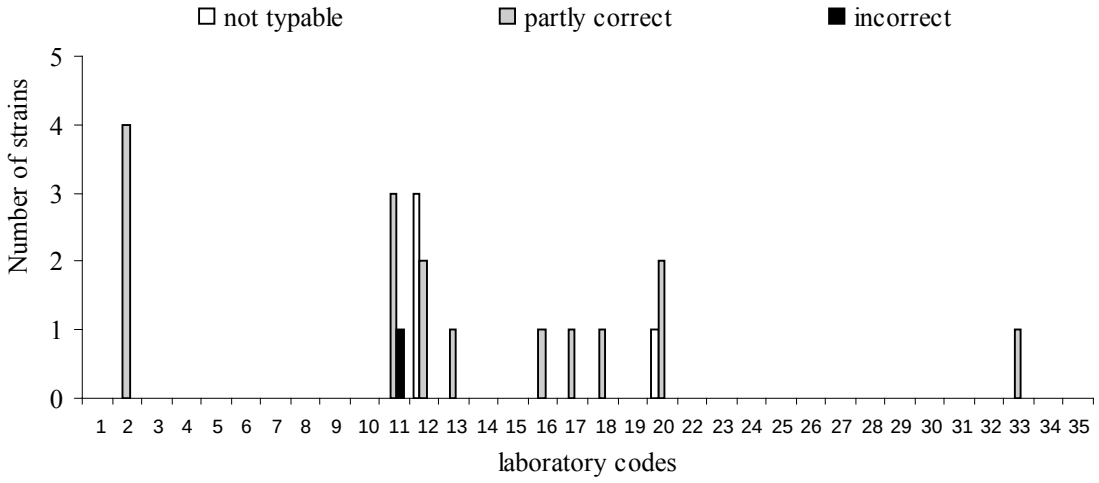


Figure 7: Deviations from correct results for assigning the correct serovar names per participant

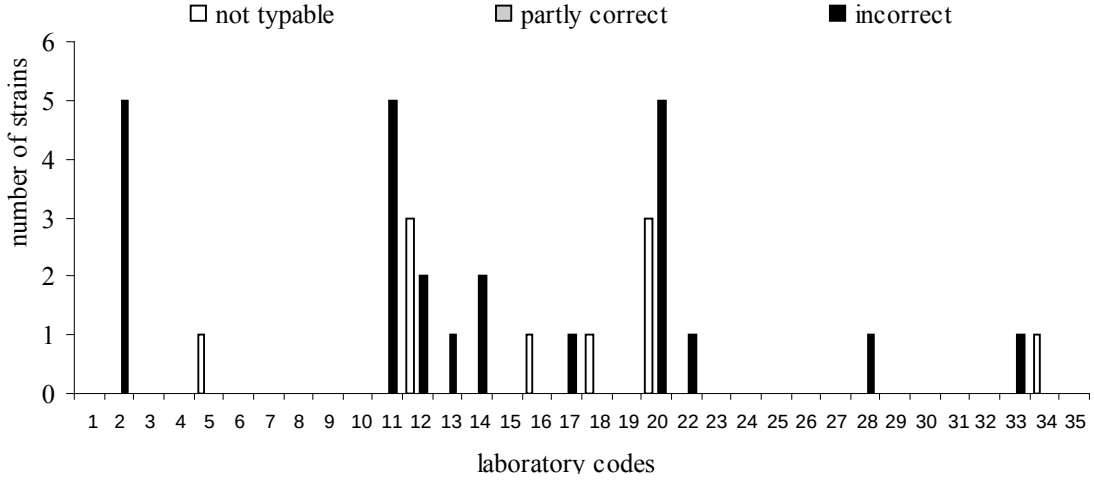
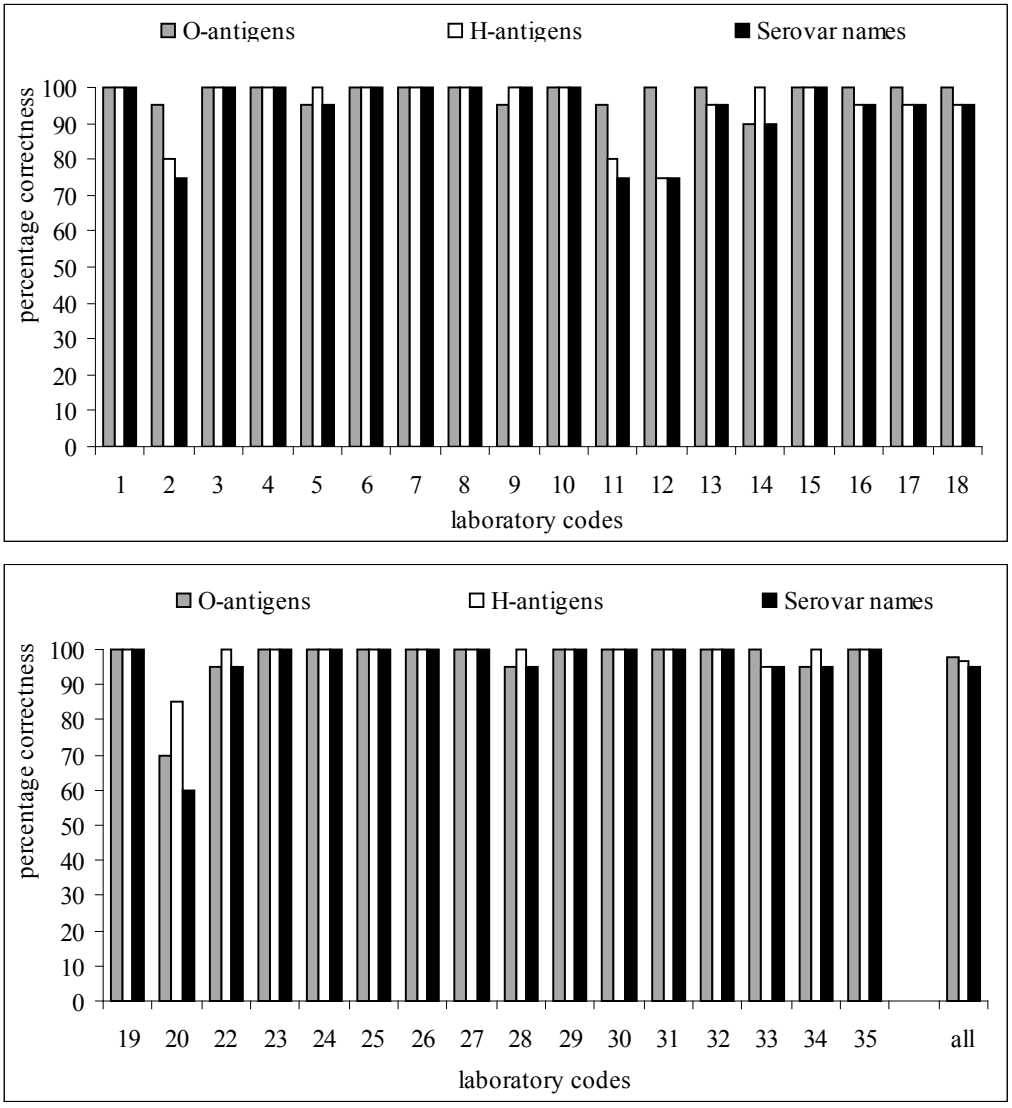


Figure 8: Achievements of the serotyping in percentages that were correct, all laboratories



Seventy-four per cent of the participants were able to correctly type the O-antigens. The H-antigens were typed correctly by 74 % of the participants. Fifty-nine per cent of the participants were able to give the correct serovar names.

5.2.4 Serotyping results per strain

The evaluation of the detection of O- and H-antigens and identification of the serovar names per strain are shown in Table 21. The O-antigens of 12 strains were typed correctly by all participants. The H-antigens were typed correctly for 11 strains by all participating laboratories. Problems arose with strains *S.* Paratyphi B var.Java (strain 1), *S.* Mbandaka (strain 3), *S.* Give (strain 4), *S.* Plymouth (strain 5), *S.* Senftenberg (strain 6), *S.* Hadar (strain 9) and *S.* Kottbus (strain 12), *S.* Blockley (strain 17), *S.* Colindale (strain 18), *S.* Derby (strains 19) and *S.* Worthington (strain 20). Correct identification by all participants was obtained for 9 strains (*S.* Dublin (strain 2), *S.* Heidelberg (strain 7), *S.* Virchow (strain 8), *S.* Infantis (strain 10), *S.* Enteritidis (strain 11), *S.* Coeln (strain 13), *S.* Brandenburg (strain 14), *S.* Typhimurium (strain 15) and *S.* Bredeney (strain 16).

Table 21: Evaluation of the typing of strains by the laboratories

Strains	O-antigens				H-antigens				Serovar names			
	+	nt	+/-	-	+	nt	+/-	-	+	nt	+/-	-
S. Paratyphi B var. Java	33	0	0	**1**	34	0	0	0	33	0	0	**1**
S. Dublin	34	0	0	0	34	0	0	0	34	0	0	0
S. Mbandaka	31	**3**	0	0	27	**3**	**3**	**1**	27	**4**	0	**3**
S. Give	34	0	0	0	31	0	**3**	0	31	0	0	**3**
S. Plymouth	31	0	**3**	0	31	0	**3**	0	29	**1**	0	**4**

Strains	O-antigens				H-antigens				Serovar names			
	+	nt	+/-	-	+	nt	+/-	-	+	nt	+/-	-
S. Senftenberg	30	0	**2**	**2**	34	0	0	0	30	0	0	**4**
S. Heidelberg	34	0	0	0	34	0	0	0	34	0	0	0
S. Virchow	34	0	0	0	34	0	0	0	34	0	0	0
S. Hadar	33	0	0	**1**	32	**1**	**1**	0	31	**1**	0	**2**
S. Infantis	34	0	0	0	34	0	0	0	34	0	0	0
S. Enteritidis	34	0	0	0	34	0	0	0	34	0	0	0
S. Kottbus	33	0	0	**1**	33	0	**1**	0	32	0	0	**2**
S. Coeln	34	0	0	0	34	0	0	0	34	0	0	0
S. Brandenburg	34	0	0	0	34	0	0	0	34	0	0	0
S. Typhimurium	34	0	0	0	34	0	0	0	34	0	0	0
S. Bredeney	34	0	0	0	34	0	0	0	34	0	0	0
S. Blockley	32	**1**	0	**1**	33	0	**1**	0	30	**1**	0	**3**
S. Colindale	34	0	0	0	33	0	**1**	0	33	**1**	0	0
S. Derby	34	0	0	0	33	0	**1**	0	33	0	0	**1**
S. Worthington	32	0	**1**	**1**	31	**1**	**2**	0	31	**2**	0	**1**

+ = correct;
nt = not typable ;
+/- = partly correct ;
- = incorrect
The figures indicate the number of laboratories finding the relevant results (total number of laboratories = 34)

The characterisations that caused major problems in serotyping by the NRLs are shown in Table 22. The empty cells in the table indicate that strains were typed correctly by the laboratories mentioned.

Table 22: Identification per strain that caused most problems in serotyping

	Strain 1	Strain 3	strain 4	strain 5	strain 6	strain 9	strain 12	Strain 17	Strain 18	Strain 19	Strain 20
	S. Paratyphi B var.Java 1,4,[5],12; b:1,2	S. Mbandaka 6,7,14;z10:e,n,z15	S. Give 3,{10}{15}{15,34};l,v:1,7	S. Plymouth 9,46;d:z6	S. Senftenberg 1,3,19;g,[s],t:-	S. Hadar 6,8;z10:e,n,x	S. Kottbus 6,8;e,h:1,5	S. Blockley 6,8;k:1,5	S. Colindale 6,7;r:1,7	S. Derby 1,4,[5],12;f,g:-	S. Worthington 1,13,23;z:l,w
F2		*S.* Jerusalem 6,7,14;z10 ; l,w		*S.* Sontheim 9,46;d ; z35	*S.* Westhampton 3,15,34;g,s,t; -		*S.* Tshiongwe 6,8;e,h; e,n,z15				*S.* Poona* 1,13,22,23;z;1,6
F5								S. l rough:k :1,5			
F9											S. Worthington 13,22;z:l,w
F11		S. Thompson 6,7,14; k,5	S. London 3,10,[15];l,v, 6	S. Typhi 9,12,[Vi];d				S. Zerifin 6,8;k,5		S. Essen 4,12;g,m	
F12		Not typable 6,7	S. Mokola 3,10;y:1,7			Not typable 6,8;NT		S. Kallo 6,8;k:1,2			Not typable 13,23;NT
F13		S. Mikawasima 7,14;y: z15									
F14	S. Hull 16; b:2			S. Zega 9;d : z6							
F16		- 6,7;z10:e, n, z15, 1,2									
F17						S. Cleveland 6,8;z10:1,7					
F18				? 9,46; d:-							
F20		*Salmonella* sp. Autoaggl		S. Zega 9;d : z6	S. Westhampton 3,10;g,s,t	S. Istanbul or Hadar* **6,8**;z10:e,n,x	S. Ferruch or Kottbus* **6,8**;h:1,5	S. Haardt or Blockley* **6,8**;k:1,5	*Salmonella* sp. 6,7; r		*Salmonella* sp. 13,23;l,w
F22					S. Kingston 4,5;g,t,s						
F28					S. Kingston 4,5,12;g,t,s						
F33			S. London 10;lv : 1,6								
F34		- Autoaggl									

5.3 Phage typing results

5.3.1 Results phage typing for the EU/EEA laboratories

The phage typing results of the EU/EEA laboratories were evaluated per strains and by laboratory and are shown in Tables 23 and 24. Fifteen laboratories performed phage typing for both *S.* Enteritidis and *S.* Typhimurium. One laboratory only performed phage typing for *S.* Enteritidis.

Four laboratories assigned the correct phage type for all ten of the *S.* Enteritidis strains. Seven laboratories had one incorrect result. Three laboratories had two incorrect results each. One laboratory had three incorrect results and another laboratory had four incorrect results. The strains that were shown to be the most difficult to phage type were E9 followed by E10.

Two laboratories correctly phage typed all 10 strains of *S.* Typhimurium. Four laboratories had only one incorrect result. Eight of the ten *S.* Typhimurium strains were correctly phage typed by three of the laboratories. Four laboratories correctly phage typed seven of the *S.* Typhimurium strains. Five of the 10 *S.* Typhimurium strains were correctly phage typed by two laboratories. The strains that were shown to be the most difficult to phage type were T17 and T11.

Separate notations per phage type and per laboratory are given in Annex 5. Correct phage types for each laboratory (in percentages) are shown in Figure 9.

Table 23: Results of *S.* Enteritidis phage typing for EU/EEA laboratories

	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10
HPA	14b	6	60	47	1b	8	6c	4	59	1
F1	14b	6	60	47	4a	8	6a	4	59	1
F2	13	6	60	47	1b	8	6c	4	59	1
F4	14b	6	60	47	1b	8	6c	4	23	1
F6	14b	6	NT	47	1b	8	6c	4b	NT	1
F7	14b	6	60	47	1b	8	6c	4b	59	1
F13	14b	6	60	47	1b	8	6c	4	NT	20a
F14	14b	6	60	47	1b	8	6c	4	59	1
F17	14b	6	60	47	1b	8	6c	4a	59	45
F19	14b	6	60	47	1b	8	6c	4	59	1
F23	14b	6	60	47	1b	8	6c	4	59	1
F24	14b	6	60	47	1b	8	6a	4	59	1
F26	14b	6	20	47	1b	28	6c	4	NT	4
F27	14b	6	60	47	1b	8	6c	4	23	1
F29	14b	6	60	47	1b	8	6c	4	59	37
F31	14b	6	60	47	1b	8	6c	4	14b	1
F35	14b	6	60	47	1b	8	6c	4	59	1

grey cells= deviating results;
NT= not typeable

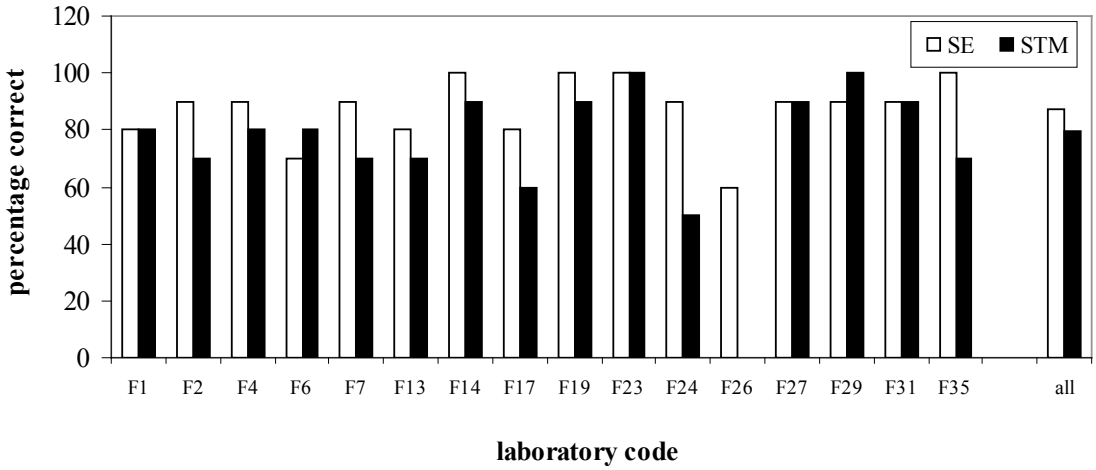
Table 24: Results of *S.* Typhimurium phage typing for EU/EEA laboratories

	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
HPA	208	36	104	18	2	U311	12a	136	193	12
F1	208	36	104L	18	2	U311	104H	136	193	RDNC
F2	208	36	110	18	2	U311	104	136	193	109
F4	U302	36	104L	18	2	U311	104H	136	193	12
F6	U302	36	104L	18	2	U311	104H	136	193	12
F7	208	36	18	104	2	U302	12a	136	193	12
F13	U302	36	104L	18	2	U311	104H	54	193	12
F14	208	36	104L	18	2	U311	104H	136	193	12
F17	U302	36	104L	118	46	U309	104H	136	193	12
F19	208	36	104	RDNC	2	U311	12a	136	193	12
F23	208	36	104	18	2	U311	12a	136	193	12
F24	208	36	U302	18	12	U311	104H	54	193	U302

	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20
F27	U302	36	104	18	2	U311	12a	136	193	12
F29	208	36	104	18	2	U311	12a	136	193	12
F31	208	36	104L	18	2	U311	12a	136	195	12
F35	U302	36	104L	18	2	U311	104H	136	194	12

RDNC = Strains reacting with the typing phages but not conform to any of the current recognised patterns
grey cells = deviating results

Figure 9: Achievements of the phage typing in percentages that were correct for EU/EEA laboratories



5.3.2 Results phage typing for all participants

The phage typing results of the participating laboratories were evaluated per strain and by laboratory and are shown in Tables 25 and 26. Nineteen laboratories performed phage typing for both *S.* Enteritidis and *S.* Typhimurium. One laboratory performed phage typing for *S.* Enteritidis only. Seven laboratories assigned the correct phage type for all ten of the *S.* Enteritidis strains. Seven laboratories had one incorrect result. Four laboratories had two incorrect results each. One laboratory had three incorrect results and another had four incorrect results. The strains that were shown to be the most difficult to phage type were E9 and E10. Three laboratories correctly phage typed all 10 strains of *S.* Typhimurium. Six laboratories had one incorrect result. Eight of the ten *S.* Typhimurium strains were correctly phage typed by three of the laboratories. Five laboratories correctly phage typed seven of the *S.* Typhimurium strains. Five of the 10 *S.* Typhimurium strains were correctly phage typed by two laboratories. The strains that were shown to be the most difficult to phage type were T17 and T11. Separate notations per phage type and per laboratory are given in Annex 5. Correct phage types for each laboratory (in percentages) are shown in Figure 10.

Table 25: Results of *S.* Enteritidis phage typing

	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10
HPA	**14b**	**6**	**60**	**47**	**1b**	**8**	**6c**	**4**	**59**	**1**
F1	14b	6	60	47	4a	8	6a	4	59	1
F2	13	6	60	47	1b	8	6c	4	59	1
F4	14b	6	60	47	1b	8	6c	4	23	1
F5	14b	6	60	47	1b	8	6c	4	59	1
F6	14b	6	NT	47	1b	8	6c	4b	NT	1
F7	14b	6	60	47	1b	8	6c	4b	59	1
F8	6a	6	60	47	1b	28	6c	4	59	1
F13	14b	6	60	47	1b	8	6c	4	NT	20a
F14	14b	6	60	47	1b	8	6c	4	59	1
F17	14b	6	60	47	1b	8	6c	4a	59	45
F19	14b	6	60	47	1b	8	6c	4	59	1
F23	14b	6	60	47	1b	8	6c	4	59	1
F24	14b	6	60	47	1b	8	6a	4	59	1
F25	14b	6	60	47	1b	8	6c	4	59	1
F26	14b	6	20	47	1b	28	6c	4	NT	4

	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	E-10
F27	14b	6	60	47	1b	8	6c	4	23	1
F29	14b	6	60	47	1b	8	6c	4	59	37
F31	14b	6	60	47	1b	8	6c	4	14b	1
F32	14b	6	60	47	1b	8	6c	4	59	1
F35	14b	6	60	47	1b	8	6c	4	59	1

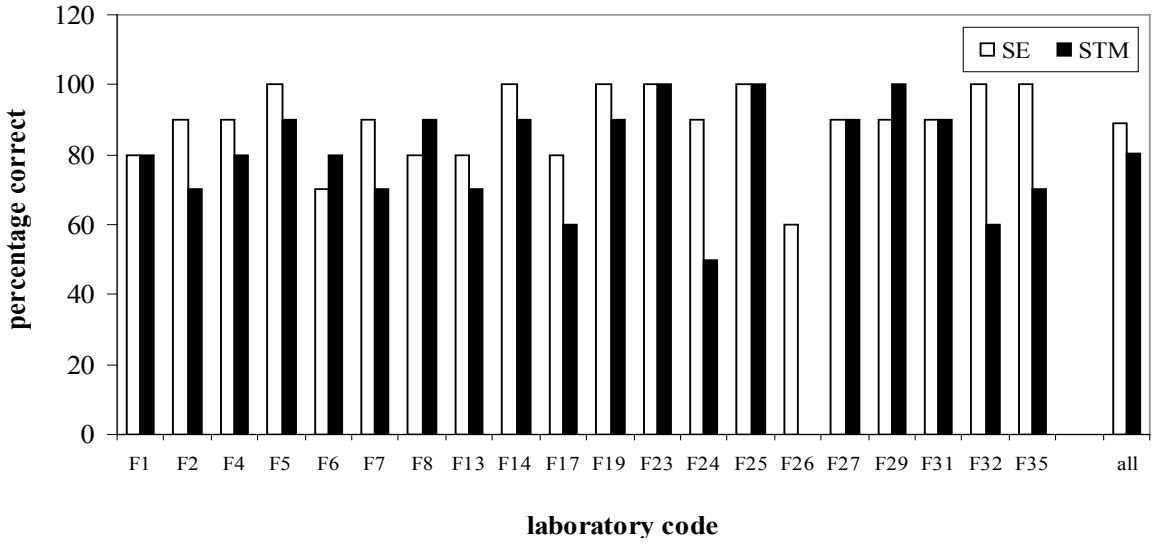
grey cells= deviating results;
NT= not typeable

Table 26: Results of *S.* Typhimurium phage typing

	T-11	T-12	T-13	T-14	T-15	T-16	T-17	T-18	T-19	T-20
HPA	**208**	**36**	**104**	**18**	**2**	**U311**	**12a**	**136**	**193**	**12**
F1	208	36	104L	18	2	U311	104H	136	193	RDNC
F2	208	36	110	18	2	U311	104	136	193	109
F4	U302	36	104L	18	2	U311	104H	136	193	12
F5	208	36	104L	18	2	U311	12a	136	195	12
F6	U302	36	104L	18	2	U311	104H	136	193	12
F7	208	36	18	104	2	U302	12a	136	193	12
F8	208	36	U302	18	2	U311	12a	136	193	12
F13	U302	36	104L	18	2	U311	104H	54	193	12
F14	208	36	104L	18	2	U311	104H	136	193	12
F17	U302	36	104L	118	46	U309	104H	136	193	12
F19	208	36	104	RDNC	2	U311	12a	136	193	12
F23	208	36	104	18	2	U311	12a	136	193	12
F24	208	36	U302	18	12	U311	104H	54	193	U302
F25	208	36	104	18	2	U311	12a	136	193	12
F27	U302	36	104	18	2	U311	12a	136	193	12
F29	208	36	104	18	2	U311	12a	136	193	12
F31	208	36	104L	18	2	U311	12a	136	195	12
F32	208	36	DT104	RDNC	132	U311	12a	136	195	12
F35	U302	36	104L	18	2	U311	104H	136	194	12

RDNC = Strains reacting with the typing phages but not conform to any of the current recognised patterns;
grey cells = deviating results

Figure 10: Achievements of the phage typing in percentages that were correct



5.4 Antimicrobial susceptibility testing

5.4.1 Test methods used by the participants

Thirty-one laboratories tested the AST strains for susceptibility. Several different methods were used. Minimal inhibition concentration values were predominantly determined by broth microdilution according to ISO 20776-1 [2]. The E-test* was used by six laboratories, including laboratories using E-test for confirmation purposes in addition to other methods. Three laboratories used an automated system (VITEK2, Sensititre ARIS, Miditech) to determine MIC values and three laboratories used a breakpoint method with antibiotics dissolved in Mueller-Hinton (MH) agar. Twenty-two laboratories used disk diffusion, 20 of them according to guidelines of CLSI and two according to national guidelines.

5.4.2 Results of all participants ordered per antibiotic

For the interpretation of the reference MIC values, determined by the CVI using broth microdilution according to ISO-20776-1 [2], only CLSI guidelines were used. The Central Veterinary Institute also participated in the ring trial and used European committee on Antimicrobial Susceptibility Testing (EUCAST) epidemiological cut-off values as prescribed for EU National Reference Laboratories on antimicrobial resistance testing by the European Food Safety Authority (EFSA) for surveillance purposes [5, 6]. However, EUCAST does not yet provide interpretive criteria for disk diffusion; due to this, for the interpretation of the disk zones, CLSI criteria were used.

The quality of the different interpretive criteria is discussed below. The interpretive criteria used by the participating laboratories varied substantially for the different antibiotics. For cefotaxime for instance, standard CLSI criteria were used but also specific criteria for detection of Extended Spectrum Beta-lactamase (ESBLs), EUCAST breakpoints and cut-off values, resulting in substantial variation of the results, as was the case for ciprofloxacin. Some laboratories applied EUCAST expert rules for the interpretation of certain phenotypes while others did not do so. Because of these differences in methods, criteria and interpretations, a quantification of deviating results was not always appropriate. Also, the reference values based on CLSI criteria can be criticised, which is discussed as well.

This section describes the results of this ring trial for each antibiotic, keeping in mind the aforementioned variation and the characteristics of the isolates.

The results of all laboratories are shown in the tables of Annex 6. For those laboratories that determined MIC values, the concentration is given in mg/L. For the laboratories that used disk diffusion, the zone diameters are given in mm.

Amoxicillin/clavulanic acid

The results of the susceptibility test using amoxicillin/clavulanic acid are difficult to interpret. Clavulanic acid is an instable compound, which warrants optimum storage of disks or plates. Also the variation in expression and production of beta-lactamases affects the test results. Moreover, test results for beta-lactamase producing strains can be affected by the fact that in the test systems used, clavulanic acid is present in fixed amounts. Susceptible strains will start growing again after the fixed amount of clavulanic acid is consumed, generally leading to higher MIC values or smaller zone diameters and an inaccurate classification of intermediate or resistance classification. For that reason in European food and animal surveillance, amoxicillin/clavulanic acid is not advocated to be used as an antibiotic [5, 6].

To determine the reference values, all isolates were tested by broth microdilution. Because of inconclusive results, all ampicillin resistant strains were retested by E-test using a new batch of strips. E-test results were also difficult to interpret accurately because of loose colonies in inhibition zones. Still, the results obtained match the genes that were present. Strains A1, A6, A7, A8, A9 were fully susceptible; strains A2, A9, A10 harboured *bla*$_{TEM-1}$, A4 *bla*$_{PSE-1}$, A3 a TEM-based ESBL and A5 *bla*$_{CMY}$.

All susceptible isolates were classified correctly by all laboratories. On the TEM-1 producers A2 and A9, two minor and one major deviation were produced. A10 caused many problems. This is a TEM-1 producing isolate with reduced MIC value for amoxicillin/clavanulate and third generation cephalosporins. The mechanism behind his phenotype is unknown. Using E-test, the isolate was classified S. The majority of the laboratories classified A10 as R (12), some as I (4) or S (3), indicating that this isolate has a borderline susceptibility. Because of this, the deviations recorded for A10 are not included in the summary results in Tables 27 and 28.

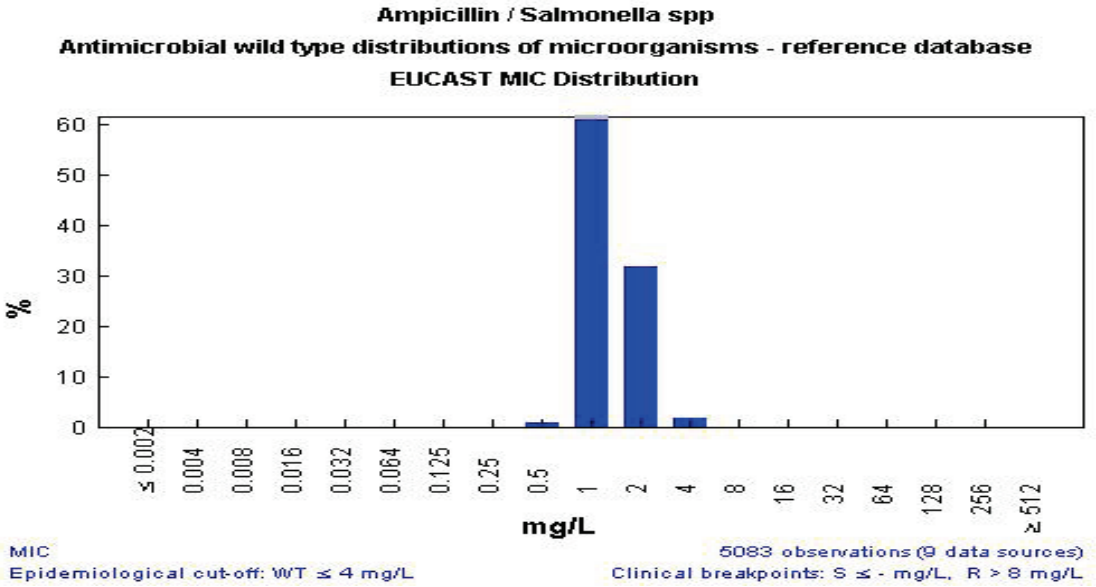
* The Etest is used to determine the on-scale Minimum Inhibitory Concentration (MIC) of antibiotics, antifungal agents and anti-mycobacterial agents

Ampicillin

Ampicillin susceptibility was tested accurately by 29 of the 31 participating laboratories. All strains harbouring a beta-lactamase were classified resistant by all participating laboratories. Four minor and four major deviating results were produced by two of the laboratories. Laboratory F33 determined high MIC values (> 256 mg/L) for all test strains including the ATCC 25922, most probably the result of some kind of contamination. Laboratory F29 classified the ampicillin susceptible isolates including ATCC 25922 as intermediate based on non-CLSI methodology and interpretive criteria.

The European committee on Antimicrobial Susceptibility Testing defined MIC values of the wild-type population for *Salmonella* as ≤ 4 mg/L (Figure 11) [7], which demonstrates that strains A1, A6, A7, A8 and ATCC25922 are truly ampicillin susceptible.

Figure 11: Ampicillin wild-type distribution of *Salmonella*



Cefotaxime

For this ring trial, two cefotaxime resistant strains were included in the panel. Strain A3 harboured an ESBL from the TEM family, probably bla_{TEM-20}, or bla_{TEM-52}, since these are common in both *E. coli* and *S.* Paratyphi B var. Java in broilers in the Netherlands. Strain A5 harboured a plasmid mediated ampC-type beta-lactamase, most probably bla_{CMY-2}. Both genes have been detected by micro array (Identibac), but have not been sequenced yet. All other isolates including those harbouring bla_{TEM-1} (A2, A9, A10) or bla_{PSE-1}(A4) were susceptible and showed low MIC values. Strain A10 is an isolate with a somewhat atypical cefotaxime phenotype. Minimal inhibition concentration values for both cefotaxime (1 mg/L) and ceftazidime (2 mg/L) are slightly higher than MIC values for the wild-type. However, this isolate only harbours bla_{TEM-1}. *S.* Saintpaul isolates with this specific phenotype have been observed previously in Germany and the Netherlands [8].

Strain A3 was highly resistant while the cefotaxime MIC value for strain A5 was more moderate in level. Using the classical CLSI breakpoints and criteria, strain A5 could be classified as S or I depending on the MIC determined or the zone diameters. However, using the CLSI criteria adapted for ESBL-detection (R ≥ 2 mg/L, or R ≤ 27 mm), all except one laboratory (F11) would have classified A5 as resistant.

If EUCAST breakpoints (R > 2 mg/L) or cut-off values (R > 0.5 mg/L) had been applied, strain A5 would also have adequately been classified as resistant. For disk diffusion, EUCAST does not yet provide interpretive criteria for *Salmonella*.

One laboratory misclassified A10 to be cefotaxime resistant.

In total for cefotaxime, four major and 10 minor deviating results were produced.

Because many laboratories used the classical CLSI breakpoints, there were many deviating results. Although the deviation can be explained, in this report they are recorded as minor or major deviations because of the importance of sensitive detection of the emerging plasmid mediated beta-lactamases in *Salmonella*. It can be concluded that the classical CLSI breakpoints and interpretive criteria are inadequate to detect bla_{CMY-2} in *Salmonella*. The specific criteria for ESBL-detection as provided by CLSI (Table 6) proved to be adequate and should preferably be used by all laboratories.

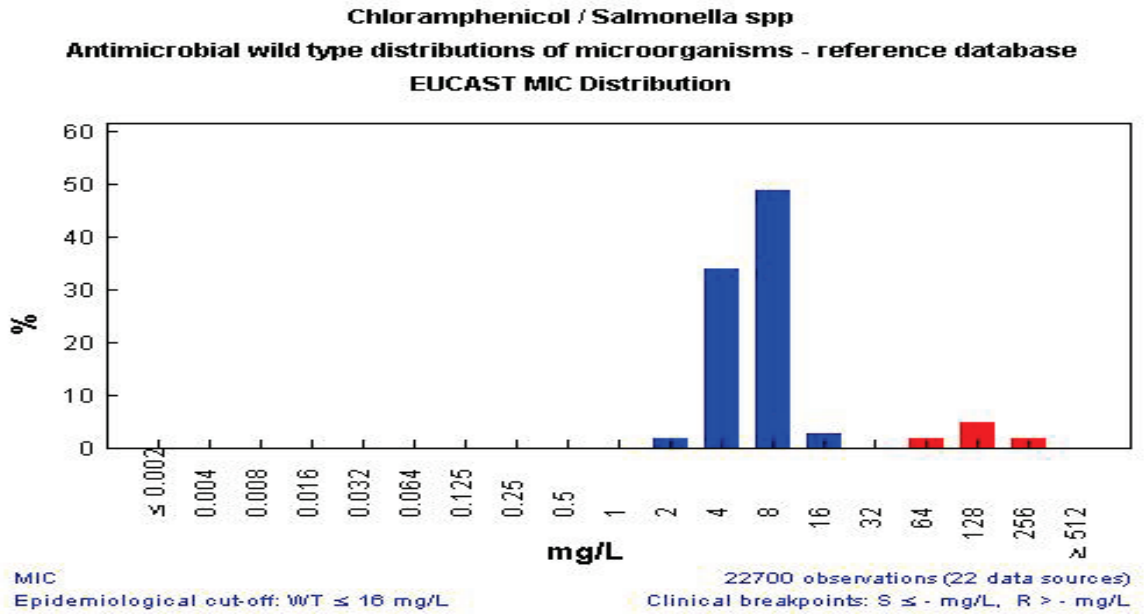
Chloramphenicol

Three chloramphenicol resistant strains were included in the panel. Strain A2 and A10 harboured the *cat4*-gene, strain A4 being *S.* Typhimurium DT104 harboured the *floR*-gene.

For the three resistant strains—A2, A4 and A10—only two deviating results were produced. One laboratory misclassified strain A2 as S due to an administrative error, since the zone diameter was correct. And one laboratory determined one major deviation on A10. The susceptible isolates (A1, A6, A7, A8, and A9) were all correctly classified.

For strains A3 and A5, repeatedly borderline MIC values (16 mg/L) were found with the international reference method (broth microdilution). No known chloramphenicol resistance genes were detected in these strains using the Identibac microarray platform. Using CLSI criteria, these isolates were classified as MIC intermediate. The EUCAST wild-type MIC value distribution of *Salmonella* for chloramphenicol indicates that strains with MIC values of 16 mg/L are part of the wild-type population. Therefore, more variation in the results of the laboratories could be expected.

Figure 12: Chloramphenicol wild-type distribution of *Salmonella*



Those laboratories that determined a MIC value of 16 mg/L for strains A3 and A5 will classify these isolates as S, I or R, depending on the different breakpoints or criteria used. Using disk diffusion assay most laboratories classified these isolates as S, based on CLSI criteria. The zone diameters determined for these two strains varied from 18–26 mm, with an average of 21 mm for both isolates. The average zone diameters for the susceptible isolates A1, A6, A7, A8, A9 and the ATCC strains varied from 24 to 28 mm, which indicates an intermediate phenotype for strains A3 and A5. Three laboratories classified one or both of these isolates as R. Two laboratories based this on non-CLSI criteria.

It is obvious that there is a discrepancy between CLSI interpretive criteria for MIC values and CLSI criteria for zone diameters. This leads to unnecessary deviations when comparing these results to reference values, which are disputable themselves. Therefore the deviations for A3 and A5 will not be included in the summary (Tables 27 and 28).

Ciprofloxacin

As mentioned earlier, many different breakpoints and interpretive criteria were used for ciprofloxacin, resulting in the fact that deviating results could not easily be quantified. Moreover, the interpretation of the reference MIC values with CLSI criteria showed that these criteria are not fully adequate. Strains A1, A2, A6 and A8, having reduced susceptibility (MIC value: 0.25–5 mg/L), were classified as S using these criteria. Strains A3, A4 and A5 with MIC values of 1–2 mg/L were classified as I.

Applying EUCAST breakpoints (S ≤ 0.5, R > 1 mg/L) would have provided similar results except for strain A5 which would have been classified as R instead of I. European committee on Antimicrobial Susceptibility Testing expert rules prescribe that all nalidixic-acid resistant *Salmonella*'s should be considered resistant to all fluoroquinolones. When epidemiological cut-off values would have been used, all isolates except strain A7 and A9 would have been classified as R.

For diagnostic laboratories, an adequate interpretation of susceptibility data should include advice for the clinician. For quinolones, the results of ciprofloxacin should be interpreted together with the results of nalidixic acid. All Nil-R *Salmonella* isolates should be classified ciprofloxacin R as well (EUCAST expert rule). Another option, applied by several participants, is for isolates with ciprofloxacin MIC values of 0.25–0.5 and high MIC values for nalidixic acid to classify them as Ciprofloxacin Reduced Susceptible/Nil R. This indicates the presence of a single point mutation and the expectation of reduced clinical efficacy. This way, these isolates are discriminated from high level ciprofloxacin R isolates.

Isolate A1 was a *qnr1*-positive *S.* Corvallis. This plasmid mediated quinolone resistance gene has been associated with *S.* Corvallis in several publications [9, 10]. The quinolone resistance phenotype, very typical for *nor*-genes, is ciprofloxacin MIC values of 0.25–0.5 mg/L (incidentally 1 mg/L), and nalidixic acid MIC values of 8–16 mg/L.

Laboratories that determined MIC values or used breakpoint concentrations of quinolones in agar plates are able to identify *nor*-suspected *Salmonella* isolates on their phenotypes. This is more complicated for disk diffusion because information on zone diameter distribution in relation to the quinolone resistance mechanism is lacking.

For the laboratories in this study that used CLSI methodology, the susceptible isolates (strains A7 and A9) had zone diameters ≥ 30 mm for ciprofloxacin. Reduced susceptible isolates (with MIC values of 0.25–0.5 mg/L) had zones that varied from 24–30 mm, and more resistant isolates (with MIC values of ≤ 1 mg/L) showed a zone of ≤ 24 mm.

Susceptible strains A7 and A9 were classified correctly by all laboratories. The reduced susceptible strains (A1, A2, A6, A8) and strains with MIC values of 1–2 mg/L were reported mostly as S and as I or R by some (eight). These results will not be included in the summary of the deviations in Tables 27 and 28.

Florfenicol

Florfenicol was tested only by three laboratories. Breakpoints and interpretive criteria are lacking for Enterobacteriaceae; only EUCAST provides epidemiological cut-off values for the wild-type, which were used to classify the isolates as S or R.

Florfenicol was included in this study for epidemiological interest because florfenicol resistance is a good indicator for the presence of *Salmonella* Genomic Island 1 (SGI1), which is present in *S.* Typhimurium DT104 and has spread to other serovars. An intermediate area has not been defined and therefore I classifications are currently inappropriate.

The three laboratories adequately classified strains A4 (*S.* Typhimurium DT104, *floR*-positive) as R.

Gentamicin

For gentamicin, two resistant isolates were included in the panel: strains A2 and A10.

Strain A2 was classified correctly by all laboratories. Strain A10, harbouring a gentamicin nucleotidyl transferase gene (ant2 or aid), was more problematic. Twelve laboratories classified this isolate as S and nine laboratories as I. The susceptible isolates were classified correctly by all laboratories except for one. Although that laboratory reported the correct MIC values, it misclassified the sensitive isolates as R.

Kanamycin

For kanamycin, three resistant strains were included: A2, A6 and A10. Of the susceptible strains (A1, A3, A4, A5, A7, A8, A9) and strains A2 and A6, only one deviating result was produced by one laboratory for A1. Again, strain A10 caused more problems. It was classified I by seven, and S by five laboratories.

Kanamycin is a somewhat difficult antibiotic to interpret because there is a large undefined area between the R and the S criteria: the CLSI R breakpoint for MIC values is ≥ 64 mg/L, and the R criteria for disk diffusion ≤ 13 mm (equals ≥ 25 mg/L), for which the criteria are far outside the wild-type populations. The wild-type population's susceptibility is ≤ 4 µg/ml for *Salmonella* (not yet publically available information at the EUCAST website), although the wild-type distribution is not defined yet. Results for strain A10 perfectly illustrate this problem. Obviously the CLSI criteria are not adequate at detecting all resistant isolates.

Nalidixic acid

For nalidixic acid, the highly resistant strains A2, A3, A4, A5, A6, A8, A10 and the susceptible A7 and A9 were classified correctly by all laboratories. Keeping in mind the EUCAST expert rule that all Nal-Resistant *Salmonella*'s should be considered as R to all fluoroquinolones, the results demonstrate that it is essential to include nalidixic acids in susceptibility test panels for this species.

Strain A1, the *qnrS1*-positive *S.* Corvallis, caused more problems. For this isolate, the nalidixic acid MIC value is slightly elevated, which resulted in zone diameters varying from 10–20 mm. Those zones were smaller than those of the susceptible strains A7 and A9. These reduced zone diameters in combination with reduced ciprofloxacin susceptibility can be used as indicator for the presence of *qnr*-genes.

For nalidixic acid, CLSI only provides criteria for an intermediate classification for disk diffusion, which means that all isolates classified as I will inevitably be considered a minor deviation of the reference MIC values. Six laboratories classified A1 as I, and six laboratories as R.

Neomycin

Neomycin is also a problematic antibiotic in ring trials because no CLSI clinical breakpoint criteria exist. Only epidemiological cut-off values are available from EUCAST. Therefore, not all laboratories were able to classify the strains based on the results. Those laboratories that did classify the isolates did this all in accordance with the reference values.

Streptomycin

In previous ring trials, much variation in results has been observed for streptomycin, especially for the isolates with moderate MIC values. In this study strains A2, A3, A4, A6, and A9 were high-level resistant, predominantly based on aadA1 and/or strA and B genes. A5 and A7 had deviating MIC values; A1 and A8 were fully susceptible.

Inclusion of streptomycin in the test panel is aimed at detection of *S.* Typhimurium DT104 and not for clinical purposes. Therefore an intermediate area is not necessary. This again will lead to minor deviations for those that use disk diffusion.

The susceptible isolates A1 and A8 were classified correctly by all laboratories. For the resistant isolates (A2, A3, A4, A5, A6, A7, A9, A10), more deviations were produced, partly because of different criteria used. Two laboratories recorded substantially larger zone diameters for strains A3–6 resulting in deviations compared to the reference value.

The breakpoint method used by F9 failed to identify most of the resistant isolates, which was probably also a breakpoint method related problem.

Sulphamethoxazole/trimethoprim

Despite the fact that sulphonamides and trimethoprim are difficult antibiotics in susceptibility tests because of the presence of antagonists in the broth or agar, for the majority of the isolates little deviating results were found. Strains are resistant to this combination of antibiotics if the isolate is resistant to both sulphonamides and trimethoprim, which applies for strains A2, A3, and A10. These strains were correctly classified by all laboratories. The susceptible isolates A1, A4, A6, A7, A8, A9 were also correctly classified except for three minor deviations for A4 (three laboratories). The isolate A5 is a *S.* Paratyphi B var. Java positive for *dfrA1* but negative for *sul*-genes and should therefore be susceptible. However, a wide variation in MIC values and zone diameters were recorded for this strain.

Sulphonamides

This is the only antibiotic for which the disk loads and the specific sulphonamide to be tested is not fully standardised. The Clinical and Laboratory Standards Institute prescribes criteria for sulfisoxazole, but states that other sulphonamides may be used as well. A disc load of 250–300 µg is advised. A variation in disk loads was also used by the participating laboratories. Still, the results were very good. Two laboratories produced three minor deviations, possibly the result of difficulties in interpretation of the end point of the measurement. One laboratory misclassified A4 as S instead of R.

Trimethoprim

Traditionally, trimethoprim causes little or no confusion when *Salmonella* strains are tested for susceptibility. Only two deviating results were produced. One laboratory classified resistant strain A10 as S and one laboratory misclassified the susceptible strain A4 as R.

5.4.3 Summary of antimicrobial susceptibility test results for EU/ EEA laboratories

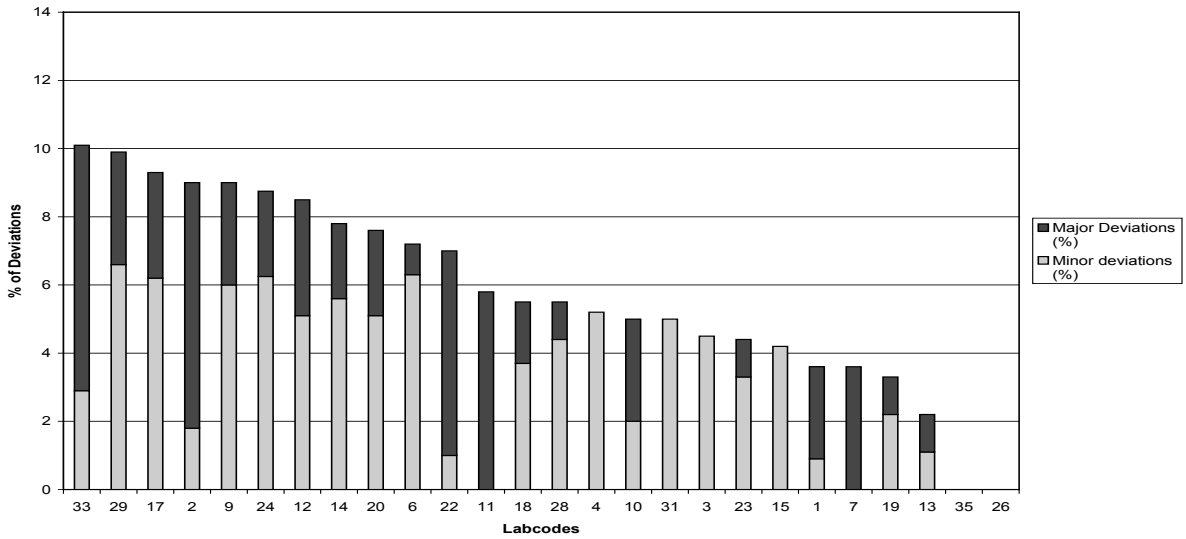
The numbers of deviating results are summarised in Table 27 and as percentages in Figure 13. Some results were excluded. Information on the excluded results is given in 5.4.4.

Table 27: Numbers of minor and major deviating results recorded for the EU and EEA laboratories

Lab code	No of tests	No of Minor deviations	No of Major Deviations	Lab code	No of tests	No of Minor deviations	No of Major Deviations
F1	109	1	2	**F18**	109	3	1
F2	109	1	5	**F19**	90	2	1
F3	109	3	0	**F20**	79	4	2
F4	79	4	0	**F22**	99	1	4

Lab code	No of tests	No of Minor deviations	No of Major Deviations	Lab code	No of tests	No of Minor deviations	No of Major Deviations
F6	109	4	1	**F23**	90	2	1
F7	109	0	2	**F24**	80	4	2
F9	100	4	2	**F26**	100	0	0
F10	98	1	2	**F28**	89	3	1
F11	69	0	4	**F29**	60	5	2
F12	59	4	2	**F31**	80	3	0
F13	90	1	1	**F33**	69	2	5
F14	89	4	2	**F35**	90	0	0
F15	119	3	0				
F17	129	4	2				

Figure 13: Percentages of minor and major deviations recorded for the EU and EEA laboratories



5.4.4 Summary of antimicrobial susceptibility test results for all participants

Certain isolate-antibiotic combinations used in this study were very complex and difficult to interpret. In addition, a wide variety in methods and interpretive criteria were used, resulting in a certain number of deviations. The most problematic isolates or antibiotics were excluded from this summary. The strains, antibiotics and their arguments are listed below:

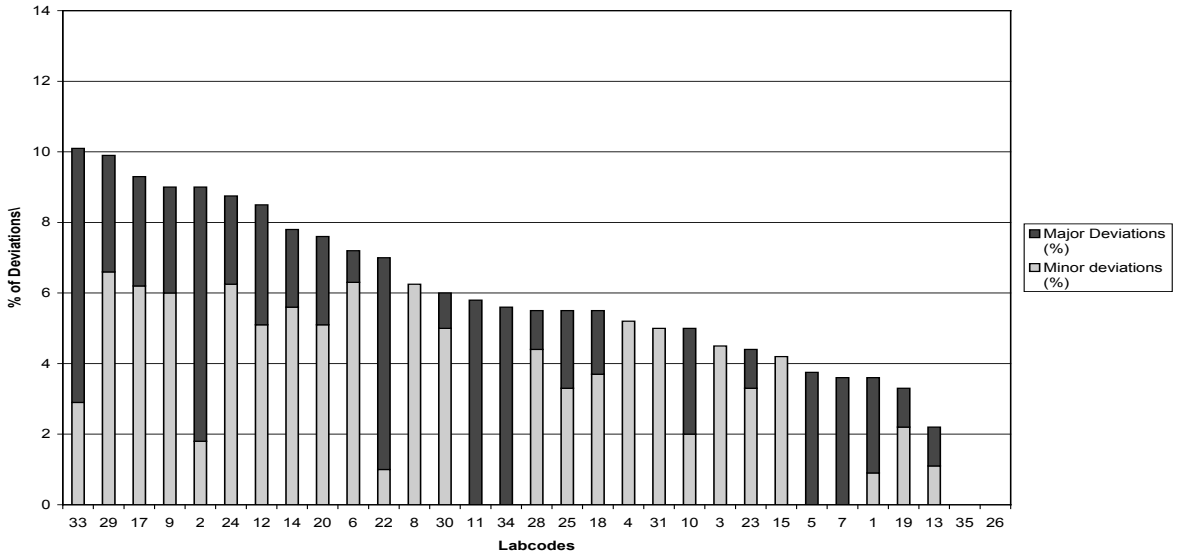
- **Strain A10, amoxicillin/clavanulate acid:** This isolate showed an atypical borderline susceptibility for this drug combination which resulted in many discrepancies in the results and was therefore excluded from this study.
- **Strain A3 and A5, chloramphenicol:** Both strains showed borderline susceptibility. Due to some discrepancy between CLSI interpretive criteria for MIC values and CLSI criteria for zone diameters, these strains were excluded.
- Results for **ciprofloxacin** were excluded because of inconsistent interpretive criteria.
- Results from laboratories that accurately determined the correct MIC value or inhibition zone diameter, but for unknown reasons incorrectly classified the organisms.

The numbers of deviating results are summarised in Table 28 and as percentages in Figure 14. In the summary of the results, all administrative errors were neglected. This includes laboratories that accurately determined the correct MIC or zone diameter, but for unknown reasons incorrectly classified the organisms.

Table 28: Numbers of minor and major deviating results recorded for all laboratories

Lab code	No of tests	No of Minor deviations	No of Major Deviations	Lab code	No of tests	No of Minor deviations	No of Major Deviations
F1	109	1	2	**F18**	109	3	1
F2	109	1	5	**F19**	90	2	1
F3	109	3	0	**F20**	79	4	2
F4	79	4	0	**F22**	99	1	4
F5	80	0	3	**F23**	90	2	1
F6	109	4	1	**F24**	80	4	2
F7	109	0	2	**F25**	89	2	2
F8	80	4	0	**F26**	100	0	0
F9	100	4	2	**F28**	89	3	1
F10	98	1	2	**F29**	60	5	2
F11	69	0	4	**F30**	99	3	1
F12	59	4	2	**F31**	80	3	0
F13	90	1	1	**F33**	69	2	5
F14	89	4	2	**F34**	89	0	4
F15	119	3	0	**F35**	90	0	0
F17	129	4	2				

Figure 14: Percentages of minor and major deviations recorded for all laboratories.



6 Discussion and conclusions

6.1 Serotyping

The majority of the laboratories did not have many problems with correctly serotyping the O-antigens.

When looking at the EU/EEA participants (28 laboratories), 75% typed all O-antigens correctly and 68% were able to correctly type all H-antigens. Fifty-seven per cent of the EU/EEA laboratories were able to assign the correct serovar names, which is comparable to the full group.

When looking at results of all participants, 26 out of the 34 participating laboratories (76%) typed all O-antigens correctly. Six laboratories showed difficulties with three different strains in having only partly correct results. Particularly, *S*. Seftenberg caused four laboratories problems for typing the O-antigens correctly.

The correct typing of the H-antigens is still the most frequently occurring problem. Twenty-four of the 34 participants (70%) typed all H-antigens correctly. Seven laboratories showed incorrect results (for six different strains). For four strains, the difficulties were caused by working with mixed sera resulting in problems with discrimination between O:6 and O:8 and O:22 or O:23 (two laboratories).

6.2 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 in London. In general, more problems were encountered when phage typing *S*. Typhimurium than with *S*. Enteritidis. Results of the EU/EEA laboratories are discussed per strain below.

Strains E1 and E6 were incorrectly phage typed by one laboratory. Strain E5 (PT 1b) was incorrectly phage typed as PT 4a by one laboratory. This was due to low or no phage reactions being obtained with some of the phages. This laboratory correctly phage typed the strain E10 (PT 1) which suggests their phages were correctly diluted. The inoculum size of the culture may have been incorrect when the phage typing was performed.

Only one of the *S*. Typhimurium strains, T12 (PT 36), was correctly phage typed by all the participating laboratories. The *S*. Typhimurium strain that caused most problems was T17 (PT 12a). All nine of the laboratories that incorrectly typed this strain called it PT 104. This was mainly due to no phage reaction being obtained with phages 21 and 27, which suggests the titres of these phages were too low. *S*. Typhimurium PT 208 (T11) was incorrectly typed as U302 by six laboratories. This was due to low or no phage reaction with additional phage 18.

Four laboratories incorrectly phage typed strain T13 (PT 104). One laboratory typed this strain as PT 110; they obtained the correct phage reactions but misinterpreted the results. One laboratory typed this strain as PT 18; they typed strain T14 (PT 18) as PT 104, suggesting these two strains had been incorrectly labelled when phage typing had been carried out. Two other laboratories typed this strain as U302. Both of these laboratories failed to obtain phage reactions with phages 12, 13 and 18. Focussing on the EU/EEA laboratories, only three laboratories incorrectly typed this strain as PT 110, PT 18, and PT U302.

Four laboratories incorrectly phage typed strain T14 (PT 18). None of these laboratories observed a phage reaction with phage 15. This phage gives opaque lysis and this can sometimes be difficult to see.

Strain T19 (PT 193) was incorrectly phage typed as PT 195 by three laboratories and PT 194 by one laboratory. Low or no phage reactions with additional phages 1 and 2 caused this strain to be called PT 195. The absence of a reaction with additional phages 1 and 3 caused one laboratory to type this strain as PT 194.

S. Typhimurium PT 2 (T15) was incorrectly typed as PT 46. This was due to a high reaction being obtained with phage 28; PT 2 does not react with this phage. Another laboratory typed this strain as PT 132. This was due to low phage reactions being obtained with phages 19 and 22. This strain was typed as PT 12 by one laboratory; they only obtained phage reactions with phages 12 and 13. They correctly typed T12 (PT 36), which reacts with all the phages, suggesting that they didn't have a problem with the titre of their phages.

Three laboratories incorrectly phage typed strain T20 (PT 12). Two laboratories had low or no phage reactions with phages 12 and 13. One laboratory obtained the correct phage reactions for this strain, but they have misinterpreted their results. Two laboratories phage typed strain T16 (PT U311) incorrectly. One laboratory observed phage reactions with additional phages 10 and 10 var 2; these phages do not react with this phage type. The other obtained the correct phage reactions, but they have misinterpreted the results.

The two laboratories that incorrectly typed strain T18 (PT 136) had the correct phage reactions, but have misinterpreted their results.

Only 25% of the laboratories correctly phage typed all *S*. Enteritidis strains, and 13% correctly phage typed all *S*. Typhimurium strains. Looking at the overall score for all tested strains, the results for the phage typing of *S*. Enteritidis were good, with 89% of the strains being correctly typed. There were more incorrect results in the phage typing of the *S*. Typhimurium strains. Overall, 80% of the *S*. Typhimurium strains were typed correctly. The EU/EEA laboratories results were comparable to results of the full group of participants. Phage typing of *S*. Enteritidis was correct for 88% of the strains. For *S*. Typhimurium, the phage typing was correct for 79% of the strains.

6.3 Antimicrobial susceptibility testing

In this study, the susceptibility of 10 *Salmonella* strains was tested to a panel of fourteen antibiotics. The participating laboratories were asked to use their standard method for susceptibility testing, resulting in a variety of methods: broth microdilution (MIC) test; breakpoint-MIC determination with antibiotics dissolved in agar; MIC values obtained with E-test; and automated methods and disk diffusion test. Other important sources of variation in the results included the wide variety in interpretive criteria used (CSLI, local guidelines, EUCAST, epidemiological cut-off values).

Within the food and animal sector in the EU, antimicrobial resistance surveillance of *Salmonella* has been harmonised with broth microdilution prescribed by EFSA as the standard method and EUCAST epidemiological cut-off values as breakpoints. Choosing cut-off values instead of clinical breakpoints has had a significant harmonising effect on the results in this field. However, interpretation of classifications based on cut-off values needs to be done carefully since resistance based on these values may not always indicate clinical resistance. On the human side of *Salmonella* antimicrobial resistance surveillance, this EU harmonisation is still ongoing, with EUCAST developing criteria for both clinical breakpoints and epidemiological cut-off values.

For laboratories that determine zone diameters by disk diffusion, the use of epidemiological cut-off values is not yet currently possible. The European committee on Antimicrobial Susceptibility Testing is currently working on a standard disk diffusion test including wild-type zone diameter distributions. In this ring trial, many different methods were used so only CLSI criteria could be used to determine the reference values. The results show that CLSI criteria are not always adequate and up-to-date (e.g., ciprofloxacin, cefotaxime, streptomycin).

The two laboratories that scored no deviations used either broth microdilution or a breakpoint method. In this study, broth microdilution was not better in quality than disk diffusion. Part of the deviations, made when using disk diffusion, was caused by differences in interpretive criteria for MIC and zone diameters.

Along with the qualitative analysis of the numbers of deviations recorded, each laboratory should carefully compare its results (MIC values or inhibition zones) with those produced by others using identical methods. This will provide detailed information about systematic or incidental differences in methodologies resulting in errors or deviations.

If a quality limit of 90% accuracy is used, all laboratories would have been approved. However, studying the results in more detail shows that, in spite of lengthily international discussions about the necessity of standardisation, this has certainly not yet been achieved by the participating laboratories.

The current discussion on 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 a very important step towards the standardisation and harmonisation of results.

References

1) Grimont PAD, Weill FX, WHO Collaborating Centre for Reference and Research on *Salmonella*. Antigenic formulae of the *Salmonella* serovars. Institut Pasteur, Paris. Available here: http://www.scacm.org/divc/Antigenic%20Formulae%20of%20the%20Salmonella%20Serovars%202007%209th%20edition.pdf

2) Anonymous. Clinical laboratory testing and in vitro diagnostic test systems -- Susceptibility testing of infectious agents and evaluation of performance of antimicrobial susceptibility test devices -- Part 1: Reference method for testing the in vitro activity of antimicrobial agents against rapidly growing aerobic bacteria involved in infectious diseases. International organisation for standardisation, Geneva, Switzerland 2006. ISO 20776-1

3) CLSI/NCCLS M31A3; Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacterial Isolated from Animals; Approved Standard 2008, Clinical and Laboratory Standards Institute

4) Clinical and Laboratory Standards Institute. 2007. Performance standards for antimicrobial susceptibility testing; 17th informational supplement. M100-S17. Wayne, PA.

5) Report of the Task Force of Zoonoses Data Collection including a proposal for a harmonized monitoring scheme of antimicrobial resistance in *Salmonella* in fowl (Gallus gallus), turkeys, and pigs and Campylobacter jejuni and C. coli in broilers, the EFSA Journal (2007), 96, 1–46. Available here: http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753816_1178620761886.htm

6) Report from the Task Force on Zoonoses Data Collection including guidance for harmonized monitoring and reporting of antimicrobial resistance in commensal Escherichia coli and Enterococcus spp. from food animals. The EFSA Journal (2008) 141: 1–44. Available here: http://www.efsa.europa.eu/en/scdocs/scdoc/141r.htm

7) The European Committee on Antimicrobial Susceptibility Testing - EUCAST clinical-breakpoints. http://www.eucast.org/. (6-11-2009)

8) Beutlich J, Rodríguez I, Schroeter A, Käsbohrer A, Helmuth R, Guerra B. A predominant multidrug-resistant Salmonella enterica serovar Saintpaul clonal line in German turkey and related food products. Appl Environ Microbiol. 2010 Jun;76(11):3657-67. Epub 2010 Apr 2

9) García-Fernández A, Fortini D, Veldman K, Mevius D, Carattoli A. Characterization of plasmids harbouring qnrS1, qnrB2 and qnrB19 genes in Salmonella. J Antimicrob Chemother. 2009 Feb; 63(2):274–81. Epub 2008 Nov

10) Cavaco LM, Hendriksen RS, Aarestrup FM. Plasmid-mediated quinolone resistance determinant qnrS1 detected in Salmonella enterica serovar Corvallis strains isolated in Denmark and Thailand. J Antimicrob Chemother. 2007 Sep;60(3):704–6. Epub 2007 Jul 16.

Annex 1. List of Participants

Participating laboratories from EU and 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 for Public Health Praha
Denmark	Statens Serum Institute Copenhagen
Estonia	Health Protection Inspectorate Tallinn
Finland	National Institute for Health and Welfare Helsinki
France	Insitut Pasteur Paris Paris
Germany	Robert Koch Institute, Wernigerode Branch Wernigerode
Greece	National School of Public Health Athens
Hungary	National Centre for Epidemiology Hungary
Iceland	Landspitali University Hospital, Dept. of Clinical Microbiology Reykjavik
Ireland	Galway UH, Medical Microbiology Department Galway
Italy	Istituto Superiore de Sanità Rome
Latvia	Infectology Center of Latvia Riga
Lithuania	Natinal Public Health Survice Laboratory Vilnius
Luxembourg	Laboratoire National de Santé Luxembourg
Malta	Mater Dei Hospital, Pathology Department Malta
the Netherlands	National Institute for Public Health and the Environment Bilthoven/CVI-Lelystad
Norway	Norwegian Institute of Public Health Oslo
Poland	National Institute of Public Health, National Institute of Hygiene Warsaw
Portugal	Instituto Nacional de Saúde Dr. Ricardo Jorge Lisboa
Romania	National Institute of Research-Development for Microbiology and Immunology Cantacuzino Bucharestt

Country	Institute/City
Slovak Republic	Public Health Authority of the Slovak Republic Bratislava
Slovenia	Institute of Public Health of the Republic of Slovenia Ljubljana
Spain	Instituo de Salud Carlos III Madrid
Sweden	Smittskyddsinstitutet (SMI) Solna
United Kingdom – England	Health Protection Agency 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	Public Health Agency of Canada 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	Luzerner Kantonsspital, Institute Medical Microbiology Luzern

Annex 2. Protocol

Protocol of the EQA scheme (March 2009) on serotyping, phage typing and antimicrobial susceptibility typing of *Salmonella* strains

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 Prevention and Control (ECDC). The study is organised by the laboratory for Zoonoses and Environmental Microbiology (LZO) of the National Institute for Public Health and the Environment (RIVM, Bilthoven, the Netherlands) in close cooperation with the Health Protection Agency (HPA, London, United Kingdom) and the Central Veterinary Institute of Wageningen UR (CVI), Department of Bacteriology and TSEs (Lelystad, the Netherlands).

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

The study will take place in week 10 (starting on 2 March 2009) or one week earlier or later. The timetable can be found on the last page of this protocol. All data will be reported in the test report, sent to RIVM and will be used for analysis.

Transportation of the *Salmonella* strains to the NRLs-*Salmonella*

RIVM will mail the strains for every part of the study in a different parcel. The strains will be sent as diagnostic specimens with a door-to-door courier to your laboratory.

Serotyping

A total number of 20 *Salmonella* strains (numbered S-1 till S-20), supplied by RIVM, 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 incorrect results.

The results will be evaluated by RIVM. 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 according to Table 1.

Table 1: Guidelines for evaluation

Results	Evaluation	Abbreviation
Autoagglutination 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	-

Phagetyping

The laboratories will receive a parcel containing 20 *Salmonella* cultures for phage typing:

- 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 Elizabeth de Pinna, HPA, London, UK.

Antimicrobial susceptibility testing

The laboratories will receive 10 *Salmonella* strains (different from the ones used for sero- and phage typing) and one control strain (*E. coli* ATCC 25922) for antimicrobial susceptibility testing. The 10 strains are numbered from A-

1 till A-10 and are to be tested according to ISO 20776-1-2006 or CLSI guidelines with one of the following methods: agar or broth microdilution (or Etest) or disk diffusion.

The strains should be tested against the following antibiotics:

- Amoxicillin and clavalunate (30 µg)
- Ampicillin (10 µg),
- Cefotaxime (30 µg),
- Chloramphenicol (30 µg),
- Ciprofloxacin (5 µg),
- Florfenicol (30 µg),
- Gentamicin (10 µg),
- Kanamycin (30 µg),
- Nalidixic Acid (30 µg),
- Neomycin (30 µg),
- Streptomycin (10 µg),
- Sulphamethoxazole and trimethoprim (23,75 + 1,25 µg),
- Sulphonamide (eg sulfoxizole),
- Trimethoprim (5 µg).

The numbers between brackets are the required concentrations of antibiotics in the disks. If dilution methods or E-test are used to determine MIC values, the same antibiotics should be tested. If you do not have disks with the specified amount please omit this antibiotic from your list.

The evaluation of the antimicrobial susceptibility testing will be done in collaboration with Prof. Dr. Dik Mevius, head of the Dutch National Reference Laboratory on Antimicrobial Resistance, Central Veterinary Institute, Lelystad, the Netherlands.

If you have questions or remarks about the inter-laboratory comparison study, please contact:

Kirsten Mooijman
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3720 BA Bilthoven
tel. number: +31-30-2744712
fax. number: +31-30-2744434
e-mail: Kirsten.Mooijman@rivm

Table 2: Timetable of the EQA SCHEME (March 2009) on serotyping, phage typing and antimicrobial susceptibility testing of *Salmonella* spp. for FWD network laboratories

Week	Date	Topic
4	26 – 30 January	Mailing of the protocol and test report 2009
8	16 – 20 February	Mailing of the parcels to the participants as diagnostic specimens by door-to-door courier service. After arrival at the laboratory the strains need to be subcultured and stored until the performance of the typing. **If you did not receive the parcel at 20 February, do contact the RIVM immediately.**
10	2 – 6 March	Starting with the identification of the strains.
12	16 – 20 March	Send the completed test report by email to the RIVM. If the test report is e-mailed to the RIVM it is not longer necessary to sent the original test report as well, unless it is not legible (to be indicated by the RIVM). **Deadline: 20 March 2009**
13	23 – 27 March and onwards	Data input at the RIVM and sending these data by the RIVM to EnterNet laboratories by email for checking. Checking the results by the participants and they will inform the RIVM whether their results are correct. If the RIVM does not receive a reaction within one week after receipt of this email the RIVM will consider the results as correct.

Annex 3. Test report

EQA scheme (March 2009) on serotyping, phage typing and antimicrobial susceptibility typing of *Salmonella* strains

Laboratory code	
Name contact person	
Email address contact person	
Name of laboratory	
Name department and/or institute	
Address	
Country	

Please write your remarks and comments on page 13 of the test report

General questions

Shipment of serotyping and phagetyping strains	
Was your parcel damaged at arrival?	☐ NO ☐ YES
Date of receipt at your laboratory	

Subculturing	
Medium used for subculturing the strains	Name Manufacturer

Remarks concerning the tables for serotyping:

Two extra tables are added to this test report, to give the RIVM more information about the antisera used. The tables on page 4 and 5 concern reactions obtained with O-antisera and the tables on pages 6 and 7 with H-antisera. On the bottom of the table there is space 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. For every combination of strain and antisera you indicate if there was agglutination (+) or not (-). If the cell remains empty this indicates that the agglutination was not determined for the specific combination of antisera and strain.

Questions: Serotyping

What was the frequency of serotyping of *Salmonella* at your laboratory in 2007?	□ Daily □ Once a week □ Twice a week □ Thrice a week □ Weekly □ Monthly
How many *Salmonella* strains did your laboratory serotype in 2007?	Number of strains
How many of these typings considered a rough strain?	Number of rough strains
What kind of sera do you use?	□ Prepared in own laboratory □ Commercial sera Manufacturer(s):
The strains in this collaborative study were serotyped by:	□ Own laboratory, Strain □ Other laboratory, namely Strains:

		Strains									
O-antisera	**Manufacturer**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
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											
Group D											
9											
9, 12											
1, 9, 12											
12											
9, 46											
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											
10											
15											
1, 3, 19											
19											
Other O-antisera											

		Strains									
O-antisera	**Manufacturer**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
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											
Group D											
9											
9, 12											
1, 9, 12											
12											
9, 46											
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											
10											
15											
1, 3, 19											
19											
Other O-antisera											

		Strains									
H-antisera	**Manufacturer**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
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											
S											
Q											
T											
q, s, t, p, u											
I											
K											
L (complex)											
l, v											
l, w											
V											
W											
R											
Y											
Z											
z_{10}											
1 (complex)											
2											
5											
6											
7											

		Strains									
H-antisera	Manufacturer	11	12	13	14	15	16	17	18	19	20
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											
S											
Q											
T											
q, s, t, p, u											
I											
K											
L (complex)											
l, v											
l, w											
V											
W											
R											
Y											
Z											
z_{10}											
1 (complex)											
2											
5											
6											
7											

Test results: Serotyping

Labcode	
Starting date of serotyping	
Finishing date of serotyping	

Strain no.	O-antigens detected	H-antigens detected	Serovar
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 of the following strains?	☐ *S.* Typhimurium ☐ *S.* Enteritidis ☐ Other(s):
Which typing system is used for:	☐ *S.* Typhimurium ..... ☐ *S.* Enteritidis .....
How many strains did your laboratory phage type in 2007?	Number of strains.....

Test results: phage typing

Labcode	
Starting date of typing	
Finishing date of typing	

Phages reactions at Routine Test Dilution (*S.*Enteritidis)																		
QA 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

Labcode	
Starting date of phagetyping	
Finishing date of phagetyping	

Phages at Routine Test Dilution (*S.* Typhimurium)																		
QA number	Phage type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
T11																			
T12																			
T13																			
T14																			
T15																			
T16																			
T17																			
T18																			
T19																			
T20																			

		Phages at Routine Test Dilution (*S.* Typhimurium)												Additional phages						
QA 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**
T11																				
T12																				
T13																				
T14																				
T15																				
T16																				
T17																				
T18																				
T19																				
T20																				

O*: O pooled
(<)CL: clear lysis
(<)OL: opaque lysis
SCL: semi confluent lysis
<< : Merging plaques towards semi-confluent lysis

Question: Antimicrobial susceptibility testing (AST)

Do you use a standard method for susceptibility testing, eg CLSI)	Disk:
	MIC:
Which control strain(s) do you use?	Disk:
	MIC:
What is the concentration of the inoculum in bacteria per ml?	Disk:
	MIC:
How many strains were tested for susceptibility in your lab in 2007?	

Which antibiotics did you use in this collaborative study?					
Antibiotic	**Abbreviation**	**Disk load (µg)**	**Manufacturer**	**Breakpoints/ interpretive criteria used (R/I/S)**	**Range used in MIC determination**
Amox/clavulanate	AMC				
Ampicillin	AMP				
Cefotaxime	CEF				
Chloramphenicol	CHL				
Ciprofloxacin	CIP				
Florfenicol	FLO				
Gentamicin	GEN				
Kanamycin	KAN				
Nalidixic Acid	NAL				
Neomycin	NEO				
Streptomycin	STR				
Sulfamethoxazole + Trimethoprim	SXT				
Sulphonamide	SUL				
Trimethoprim	TMP				

Results: Antimicrobial susceptibility testing (AST)

Labcode	
Starting date of AST	
Finishing date of AST	

Please fill in the diameter of the inhibition zones in mm if your method is disk diffusion and the MIC-value in mg/L if your method of choice is the Minimal Inhibition Concentration and include your interpretation according to your criteria between brackets (R, I, or S).

Antibiotic	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8	A-9	A-10	ATCC 25922
AMC											
AMP											
CEF											
CHL											
CIP											
ENR											
FLO											
GEN											
KAN											
NAL											
NEO											
STR											
SXT											
TMP											

Results and comments

Name of person(s) carrying out the typing	
Date and signature	

Name of person in charge	
Date and signature	

Annex 4: Test results of serotyping per strain for all laboratories

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
CRL	**Paratyphi B var. Java**	**Dublin**	**Mbandaka**	**Give**	**Plymouth**	**Senftenberg**	**Heidelberg**	**Virchow**	**Hadar**	**Infantis**
F1	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F2	Paratyphi B var. Java	Dublin	Jerusalem	Give	Sontheim	Westhampton	Heidelberg	Virchow	Hadar	Infantis
F3	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F4	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F5	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F6	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F7	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F8	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F9	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F10	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F11	Paratyphi B var. Java	Dublin	Thompson	London	Typhi	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F12	Paratyphi B var. Java	Dublin	Not Typable	Mokola	Plymouth	Senftenberg	Heidelberg	Virchow	Not Typable	Infantis
F13	Paratyphi B var. Java	Dublin	S. Mikawasima	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F14	Hull	Dublin	Mbandaka	Give	Zega	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F15	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F16	Paratyphi B var. Java	Dublin	Not Typable	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F17	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Cleveland	Infantis
F18	Paratyphi B var. Java	Dublin	Mbandaka	Give	Not Typable	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F19	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F20	Paratyphi B var. Java	Dublin	Not Typable	Give	Zega	Westhampton	Heidelberg	Virchow	Istanbul/Hadar	Infantis
F22	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Kingston	Heidelberg	Virchow	Hadar	Infantis
F23	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
F24	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F25	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F26	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F27	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F28	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Kingston	Heidelberg	Virchow	Hadar	Infantis
F29	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F30	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F31	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F33	Paratyphi B var. Java	Dublin	Mbandaka	London	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F32	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F34	Paratyphi B	Dublin	Not Typable	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis
F35	Paratyphi B var. Java	Dublin	Mbandaka	Give	Plymouth	Senftenberg	Heidelberg	Virchow	Hadar	Infantis

	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
CRL	**Enteritidis**	**Kottbus**	**Coeln**	**Brandenburg**	**Typhimurium**	**Bredeney**	**Blockley**	**Colindale**	**Derby**	**Worthington**
F1	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F2	Enteritidis	Tshiongwe	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Poona
F3	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F4	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F5	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Not Typable	Colindale	Derby	Worthington
F6	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F7	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F8	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F9	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F10	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F11	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Zerifin	Colindale	Essen	Worthington
F12	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Kallo	Colindale	Derby	Not Typable
F13	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F14	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F15	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F16	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F17	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F18	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F19	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F20	Enteritidis	Ferruch/Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Haardt/Blockley	Salmonella spp.	Derby	Salmonella spp.
F22	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F23	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F24	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F25	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F26	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F27	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F28	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F29	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F30	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F31	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F32	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F33	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F34	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington
F35	Enteritidis	Kottbus	Coeln	Brandenburg	Typhimurium	Bredeney	Blockley	Colindale	Derby	Worthington

Annex 5. Test results of phage typing per strain for all laboratories

Strain E1		Phages 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	14b	-	-	-	+	-	SCL	-	-	+	-	-	-	-	-	-	-	OL
F1	14b	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	+++
F2	13	-	-	-	++	-	SCL	-	-	++	-	-	-	-	-	-	-	SCL
F4	14b	-	-	-	2	-	<SCL	-	-	++	-	-	-	-	-	-	-	<SCL
F5	14b	-	-	-	-	-	SCL	-	±	-	-	-	-	-	-	/	-	OL
F6	14b	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	<<
F7	14b	-	-	-	-	-	SCL	-	-	+	-	-	-	-	-	-	-	OL
F8	6a	-	+	-	OL	-	OL	-	-	OL	-	-	-	-	-	-	-	OL
F13	14b	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+
F14	14b	-	-	-	-	-	<CL	-	-	-	-	-	-	-	-	-	-	<SCL
F17	14b	-	-	-	4	-	SCL	-	-	1	-	-	-	-	-	/	-	SCL
F19	14b	-	-	-	-	-	+++	-	-	-	-	-	-	-	-	-	-	<OL
F23	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	<OL
F24	14b	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	SCL
F25	14b	-	-	-	2	-	OL	-	-	-	-	-	-	-	-	-	-	OL
F26	14b	-	-	-	±	-	SCL	-	-	-	-	-	-	-	-	-	-	OL
F27	14b	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	OL
F29	14b	-	-	-	3	-	OL	-	-	3	-	-	-	-	-	-	-	OL
F31	14b	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	-	<SCL
F32	14b	-	-	-	±	-	SCL	-	-	±	-	-	-	-	-	-	-	<OL
F35	14b	-	-	-	-	-	+	-	-	-	-	-	-	-	--	-	-	OL

Strain E2		Phages 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	-	<OL	-	OL	<OL	OL	-	-	-	-	-	-	<OL
F1	6	-	+++	-	+++	-	SCL	-	OL	++	+++	-	-	-	-	-	-	+++
F2	6	-	SCL	-	OL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	SCL
F4	6	-	<SCL	-	<SCL	-	<SCL	-	OL	SCL	SCL	-	-	-	-	-	-	<SCL
F5	6	-	<SCL	-	<SCL	-	<SCL	±	OL	<SCL	OL	-	-	-	-	/	-	SCL
F6	6	-	<<	-	<<	-	SCL	-	SCL	<<	SCL	-	-	-	-	-	<<	<<
F7	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	OL
F8	6	-	+++	-	OL	-	OL	-	OL	OL	OL	-	-	-	-	-	-	OL
F13	6	-	++	-	+	-	+	-	OL	-	++	-	-	-	-	-	-	-
F14	6	-	+++	-	±	-	SCL	-	OL	SCL	OL	-	-	-	-	-	-	SCL
F17	6	-	SCL	-	SCL	-	SCL	-	-	<OL	<OL	-	-	-	-	/	-	+++
F19	6	-	+++	-	+++	-	+++	-	+++	<OL	+++	-	-	-	-	-	-	OL
F23	6	-	+++	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL
F24	6	-	<CL	-	<<	-	SCL	-	OL	SCL	SCL	-	-	-	-	-	-	SCL
F25	6	-	OL	-	<OL	-	OL	-	OL	<OL	OL	-	-	-	-	-	-	OL
F26	6	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	-	<OL
F27	6	-	CL	-	OL	-	SCL	-	SCL	OL	OL	-	-	-	-	-	-	OL
F29	6	3	++	-	+++	-	OL	-	OL	SCL	OL	-	-	-	1	-	1	OL
F31	6	-	+++	-	+++	-	<SCL	-	OL	+++	OL	-	-	-	-	-	-	+++
F32	6	-	SCL	-	<OL	-	SCL	-	OL	SCL	OL	-	-	-	-	-	-	<OL
F35	6	-	+	-	+	-	+	-	OL	OL	OL	-	-	-	-	-	-	OL

Strain E3		Phages 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	60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	CL	CL	CL	-	-	-
F1	60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	CL	CL	CL	±	±	-
F2	60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	CL	CL	CL	+	+	-
F4	60	OL	-	SCL	-	<SCL	<SCL	-	OL	-	SCL	-	SCL	SCL	SCL	-	-	-
F5	60	OL	-	CL	-	CL	SCL	±	OL	-	OL	±	CL	CL	CL	/	+	-
F6	?	SCL	-	SCL	-	SCL	SCL	-	SCL	-	SCL	-	SCL	SCL	SCL	<<	SCL	-
F7	60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	OL	OL	OL	-	-	-
F8	60	OL	-	SCL	-	CL	OL	-	OL	-	OL	-	CL	CL	CL	-	-	-
F13	60	+++	-	+++	-	+++	-	-	OL	-	++	-	CL	++	++	-	-	-
F14	60	OL	-	CL	-	CL	SCL	3	OL	-	OL	-	CL	CL	CL	-	2	-
F17	60	<OL	-	CL	-	CL	OL	-	-	-	+++	-	CL	CL	CL	/	-	-
F19	60	+++	-	<CL	-	CL	+++	-	SCL	-	+++	-	CL	CL	CL	-	-	-
F23	60	OL	-	CL	-	CL	+++	-	SCL	-	OL.	±	CL	CL	OL	-	-	-
F24	60	OL	-	<<	-	CL	SCL	-	OL	-	SCL	-	CL	CL	CL	-	-	-
F25	60	OL	-	<CL	-	<CL	SCL	-	OL	-	OL	-	<CL	<CL	SCL	±	+	-
F26	20	OL	-	CL	-	CL	-	+	OL	-	OL	+	CL	-	CL	SCL	CL	-
F27	60	OL	-	CL	-	CL	SCL	-	SCL	-	OL	-	CL	CL	CL	-	-	-
F29	60	OL	-	CL	-	CL	OL	-	OL	-	OL	-	CL	CL	CL	±	++	-
F31	60	OL	-	SCL	-	CL	<SCL	-	OL	-	OL	-	CL	+++	CL	±	+++	-
F32	60	OL	-	CL	-	CL	SCL	-	OL	-	OL	-	CL	CL	CL	-	-	-
F35	60	OL	-	CL	-	CL	+	-	OL	-	OL	+	CL	CL	CL	-	-	-

Strain E4		Phages 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	47	-	SCL	-	-	-	<OL	-	-	-	-	-	-	-	CL	-	-	-
F1	47	-	+++	-	-	-	SCL	-	-	-	-	-	-	-	OL	-	-	-
F2	47	-	SCL	-	-	-	+++	-	-	±	-	-	-	-	CL	-	-	-
F4	47	-	+++	-	-	-	<SCL	-	-	-	-	-	-	-	SCL	-	-	-
F5	47	-	SCL	-	-	-	<SCL	-	-	-	-	-	-	-	SCL	/	-	±
F6	47	-	<<	-	-	-	SCL	-	-	-	-	-	-	-	SCL	-	-	-
F7	47	-	+++	-	-	-	SCL	-	-	-	-	-	-	-	OL	-	-	-
F8	47	-	+++	-	-	-	OL	-	-	-	-	-	-	-	CL	-	-	-
F13	47	-	++	-	-	-	+	-	-	-	-	-	-	-	++	-	-	-
F14	47	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	CL	-	-	-
F17	47	-	SCL	-	-	-	SCL	-	-	1	-	-	-	-	OL	/	-	-
F19	47	-	+++	-	-	-	+++	-	-	-	-	-	-	-	<CL	-	-	-
F23	47	-	+++	-	-	-	<SCL	-	-	-	-	-	-	-	<OL	-	-	-
F24	47	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	CL	-	-	-
F25	47	-	OL	-	-	-	OL	-	-	-	-	-	-	-	OL	-	-	-
F26	47	-	SCL	-	-	-	SCL	-	-	-	-	-	-	-	OL	-	-	-
F27	47	-	CL	-	-	-	SCL	-	-	-	-	-	-	-	OL	-	-	-
F29	47	-	+++	-	-	-	OL	-	-	-	-	-	-	-	CL	-	-	-
F31	47	-	+++	-	-	-	SCL	-	-	-	-	-	-	-	CL	-	-	-
F32	47	-	<CL	-	+	±	SCL	-	-	-	-	-	-	-	OL	-	-	-
F35	47	-	+	-	-	-	+	-	-	-	-	-	-	-	CL	-	-	±

Strain E5		Phages 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	<OL	<CL	OL	<OL	<OL	CL	CL	CL	CL	SCL	CL	<OL
F1	4a	-	+++	CL	+++	CL	SCL	CL	-	++	-	CL	CL	CL	-	+	+	+++
F2	1b	OL	SCL	CL	OL	CL	<SCL	CL	OL	OL	OL	CL	CL	CL	CL	CL	OL	OL
F4	1b	SCL	<SCL	<CL	<SCL	<CL	<SCL	SCL	SCL	<SCL	SCL	SCL	<CL	SCL	SCL	SCL	SCL	<SCL
F5	1b	OL	SCL	CL	SCL	CL	SCL	<CL	OL	SCL	<CL	CL	CL	CL	CL	/	CL	SCL
F6	1b	<<	<<	CL	<<	CL	SCL	CL	SCL	<<	<<	CL	CL	CL	SCL	CL	CL	<<
F7	1b	OL	SCL	CL	OL	CL	SCL	CL	OL	OL	OL	OL	CL	CL	CL	OL	OL	OL
F8	1b	OL	+++	CL	OL	CL	OL	+	OL	OL	OL	CL	CL	CL	CL	CL	CL	CL
F13	1b	OL	+++	SCL	+++	SCL	+	<SCL	OL	+	++	SCL	SCL	SCL	++	SCL	SCL	+
F14	1b	OL	+++	CL	+	CL	SCL	<CL	SCL	+++	<CL	CL	CL	CL	CL	CL	< CL	+++
F17	1b	<OL	+++	CL	<OL	CL	SCL	CL	-	<OL	+++	CL	CL	CL	SCL	/	+++	+++
F19	1b	+++	+++	CL	<OL	CL	+++	CL	+++	+++	+++	CL	CL	CL	SCL	<SCL	<SCL	OL
F23	1b	OL	SCL	CL	OL	CL	SCL	CL	SOL	<OL	<OL	<CL	CL	CL	CL	SCL	SCL	<OL
F24	1b	OL	SCL	<CL	OL	CL	SCL	CL	SCL	OL	<<	SCL	CL	CL	CL	<<	CL	OL
F25	1b	OL	OL	OL	OL	OL	OL	OL	OL	<OL	<OL	OL	OL	OL	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	SCL	OL	OL	CL	CL	CL	CL	SCL	SCL	OL
F29	1b	OL	++	CL	+++	CL	OL	SCL	OL	+++	OL	CL	CL	CL	CL	SCL	SCL	OL
F31	1b	<SCL	+++	CL	+++	CL	SCL	SCL	OL	+++	+++	SCL	CL	+++	CL	+	SCL	+++
F32	1b	<OL	SCL	<CL	<OL	CL	SCL	CL	OL	SCL	<OL	<CL	CL	CL	CL	<CL	CL	<OL
F35	1b	OL	+	CL	+	CL	+	CL	OL	OL	OL	CL	CL	CL	SCL	CL	CL	OL

Strain E6		Phages reactions at routine test dilution (*S.* Enteritidis)																
Labcode	Phage type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
HPA	8	-	-	<SCL	<OL	CL	<OL	SCL	OL	<OL	OL	SCL	CL	-	-	-	-	<OL
F1	8	-	-	SCL	+++	CL	CL	++	OL	+++	+++	SCL	CL	-	-	-	-	+++
F2	8	+	-	SCL	SCL	CL	SCL	<CL	OL	OL	OL	CL	CL	-	-	-	-	+++
F4	8	-	-	++	<SCL	SCL	<SCL	<SCL	OL	<SCL	SCL	++	<CL	-	-	-	-	<SCL
F5	8	-	-	++	<OL	CL	<SCL	+	OL	SCL	CL	SCL	OL	-	-	/	±	-
F6	8	-	-	SCL	<<	SCL	SCL	<<	SCL	<<	SCL	<<	SCL	-	-	-	-	-
F7	8	-	-	SCL	SCL	CL	SCL	CL	OL	OL	OL	SCL	CL	-	-	-	-	OL
F8	28	-	-	±	OL	CL	OL	-	OL	OL	OL	+	OL	-	-	-	-	OL
F13	8	-	-	+	+	++	++	++	OL	-	<SCL	SCL	SCL	-	-	-	-	±
F14	8	±	-	+++	±	CL	SCL	++	OL	<SCL	OL	+	CL	-	-	-	-	+++
F17	8	-	-	SCL	SCL	CL	SCL	CL	-	<OL	<OL	SCL	CL	-	-	/	-	++
F19	8	-	-	+++	+++	<CL	+++	+++	+++	<OL	+++	+++	CL	-	-	-	-	OL
F23	8	-	-	<SCL	<OL	CL	<SCL	SCL	<OL	OL.	OL	<SCL	CL	-	-	-	-	<OL
F24	8	-	-	SCL	SCL	CL	SCL	<CL	OL	SCL	SCL	SCL	CL	-	-	-	-	OL
F25	8	-	-	SCL	<OL	<CL	<OL	++	OL	<OL	OL	<CL	<CL	-	-	-	-	<OL
F26	28	-	-	++	SCL	SCL	SCL	-	OL	OL	OL	+	SCL	-	-	-	-	OL
F27	8	-	-	SCL	OL	CL	SCL	SCL	SCL	OL	OL	SCL	CL	-	-	-	-	OL
F29	8	1	-	+++	+++	CL	OL	+++	OL	+++	OL	+++	CL	-	2	-	-	OL
F31	8	-	-	++	+++	CL	SCL	++	OL	+++	+++	+++	CL	-	-	-	-	<SCL
F32	8	-	-	SCL	<OL	CL	SCL	CL	OL	+	<OL	SCL	CL	-	-	-	-	<OL
F35	8	-	-	CL	+	CL	+	CL	OL	OL	OL	SCL	CL	-	-	-	-	OL

Strain E7		Phages 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	6c	-	SCL	-	SCL	-	<OL	-	SCL	<OL	<OL	-	-	-	-	-	CL	<OL
F1	6a	-	++	-	++	-	SCL	-	-	++	-	-	-	-	-	-	+	+++
F2	6c	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	++	CL	SCL
F4	6c	-	<SCL	-	<SCL	-	<SCL	-	SCL	<SCL	SCL	-	-	-	-	-	SCL	<SCL
F5	6c	-	SCL	-	<SCL	-	<SCL	-	OL	<SCL	SCL	-	-	-	-	/	CL	SCL
F6	6c	-	<<	-	SCL	-	SCL	-	-	SCL	<<	<<	-	-	-	<<	CL	SCL
F7	6c	-	SCL	-	SCL	-	SCL	-	OL	OL	OL	-	-	-	-	-	OL	OL
F8	6c	-	+++	-	OL	-	OL	-	OL	OL	OL	-	-	-	-	-	CL	CL
F13	6c	-	++	-	+/-	-	+	-	OL	+	++	-	-	-	-	+	SCL	+
F14	6c	-	+++	-	+ s	-	SCL	-	< CL	SCL	< CL	-	-	-	-	4 L	< CL	SCL
F17	6c	-	SCL	-	SCL	-	<SCL	-	(-)	<OL	-	-	-	-	-	/	<SCL	SCL
F19	6c	-	++	-	+++	-	+++	-	+++	++	++	-	-	-	-	-	+++	OL
F23	6c	-	SCL	-	<OL	-	<SCL	-	++	SOL	+++	-	-	-	-	-	<OL	<OL
F24	6a	-	SCL	-	OL	-	SCL	-	-	SCL	-	-	-	-	-	-	-	OL
F25	6c	-	OL	-	<<OL	-	<OL	-	OL	<OL	<<OL	-	-	-	-	+/- L	<CL	<OL
F26	6c	-	SCL	-	SCL	-	SCL	-	OL	<OL	OL	-	-	-	-	+	SCL	OL
F27	6c	-	SCL	-	OL	-	SCL	-	SCL	OL	OL	-	-	-	-	-	SCL	OL
F29	6c	-1	+	-	±±	-	OL	-	SCL	+++	OL	-	-	-	-2	-2	SCL	<OL
F31	6c	-	++	-	++	-	SCL	-	<OL	+++	++	-	-	-	-	-	CL	+++
F32	6c	-	+++	-	SCL	-	SCL	-	<OL	+++	+++	-	-	-	-	+/- L	<CL	<OL
F35	6c	-	+	-	+	-	+	-	OL	OL	OL	-	-	-	-	+	SCL	OL

Strain E8		Phages 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	<OL	CL	OL	OL	OL	CL	CL	CL	-	-	-	<OL
F1	4	-	+++	CL	+++	CL	CL	CL	CL	+++	+++	CL	CL	CL	-	-	-	+++
F2	4	-	CL	CL	OL	CL	+++	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL
F4	4	-	<SCL	SCL	SCL	SCL	<SCL	<CL	SCL	OL	SCL	SCL	<CL	SCL	-	-	-	SCL
F5	4	-	SCL	CL	SCL	OL	SCL	<CL	OL	OL	CL	OL	OL	CL	-	/	±	OL
F6	4b	-	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	-	-	SCL	-
F7	4b	-	SCL	CL	SCL	CL	SCL	CL	CL	OL	OL	CL	CL	CL	-	-	SCL	OL
F8	4	-	+++	SCL	OL	CL	OL	SCL	OL	OL	OL	CL	CL	CL	-	-	-	OL
F13	4	-	+++	SCL	+++	SCL	+	SCL	OL	++	++	SCL	SCL	SCL	-	-	-	+++
F14	4	-	+++	<CL	+	CL	SCL	<CL	OL	SCL	OL	<CL	CL	CL	-	-	-	OL
F17	4a	-	SCL	CL	SCL	CL	SCL	CL	-	+++	++	CL	CL	CL	-	/	-	+++
F19	4	-	+++	CL	<OL	CL	+++	CL	<SCL	OL	<SCL	CL	CL	CL	-	-	-	OL
F23	4	-	SCL	<CL	OL	CL	SCL	CL	OL	<OL	OL	<CL	CL	CL	-	-	-	<OL
F24	4	-	SCL	SCL	OL	CL	SCL	CL	OL	SCL	SCL	<CL	CL	CL	-	-	-	SCL
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	SCL	OL	OL	CL	CL	CL	-	-	-	OL
F29	4	2	+++	CL	OL	CL	OL	CL	OL	OL	OL	CL	CL	CL	2	-	-	OL
F31	4	-	+++	SCL	+++	CL	SCL	SCL	OL	+++	OL	SCL	CL	++	-	-	+	+++
F32	4	-	<CL	CL	OL	CL	SCL	CL	OL	<OL	OL	<CL	CL	CL	-	-	-	<OL
F35	4	-	+	CL	+	CL	+	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL

Strain E9		Phages 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	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
F1	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	++
F2	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL
F4	23	-	-	-	<SCL	-	-	-	-	<SCL	-	-	-	-	-	-	-	SCL
F5	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	<SCL
F6	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F7	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CL
F8	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL
F13	NT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F14	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++
F17	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	SCL
F19	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL
F23	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL
F24	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
F25	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
F26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F27	23	-	-	-	OL	-	-	-	-	OL	-	-	-	-	-	-	-	OL
F29	59	-	-	-	2	-	-	-	-	5	-	-	-	-	-	-	-	OL
F31	14b	-	-	-	-	-	+++	-	-	-	-	-	-	-	-	-	-	++
F32	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL
F35	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL

Strain E10		Phages reactions at routine test dilution (*S.* Enteritidis)																
Labcode	**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	<OL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	SCL
F1	1	OL	+++	CL	+++	CL	CL	SCL	CL	++	+++	CL	CL	CL	CL	-	-	+++
F2	1	OL	++	CL	+++	CL	SCL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	++
F4	1	OL	<SCL	<CL	<SCL	CL	<SCL	CL	OL	<SCL	OL	SCL	<CL	SCL	SCL	-	-	<SCL
F5	1	CL	<SCL	CL	<SCL	CL	SCL	<CL	OL	<SCL	OL	CL	CL	CL	CL	/	+	<SCL
F6	1	SCL	<<	SCL	<<	SCL	SCL	SCL	SCL	<<	SCL	SCL	SCL	SCL	SCL	-	-	<<
F7	1	OL	SCL	CL	SCL	CL	SCL	CL	OL	OL	CL	CL	CL	CL	CL	-	-	CL
F8	1	OL	+++	SCL	OL	CL	OL	SCL	OL	OL	OL	CL	CL	CL	CL	-	-	OL
F13	20a	++	-	SCL	-	SCL	-	<SCL	CL	-	++	SCL	SCL	SCL	+++	-	-	-
F14	1	OL	SCL	CL	++	CL	SCL	CL	OL	SCL	OL	<CL	CL	CL	+++	-	-	SCL
F17	45	++	+++	<OL	SCL	CL	<OL	<CL	-	+++	<SCL	+++	OL	+++	++	/	-	SCL
F19	1	+++	+++	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	1	OL	SCL	OL	<SCL	CL	<CL	CL	CL	OL	SCL	<CL	CL	CL	CL	-	-	SCL
F25	1	OL	SCL	<CL	<OL	<CL	<OL	<CL	OL	<OL	OL	<CL	<CL	<CL	OL	-	-	OL
F26	4	-	SCL	CL	SCL	CL	SCL	CL	OL	OL	OL	CL	CL	CL	-	-	-	OL
F27	1	OL	SCL	CL	OL	CL	SCL	CL	SCL	OL	OL	CL	CL	CL	CL	-	-	OL
F29	37	OL	1	CL	-	CL	OL	CL	OL	-	OL	CL	CL	CL	CL	-	-	+
F31	1	OL	+++	SCL	++	CL	SCL	SCL	OL	++	OL	SCL	CL	++	CL	-	-	+++
F32	1	<OL	SCL	CL	OL	CL	SCL	CL	OL	<CL	OL	CL	CL	CL	CL	5	-	<OL
F35	1	CL	+	CL	+	CL	+	CL	OL	OL	OL	CL	CL	CL	CL	.	-	OL
HPA	1	OL	SCL	CL	OL	CL	<OL	CL	OL	OL	OL	CL	CL	CL	CL	-	-	SCL

Strain T11		Phages 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	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F4	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F6	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F7	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F8	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F13	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F14	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F17	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F19	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F23	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F24	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F27	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F29	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F31	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F32	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F35	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T11		Phages 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	10 var2	10 var3	18
HPA	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	+++	+	OL
F1	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	+++	++
F2	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	++
F4	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F5	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	<SCL	++	<OL
F6	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<<	<<	<<	-
F7	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	<OL	OL
F8	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
F13	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F14	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	3
F17	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	++	-
F19	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	OL	+++
F23	208	-	-	-	-	-	-	-	-	-	-	-	-	-	±	-	OL.	SCL	<SCL	+++
F24	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	OL
F25	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	<OL	<OL
F27	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F29	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	+++	SCL	++
F31	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	+++	OL	+++
F32	208	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<CL	SCL	SCL	<OL
F35	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	++	OL	-

Strain T12		Phages 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	+++	++	++	CL	CL	CL	CL	CL	CL	CL	++	+++	CL	CL	CL	CL	CL	+++
F2	36	SCL	CL	CL	OL	CL	CL	SCL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	CL	CL
F4	36	<SCL	SCL	OL	OL	OL	OL	SCL	SCL	OL	OL	SCL	SCL	OL	SCL	OL	OL	SCL	SCL
F5	36	CL	CL	CL	CL	CL	CL	CL	<CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
F6	36	SCL	SCL	SCL	OL	SCL	SCL	SCL	SCL	SCL	<<	<<	SCL	SCL	SCL	SCL	SCL	SCL	SCL
F7	36	CL	CL	CL	CL	CL	CL	CL	+++	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
F8	36	+++	++	+++	SCL	CL	OL	SCL	SCL	++	CL	SCL	SCL	CL	CL	CL	SCL	+++	+++
F13	36	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL
F14	36	<CL	SCL	CL	OL	SCL	CL	CL	OL	CL	CL	<SCL	SCL	CL	CL	CL	<CL	<CL	<CL
F17	36	<SCL	CL	SCL	CL	CL	CL	CL	CL	CL	CL	<CL	CL	CL	CL	CL	CL	CL	CL
F19	36	CL	SCL	CL	OL	CL	CL	<CL	<CL	+++	CL	SCL	<CL	CL	CL	CL	CL	CL	SCL
F23	36	CL.	<CL	CL	CL	CL	CL	CL	CL	<CL	<CL	+ <<	SCL	CL	<CL	CL	CL	<CL	<CL
F24	36	<CL	SCL	<CL	OL	SCL	<CL	SCL	CL	<CL	<CL	<<	<<	OL	CL	<CL	<CL	SCL	<CL
F25	36	SCL	OL	<CL	OL	SCL	<CL	SCL	<CL	<CL	<CL	<SCL	SCL	CL	CL	CL	<CL	<CL	<CL
F27	36	CL	CL	CL	OL	CL	CL	CL	SCL	CL	SCL	SCL	CL	SCL	CL	CL	SCL	CL	CL
F29	36	CL	SCL	+++	OL	+++	CL	CL	CL	SCL	CL	CL	CL	CL	CL	CL	SCL	CL	CL
F31	36	CL	SCL	CL	SCL	SCL	SCL	CL	SCL	++	SCL	SCL	SCL	CL	CL	CL	CL	CL	CL
F32	36	<CL	<CL	<CL	SCL	<CL	<CL	SCL	<CL	CL	CL	<CL	<CL	<CL	<CL	CL	SCL	<CL	<CL
F35	36	CL	CL	CL	OL	SCL	CL	CL	CL	SCL	CL	SCL	SCL	CL	CL	CL	CL	CL	CL

Strain T12		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	36	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	+++	++	+++	OL	OL	++	OL
F1	36	+++	CL	+++	+++	CL	CL	CL	CL	CL	CL	++	CL	+	+	++	OL	OL	OL	OL
F2	36	SCL	CL	CL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	+++	+++	+++	OL	OL	OL	OL
F4	36	SCL	OL	OL	SCL	OL	OL	SCL	OL	OL	SCL	SCL	OL							
F5	36	<CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	OL	-	++	SCL	OL	OL	SCL	CL
F6	36	<<	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	CL	CL							
F8	36	SCL	SCL	SCL	SCL	+++	++	+++	CL	CL	CL	++	CL	+++	+++	+++	OL	OL	OL	CL
F13	36	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	++	++	++	OL	OL	OL	SCL
F14	36	OL	SCL	OL	<CL	SCL	<CL	<CL	SCL	OL	CL	<SCL	OL	+	+	+	OL	OL	OL	CL
F17	36	<CL	CL	CL	CL	CL	CL	SCL	CL	OL	CL	CL	OL							
F19	36	+++	<SCL	SCL	+++	SCL	<SCL	<SCL	CL	CL	CL	++	OL	+++	+	++	OL	OL		CL
F23	36	CL	<CL	CL	CL	CL	<CL	CL	CL	CL	CL	CL	CL	++	+++	+++	OL	<OL	SCL	CL
F24	36	SCL	CL	<CL	<CL	<CL	SCL	<CL	SCL	SCL	OL	SCL	OL							
F25	36	SCL	OL	OL	<CL	<CL	<CL	<CL	<CL	OL	CL	CL	OL							
F27	36	SCL	SCL	SCL	CL	CL	CL	CL	CL	SCL	SCL	SCL	CL	+++	++	-	OL	OL	SCL	CL
F29	36	CL	OL	OL	CL	CL	SCL	CL	CL	OL	CL	SCL	OL	+	+	+	OL	OL	OL	OL
F31	36	+++	CL	SCL	SCL	CL	SCL	SCL	CL	++	SCL	++	SCL	-	-	+++	OL	+++	OL	CL
F32	36	<CL	<CL	<CL	CL	CL	<CL	<CL	OL	<CL	CL	<CL	OL							
F35	36	SCL	CL	CL	CL	CL	SCL	CL	CL	CL	CL	CL	OL							

Strain T13		Phages 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	-	-	-	-	++	-
F1	104	-	-	-	-	-	-	-	-	-	-	++	+++	-	-	-	-	+++	-
F2	110	-	-	-	-	-	-	-	-	-	-	+	++	-	-	-	-	+++	-
F4	104	-	-	-	-	-	-	-	-	-	-	<SCL	<SCL	-	-	-	-	++	-
F5	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	<SCL	-
F6	104	-	-	-	-	-	-	-	-	-	-	<<	SCL	-	-	-	-	<<	-
F7	18	-	-	-	-	-	-	-	-	-	<CL	-	-	-	SCL	-	SCL	SCL	SCL
F8	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F13	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	+++	-
F14	104	-	-	-	-	-	-	-	-	-	-	<SCL	SCL	-	-	-	-	+++	-
F17	104	-	-	-	-	-	-	-	-	-	-	+++	+++	-	-	-	-	+	-
F19	104	-	-	-	-	-	-	-	-	-	-	<SCL	SCL	-	-	-	-	-	-
F23	104	-	-	-	-	-	-	-	-	-	-	±	SCL	-	-	-	-	++	-
F24	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	104	-	-	-	-	-	-	-	-	-	-	<SCL	<CL	-	-	-	-	++	-
F27	104	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	++	-
F29	104	-	-	-	-	-	-	-	3	-	-	+++	SCL	-	-	-	-	+++	-
F31	104	-	-	-	-	-	-	-	-	-	-	++	+++	-	-	-	-	+++	-
F32	104	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	+++	-
F35	104	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	+	-

Strain T13		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	+++	-
F1	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F2	110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F4	104	-	-	-	-	-	-	-	-	-	-	-	-							
F5	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	SCL	-
F6	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-
F7	18	SCL	-	-	-	-	-	-	-	-	-	+++	++							
F8	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F13	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F14	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F17	104	-	-	-	-	-	-	-	-	-	-	-	-							
F19	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL		-
F23	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL.	SCL	-
F24	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F25	104	-	-	-	-	-	-	-	-	-	-	-	-							
F27	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F29	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F31	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	+++	CL	-
F32	104	-	-	-	-	-	-	-	-	-	-	-	-							
F35	104	-	-	-	-	-	-	-	-	-	-	-	-							

Strain T14		Phages 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	18	-	-	-	-	-	-	-	-	-	<OL	-	-	-	SCL	-	<OL	SCL	SCL
F1	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	OL	-	++	OL	+
F2	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	CL	-	CL	+++	CL
F4	18	-	-	-	-	-	-	-	-	-	<SCL	-	-	-	++	-	<SCL	<SCL	<SCL
F5	18	-	-	-	-	-	-	-	-	-	<OL	-	-	-	OL	-	OL	CL	OL
F6	18	-	-	-	-	-	-	-	+	-	OL	-	-	-	OL	-	OL	SCL	<<
F7	104	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	SCL	-
F8	18	-	-	-	-	-	-	-	-	-	CL	-	-	-	OL	-	++	+++	-
F13	18	-	-	-	-	-	-	-	-	-	+++	-	-	-	OL	-	+++	CL	++
F14	18	-	-	-	-	-	-	-	1	-	CL	-	-	-	CL	-	SCL	< CL	<SCL
F17	118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+++	SCL	SCL
F19	?	-	-	-	-	-	-	-	-	-	+++	-	-	-	-	-	+++	SCL	-
F23	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	+	-	SCL	SCL	±
F24	18	-	-	-	-	-	-	-	-	-	<<	-	-	-	OL	-	OL	SCL	OL
F25	18	-	-	-	-	-	-	-	-	-	OL	-	-	-	<SCL	-	<OL	SCL	<SCL
F27	18	-	-	-	-	-	-	-	-	-	SCL	-	-	-	OL	-	SCL	SCL	SCL
F29	18	-	-	-	-	-	-	-	±	-	CL	-	-	-	±	-	++	CL	++
F31	18	-	-	-	-	-	-	-	-	-	+++	-	-	-	<OL	-	OL	CL	+++
F32	RDNC	-	-	-	-	-	-	-	5	-	OL	-	-	-	-	-	-	<CL	5
F35	18	-	-	-	-	-	-	-	-	-	CL	-	-	-	CL	-	CL	<CL	++

Strain T14		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	18	SCL	-	-	-	-	-	-	+	-	-	OL	+	+++	++	+++	OL	<OL	+	-
F1	18	++	-	-	-	-	-	-	±	±	-	+	±	-	+	+	OL	OL	OL	±
F2	18	+++	-	-	-	-	-	-	+	-	-	CL	+	+++	+++	+++	SCL	SCL	SCL	-
F4	18	<SCL	-	-	-	-	-	-	+	-	-	<SCL	3							
F5	18	SCL	-	-	-	-	-	-	-	-	-	OL	-	-	-	<SCL	SCL	OL	SCL	±
F6	18	<<	-	-	-	-	-	-	-	-	-	SCL	-	-	-	-	SCL	SCL	SCL	-
F7	104	-	-	-	-	-	-	-	-	-	-	-	-							
F8	18	+++	-	-	-	-	-	-	+	-	-	+++	++	-	+	-	OL	OL	OL	-
F13	18	+++	-	-	-		-	-	+	-	-	SCL	-	+	+	++	SCL	OL	OL	-
F14	18	<SCL	-	-	-	-	-	-	-	-	-	SCL	-	-	3	4	OL	OL	OL	-
F17	118	SCL	-	-	-	-	-	-	-	-	-	SCL	-							
F19	?	++	-	-	-	-	-	-	-	-	-	-	+	+	-	+	<OL	<OL		-
F23	18	<SCL	-	-	-	-	-	-	±	-	-	++	-	++	++	+	<OL	SCL	<SCL	-
F24	18	OL	-	-	-	-	-	-	<<	-	-	OL	OL							
F25	18	<SCL	-	-	-	-	-	-	2	-	-	<OL	3							
F27	18	SCL	-	-	-	-	-	-	-	-	-	SCL	-	+	+	-	OL	OL	OL	-
F29	18	SCL	-	-	-	-	-	1	-	1	-	+++	±	+	+	+	OL	OL	OL	5
F31	18	+++	-	-	-	-	-	-	++	-	-	++	1-	-	-	+++	OL	+++	OL	-
F32	RDNC	SCL	-	-	-	-	-	-	5	-	-	SCL	-							
F35	18	++	-	-	-	-	-	-	+	-	-	CL	-							

Strain T15		Phages 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	2	-	CL	CL	OL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
F1	2	-	++	++	CL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	+++
F2	2	-	CL	CL	CL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
F4	2	-	SCL	OL	OL	OL	OL	-	-	OL	OL	OL	OL	OL	SCL	OL	OL	-	OL
F5	2	-	SCL	<CL	OL	CL	CL	-	-	<CL	<CL	<CL	<CL	CL	CL	CL	CL	±	CL
F6	2	-	SCL	SCL	SCL	SCL	SCL	-	-	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	-	SCL
F7	2	-	CL	CL	CL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
F8	2	-	+	+++	SCL	CL	OL	-	-	SCL	CL	CL	CL	CL	CL	CL	+	-	+
F13	2	-	SCL	SCL	SCL	SCL	SCL	-	-	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	-	SCL
F14	2	-	SCL	CL	OL	SCL	CL	-	-	CL	CL	SCL	CL	CL	CL	CL	CL	-	SCL
F17	46	-	CL	CL	CL	CL	CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	CL
F19	2	-	SCL	CL	OL	CL	CL	-	-	+++	CL	SCL	CL	CL	CL	CL	CL	-	SCL
F23	2	-	SCL	<CL	CL	CL	<CL	-	-	CL	CL	CL	CL	CL	CL	CL	CL	-	<CL
F24	12	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	-	-
F25	2	-	SCL	<CL	OL	SCL	<CL	-	-	<CL	SCL	<CL	<CL	CL	SCL	<CL	SCL	-	SCL
F27	2	-	CL	CL	OL	SCL	CL	-	-	CL	SCL	SCL	SCL	SCL	CL	CL	SCL	-	SCL
F29	2	-	+++	+++	OL	++	CL	-	-	SCL	SCL	CL	CL	CL	CL	CL	SCL	-	SCL
F31	2	-	SCL	CL	OL	<SCL	SCL	-	-	++	SCL	SCL	SCL	CL	CL	CL	CL	-	SCL
F32	132	-	SCL	SCL	SCL	<CL	<CL	-	-	CL	CL	<CL	<CL	<CL	SCL	<CL	-	-	±
F35	2	-	CL	CL	OL	SCL	CL	-	-	SCL	CL	CL	CL	CL	CL	CL	CL	-	SCL

Strain T15		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	2	CL	OL	OL	CL	CL	CL	<CL	CL	-	CL	CL	OL	+++	+	++	OL	OL	SCL	OL
F1	2	CL	CL	++	CL	CL	CL	CL	CL	-	CL	++	CL	±	+	+	OL	OL	OL	OL
F2	2	CL	CL	CL	CL	CL	CL	CL	CL	+	CL	CL	CL	++	++	+	OL	OL	OL	OL
F4	2	SCL	OL	OL	OL	OL	OL	SCL	OL	-	SCL	SCL	OL							
F5	2	SCL	CL	<CL	SCL	CL	CL	<CL	<CL	-	CL	CL	OL	±	+	<SCL	<SCL	<SCL	SCL	CL
F6	2	<<	SCL	SCL	SCL	SCL	SCL	SCL	SCL	-	SCL	SCL	SCL	-	-	-	SCL	SCL	SCL	SCL
F7	2	CL	CL	CL	CL	CL	CL	CL	CL	-	CL	CL	CL							
F8	2	SCL	SCL	SCL	CL	CL	CL	CL	CL	-	CL	CL	CL	+	+	+	OL	OL	OL	OL
F13	2	SCL	SCL	SCL	SCL	SCL	SCL	SCL	SCL	-	SCL	SCL	SCL	-	-	+	OL	OL	OL	SCL
F14	2	SCL	CL	CL	CL	CL	++	CL	CL	5	CL	++	OL	-	-	-	OL	OL	OL	CL
F17	46	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL							
F19	2	+++	<SCL	<SCL	SCL	CL	<SCL	<SCL	CL	-	<CL	+++	OL	+	±	±	OL	OL		CL
F23	2	CL	<CL	CL	CL	CL	<CL	CL	CL	3	CL	<CL	CL	++	+++	++	OL	OL	SCL	CL
F24	12	-	-	-	-	-	-	-	-	-	-	-	-							
F25	2	<SCL	OL	<OL	<CL	CL	<CL	SCL	SCL	-	CL	<CL	OL							
F27	2	SCL	SCL	SCL	CL	CL	CL	CL	CL	-	CL	SCL	SCL	+	+	-	OL	OL	OL	SCL
F29	2	SCL	CL	SCL	CL	CL	SCL	SCL	SCL	1	CL	+++	OL	1	±	±	OL	OL	OL	OL
F31	2	+++	CL	SCL	SCL	CL	SCL	SCL	CL	-	CL	+++	OL	±	±	+++	OL	OL	OL	CL
F32	132	<CL	<CL	±	<CL	CL	<CL	SCL	<CL	-	<CL	SCL	<CL							
F35	2	SCL	CL	CL	CL	CL	SCL	CL	CL	-	CL	CL	OL							

Strain T16		Phages 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	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F1	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F2	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F4	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F5	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
F6	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F7	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F8	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F13	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F14	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F17	U309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F19	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F23	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F24	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F27	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F29	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
F31	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F32	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F35	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T16		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-
F1	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	-
F2	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F4	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F5	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	±	OL	-
F6	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-
F7	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<OL	<OL	<OL	-
F8	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F13	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F14	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F17	U309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
F19	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F23	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-
F24	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F25	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-
F27	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	-
F29	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	<OL	-
F31	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	OL	-
F32	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<CL	-
F35	U311	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	-

Strain T17		Phages 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	12a	-	-	-	-	-	-	-	+	-	-	OL	OL	-	-	-	-	<CL	-
F1	104H	-	-	-	-	-	-	-	-	-	-	SCL	CL	-	-	-	-	CL	-
F2	104	-	-	-	-	-	-	-	-	-	-	SCL	CL	-	-	-	-	CL	-
F4	104H	-	-	-	-	-	-	-	-	-	-	OL	OL	-	-	-	-	SCL	-
F5	12a	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	CL	-
F6	104H	-	-	-	-	-	-	-	+	-	-	SCL	SCL	-	-	-	-	-	-
F7	12a	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	SCL	-
F8	12a	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	++	-
F13	104H	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	CL	-
F14	104H	-	-	-	-	-	-	-	2	-	-	<CL	<CL	-	-	-	-	CL	-
F17	104H	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	CL	-
F19	12a	-	-	-	-	-	-	-	-	-	-	<CL	CL	-	-	-	-	CL	-
F23	12a	-	-	-	-	-	-	-	1	-	-	<CL	CL	-	-	-	-	CL	-
F24	104 H	-	-	-	-	-	-	-	-	-	-	<<	SCL	-	-	-	-	SCL	-
F25	12a	-	-	-	-	-	-	-	2	-	-	<SCL	<CL	-	-	-	-	<CL	-
F27	12a	-	-	-	-	-	-	-	-	-	-	SCL	CL	-	-	-	-	CL	-
F29	12a	-	-	-	-	-	-	-	2	-	-	CL	CL	-	-	-	-	CL	-
F31	12a	-	-	-	-	-	-	-	-	-	-	<CL	<CL	-	-	-	-	CL	-
F32	12a	-	-	-	-	-	-	-	5	-	-	CL	CL	-	-	-	-	<CL	-
F35	104 H	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	CL	-

Strain T17		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	12a	-	+	-	-	-	-	-	++	-	-	-	OL	++	+	++	OL	OL	++	+
F1	104H	-	-	-	-	-	-	-	-	-	-	-	CL	+	+	++	OL	OL	OL	++
F2	104	-	-	-	-	-	-	-	-	-	-	-	++	+	+	+	SCL	SCL	SCL	-
F4	104H	-	-	-	-	-	-	-	+	-	-	-	++							
F5	12a	-	+	-	-	-	-	-	+	-	-	-	OL	-	-	±	SCL	SCL	<SCL	++
F6	104H	-	+	-	-	-	-	-	-	-	-	-	SCL	-	-	-	SCL	SCL	SCL	-
F7	12a	-	+	-	-	-	-	-	OL	-	-	-	OL							
F8	12a	-	-	-	-	-	-	-	CL	-	-	-	CL	-	-	-	OL	OL	OL	+
F13	104H	-	-	-	-	-	-	-	+				+++	-	-	-	OL	OL	OL	+++
F14	104H	-	2	-	-	-	-	-	4	-	-	-	++	-	-	-	OL	OL	OL	1
F17	104H	-	-	-	-	-	-	-	+	-	-	-	+							
F19	12a	-	-	-	-	-	-	-	++	-	-	-	-	+	±	±	<OL	<OL	OL	OL
F23	12a	-	±	-	-	-	-	-	<OL	-	-	-	OL	++	+++	++	OL	<OL	SCL	SCL
F24	104H	-	-	-	-	-	-	-	-	-	-	-	OL							
F25	12a	-	-	-	-	-	-	-	+	-	-	-	<OL							
F27	12a	-	-	-	-	-	-	-	OL	-	-	-	SCL	-	+	-	OL	OL	OL	SCL
F29	12a	-	±	-	-	-	-	-	-	-	-	-	OL	-	±	4	OL	OL	OL	+
F31	12a	-	+	-	-	-	-	-	<SCL	-	-	-	SCL	-	-	+++	OL	+++	SCL	+
F32	12a	-	5	-	-	-	-	-	SCL	-	-	-	<CL							
F35	104H	-	-	-	-	-	-	-	-	-	-	-	+++							

Strain T18		Phages 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	136	-	-	-	OL	CL	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
F1	136	-	-	-	CL	CL	CL	+	-	-	CL	CL	CL	-	CL	CL	-	-	+++
F2	136	-	-	-	OL	OL	OL	-	-	-	OL	OL	OL	-	OL	OL	-	-	CL
F4	136	-	-	-	OL	OL	OL	-	-	-	OL	SCL	SCL	-	SCL	OL	-	-	OL
F5	136	-	-	-	OL	CL	<CL	-	-	-	CL	CL	CL	-	CL	CL	-	±	CL
F6	136	-	-	-	SCL	SCL	SCL	-	-	-	SCL	SCL	SCL	-	SCL	SCL	-	-	SCL
F7	136	-	-	-	OL	OL	OL	-	-	-	OL	OL	OL	-	OL	OL	-	-	CL
F8	136	-	-	-	OL	CL	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	++
F13	54	-	-	-	OL	SCL	SCL	-	-	-	SCL	SCL	SCL	-	SCL	SCL	-	-	SCL
F14	136	-	-	-	OL	<CL	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
F17	136	-	-	-	OL	<OL	<OL	-	-	-	<OL	<OL	<OL	-	<OL	<OL	-	-	CL
F19	136	-	-	-	SCL	CL	CL	-	-	-	CL	CL	CL	-	SCL	CL	-	-	<SCL
F23	136	-	-	-	OL	<OL	<OL	-	-	-	CL	<CL	CL	-	SCL	CL	-	-	SCL
F24	54	-	-	-	OL	SCL	<CL	-	-	-	<CL	<<	SCL	-	CL	CL	-	-	SCL
F25	136	-	-	-	OL	<OL	OL	-	-	-	<OL	<OL	<OL	-	<CL	CL	-	-	<CL
F27	136	-	-	-	OL	SCL	CL	-	-	-	SCL	CL	CL	-	CL	CL	-	-	SCL
F29	136	-	-	-	OL	+	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL
F31	136	-	-	-	OL	SCL	SCL	-	-	-	SCL	SCL	SCL	-	CL	CL	-	-	SCL
F32	136	-	-	-	<CL	<CL	<CL	-	-	-	CL	CL	CL	-	SCL	<CL	-	-	SCL
F35	136	-	-	-	OL	++	CL	-	-	-	CL	CL	CL	-	CL	CL	-	-	CL

Strain T18		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	136	+	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	SCL	SCL	++	-
F1	136	+	-	-	-	-	CL	-	-	-	-	-	-	-	±	+	+++	OL	+++	-
F2	136	+	-	-	-	-	CL	-	-	-	-	-	-	+	+	+	OL	OL	OL	-
F4	136	-	-	-	-	-	OL	-	-	-	-	-	-							
F5	136	++	-	-	-	-	CL	-	-	-	-	-	-	-	-	-	<SCL	SCL	<SCL	-
F6	136	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-
F7	136	-	-	-	-	-	OL	-	-	-	-	-	-							
F8	136	++	-	-	-	-	++	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F13	54	++	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F14	136	<SCL	-	-	-	-	<CL	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F17	136	+	-	-	-	-	<OL	-	-	-	-	-	-							
F19	136	-	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	<OL	<OL		-
F23	136	+	-	-	-	-	<CL	-	-	-	-	-	-	±	±	±	<OL	OL.	SOL	-
F24	54	SCL	-	-	-	-	SCL	-	-	-	-	-	-							
F25	136	-	-	-	-	-	<CL	-	-	-	-	-	-							
F27	136	-	-	-	-	-	OL	-	-	-	-	-	-	-	-	-	OL	OL	SCL	-
F29	136	++	-	-	-	-	CL	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F31	136	6	-	-	-	-	SCL	-	-	-	-	-	-	-	-	-	OL	+++	SCL	-
F32	136	±	-	-	-	-	<CL	-	-	-	-	-	-							
F35	136	+	-	-	-	-	++	-	-	-	-	-	-							

Strain T19		Phages 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	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F6	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F7	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F8	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F13	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F14	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F17	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F19	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F23	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F24	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F27	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F29	193	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F31	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F32	195	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F35	194	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Strain T19		Phages 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	10 var2	10 var3	18
HPA	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
F1	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	+	+++	-	-
F2	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	OL	OL	OL	-
F4	193	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	<SCL	<SCL	-	-	-	-
F5	195	-	-	-	-	-	-	-	-	-	-	-	-	±	++	SCL	<SCL	SCL	-	-
F6	193	-	-	-	-	-	-	-	-	-	-	-	-	<<	<<	<<	-	-	-	-
F7	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	<OL	<OL	<OL	-
F8	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	-	-	-	-
F13	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	++	++	++	-
F14	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	+++	OL	OL	OL	-
F17	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	<OL	<OL	-	-
F19	193	-	-	-	-	-	-	-	-	-	-	-	-	+++	+	++	<OL	<OL		-
F23	193	-	-	-	-	-	-	-	-	-	-	-	-	++ns	SCL	SCL	-	-	-	-
F24	193	-	-	-	-	-	-	-	-	-	-	-	-	<<	<<	<<	-	-	-	-
F25	193	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	±	-	-	-
F27	193	-	-	-	-	-	-	-	-	-	-	-	-	++	++	+	-	-	-	-
F29	193	±	-	-	-	-	-	-	-	-	-	-	-	+	+	++	-	-	-	-
F31	195	-	-	-	-	-	-	-	-	-	-	-	-	-	+	SCL	-	-	-	-
F32	195	-	-	-	-	-	-	-	-	-	-	-	-	+	±	SCL	SCL	-	+	-
F35	194	-	-	-	-	-	-	-	-	-	-	-	-	-	++	-	-	-	-	-

Strain T20		Phages 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	12	-	-	-	-	-	-	-	-	-	-	SCL	<CL	-	-	-	-	-	-
F1	RDNC	-	-	-	-	-	-	-	-	-	-	+	++	-	-	-	-	-	-
F2	109	-	-	-	-	-	-	-	-	-	-	++	+++	-	-	-	-	-	-
F4	12	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	-	-
F5	12	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	-	-
F6	12	-	-	-	-	-	-	-	-	-	-	<<	SCL	-	-	-	-	-	-
F7	12	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	-	-
F8	12	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	-	-
F13	12	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	-	-
F14	12	-	-	-	-	-	-	-	-	-	-	++	<CL	-	-	-	-	-	-
F17	12	-	-	-	-	-	-	-	-	-	-	<CL	<CL	-	-	-	-	-	-
F19	12	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	-	-
F23	12	-	-	-	-	-	-	-	-	-	-	+	SCL	-	-	-	-	-	-
F24	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F25	12	-	-	-	-	-	-	-	-	-	-	<SCL	SCL	-	-	-	-	-	-
F27	12	-	-	-	-	-	-	-	-	-	-	SCL	CL	-	-	-	-	-	-
F29	12	-	-	-	-	-	-	-	-	-	-	CL	CL	-	-	-	-	-	-
F31	12	-	-	-	-	-	-	-	-	-	-	SCL	SCL	-	-	-	-	-	-
F32	12	-	-	-	-	-	-	-	-	-	-	<CL	<CL	-	-	-	-	-	-
F35	12	-	-	-	-	-	-	-	-	-	-	+	++	-	-	-	-	-	-

Strain T20		Phages 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**	**10 var2**	**10 var3**	**18**
HPA	12	-	-	-	-	-	-	-	-	-	-	-	-	+++	++	+++	OL	OL	++	-
F1	RDNC	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+++	OL	OL	OL	-
F2	109	-	-	-	-	-	-	-	-	-	-	-	-	+++	+++	++	SCL	SCL	SCL	-
F4	12	-	-	-	-	-	-	-	-	-	-	-	-							
F5	12	-	-	-	-	-	-	-	-	-	-	-	-	-	+	<SCL	OL	OL	SCL	-
F6	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SCL	SCL	SCL	-
F7	12	-	-	-	-	-	-	-	-	-	-	-	-							
F8	12	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	OL	OL	OL	-
F13	12	-	-	-	-	-	-	-	-	-	-	-	-	++	++	++	OL	OL	OL	-
F14	12	-	-	-	-	-	-	-	-	-	-	-	-	±	±	±	OL	OL	OL	-
F17	12	-	-	-	-	-	-	-	-	-	-	-	-							
F19	12	-	-	-	-	-	-	-	-	-	-	-	-	+++	+	++	<OL	<OL		-
F23	12	-	-	-	-	-	-	-	-	-	-	-	-	++	+++	+++	OL	OL	SCL	-
F24	U302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	OL	OL	OL	-
F25	12	-	-	-	-	-	-	-	-	-	-	-	-	<SCL	SCL	SCL	<OL	OL	<OL	-
F27	12	-	-	-	-	-	-	-	-	-	-	-	-	+	++	-	OL	OL	SCL	-
F29	12	-	-	-	-	-	-	-	-	-	-	-	-	++	+	+	OL	OL	OL	-
F31	12	-	-	-	-	-	-	-	-	-	-	-	-	-	±	+++	OL	+++	OL	-
F32	12	-	-	-	-	-	-	-	-	-	-	-	-							
F35	12	-	-	-	-	-	-	-	-	-	-	-	-							

Annex 6. Results antimicrobial susceptibility testing per antibiotic

AMOXICILLIN + CLAVALUNATE												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		1/0.5	4/2	6/3	8/4	32/16	1/0.5	1/0.5	2/1	3/1.5	8/4	
F4												
F12	<8/4-32/16	≤2 (S)	4 (S)	16 (I)	16 (I)	≥32 (R)	≤2 (S)	≤2 (S)	≤2 (S)	4 (S)	≥32 (R)	4 (S)
F25	1/0.5-32/16	≤1/0.5(S)	8/4(S)	16/8 (I)	8/4(S)	>32/16(R)	≤1/0.5(S)	≤1/0.5(S)	≤1/0.5(S)	4/2(S)	32/16(R)	8/4
F26												
F28	2/1-32/16	≤2/1 (S)	8/4 (S)	16/8 (I)	16/8 (I)	>32/16(R)	≤2/1 (S)	≤2/1 (S)	≤2/1 (S)	4/2 (S)	>32/16(R)	4/2 (S)
F33	0.016-256	0.75 (S)	6 (S)	12 (I)	16 (I)	64 (R)	0.5 (S)	0.75 (S)	0.75 (S)	8 (S)	16 (I)	6 (S)
F34	0.016-256	0.125 (S)	4(S)	8(R)	8(S)	32(R)	1.0(S)	1.0(S)	1.0(S)	4(S)	32(R)	4(S)
QC-range												2/1 - 8/4
Disk load	µg	Inhibition zones in mm										
F1	20/10	30 (S)	20(S)	16 (R)	18(S)	6 (R)	34(S)	28(S)	30(S)	22(S)	11(R)	22(S)
F2	20/10	24-S	21-S	17-I	20-S	10-R	27-S	25-S	26-S	20-S	20-S	24
F3	30	29(S)	22(S)	18(S)	19(S)	10 (R)	32(S)	28(S)	30(S)	23(S)	18(S)	23
F6	20/10	26 (S)	18 (S)	16 (I)	18 (S)	7 (R)	34 (S)	28 (S)	26 (S)	24 (S)	14 (I)	22 (S)
F8												
F10	20/10	29 (S)	22 (S)	17 (I)	18 (I)	10 (R)	33 (S)	28 (S)	29 (S)	24 (S)	10 (R)	22 (S)
F11	20/10	28-S	26-S	22-S	25-S	23-S	32-S	30-S	28-S	26-S	24-S	24-S
F13												
F14	30	26.68(S)	20.91(S)	15.83(I)	16.73(I)	10.01(R)	34.81(S)	25.92(S)	30.14(S)	22.32(S)	11.49(R)	23.56(S)
F15	30	27 (S)	17 (I)	15 (I)	15 (I)	9 (R)	31 (S)	26 (S)	27 (S)	20 (S)	11 (R)	20 (S)
F17	30	23 S	18 S	15 R	15 I	≤6	29 S	20 S	24 S	21 S	15 I	22
F18	20/10	28 (S)	22 (S)	18 (S)	17 (I)	15 (I)	30 (S)	27 (S)	27 (S)	22 (S)	16 (I)	21
F19												
F20	30	26 (S)	14 (I)	16 (I)	17 (I)	12 (R)	29 (S)	26 (S)	26 (S)	22 (S)	10 (R)	21 (S)
F22	30	27 (S)	13 (R)	9 (R)	9 (R)	6 (R)	29 (S)	27 (S)	27 (S)	13 (R)	6 (R)	24 (S)
F23		-	-	-	-	-	-	-	-	-	-	22
F24												
F29												
F30	30	21(S)	20(S)	15(I)	16(I)	6(R)	30(S)	26(S)	28(S)	19(S)	10(R)	21(S)
F31		-	-	-	-	-	-	-	-	-	-	-
QC-range												18-24
Breakpoint												
F5												
F9												
F35												
Combination												
F7	20/10	29 (S)	22 (S)	18 (S)	19 (S)	11 (S)	34 (S)	29 (S)	30 (S)	23 (S)	14 (R)	24 (S)

AMPICILLIN												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		1	> 32	> 32	> 32	> 32	1	1	2	> 32	> 32	
F4		≤ 1(S)	>16(R)	>16(R)	>16 (R)	>16(R)	≤1(S)	≤1(S)	2(S)	>16 (R)	>16(R)	4 (I)
F12	<8->32	≤2 (S)	≥32 (R)	≥32 (R)	≥32 (R)	≥32 (R)	≤2 (S)	≤2 (S)	≤2 (S)	≥32 (R)	≥32 (R)	≤2 (S)
F25	1-32	≤1(S)	>32(R)	>32(R)	>32 (R)	>32(R)	≤1(S)	≤1(S)	≤1(S)	>32 (R)	>32(R)	4
F26	0.5-32	1 (S)	>32 (R)	>32 (R)	>32 (R)	>32 (R)	1 (S)	1 (S)	1 (S)	>32 (R)	>32 (R)	8
F28	1-32	≤1 (S)	>32 (R)	>32 (R)	>32 (R)	>32 (R)	≤1 (S)	≤1 (S)	≤1 (S)	>32 (R)	>32 (R)	4 (S)
F33	0.016-256	>256(R)	>256(R)	>256(R)	>256(R)	>256(R)	>256(R)	>256(R)	>256(R)	>256(R)	>256(R)	>256 (R)
F34	0.16-0256	1.0(S)	256(R)	256(R)	256 (R)	256(R)	1.0(S)	1.0(S)	1.0(S)	256 (R)	256(R)	4(S)
QC-range												2-8
Disk load		Inhibition zones in mm										
F1	10	22(S)	6(R)	6 (R)	6 (R)	6 (R)	27(S)	23(S)	25(S)	6(R)	6(R)	18(S)
F2	10	23-S	6-R	6-R	6-R	6-R	26-S	23-S	23-S	6-R	6-R	22
F3	10	30(S)	6(R)	6(R)	6(R)	6(R)	33(S)	29(S)	30(S)	6(R)	6(R)	23
F6	10	26 (S)	7 (R)	7 (R)	7 (R)	7 (R)	31 (S)	26 (S)	26 (S)	7 (R)	7 (R)	20 (S)
F8	10	20/S	6/R	6/R	6/R	6/R	23/S	21/S	21/S	6/R	6/R	17
F10		-	-	-	-	-	-	-	-	-	-	-
F11	10	26-S	6-R	6-R	6-R	6-R	30-S	28-S	26-S	6-R	6-R	20-S
F13	10	24 (S)	6 (R)	6 (R)	6 (R)	6 (R)	26 (S)	24 (S)	24 (S)	6 (R)	6 (R)	17
F14	10	26.02(S)	0(R)	0(R)	0(R)	0(R)	30.83(S)	25.95(S)	27.91(S)	0(R)	0(R)	16.64(I)
F15	10	25 (S)	6 (R)	6 (R)	6 (R)	6 (R)	27 (S)	23 (S)	23 (S)	6 (R)	6 (R)	17 (S)
F17	10	24 S	≤6 R	≤6 R	≤6 R	≤6*	26 S	21 S	23 S	≤6 R	≤6 R	17
F18	10	25 (S)	6 (R)	6 (R)	6 (R)	6 (R)	29 (S)	25 (S)	25 (S)	6 (R)	6 (R)	19
F19	10	23 (S)	6 (R)	6 (R)	6 (R)	6 (R)	22 (S)	25 (S)	22 (S)	6 (R)	6 (R)	16
F20	10	23 (S)	6 (R)	6 (R)	6 (R)	6 (R)	26 (S)	23 (S)	24 (S)	6 (R)	6 (R)	15 (I)
F22	10	26 (S)	6 (R)	6 (R)	6 (R)	6 (R)	28 (S)	25 (S)	24 (S)	6 (R)	6 (R)	21 (S)
F23	10	26 (S)	6 (R)	6 (R)	6 (R)	6 (R)	26 (S)	24 (S)	25 (S)	6 (R)	6 (R)	18
F24	10	25/S	0/R	0/R	0/R	0/R	29/S	26/S	25/S	0/R	0/R	20/S
F29	10	26 (I)	6 (R)	6 (R)	6 (R)	6 (R)	30 (I)	26 (I)	24 (I)	6 (R)	6 (R)	20 (I)
F30	10	25(S)	6(R)	6(R)	6(R)	6(R)	28(S)	24(S)	26(S)	6(R)	6(R)	19(S)
F31	10	24(S)	0(R)	0(R)	0(R)	0(R)	28(S)	24(S)	23(S)	0(R)	0(R)	17(S)
QC-range												16-22
Breakpoint												
F5	16	S	R	R	R	R	S	S	S	R	R	
F9	8-1.128	<8 (S)	>128(R)	>128(R)	>128(R)	>128(R)	<8 (S)	<8 (S)	<8 (S)	>128(R)	>128(R)	
F35	8	S	R	R	R	R	S	S	S	R	R	S
Combination												
F7	0.25-32 MIC	0,5 (S)	>32 (R)	>32 (R)	>32 (R)	>32 (R)	0,5 (S)	0,5 (S)	2 (S)	>32 (R)	>32 (R)	2 (S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

CEFOTAXIME												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		≤ 0.06	0.5	> 4	0.5	> 4	0.12	0.12	0.12	≤ 0.06	1	
F4		≤1(S)	≤1(S)	>16(R)	≤1(S)	>16 (R)	≤1(S)	≤1(S)	≤1(S)	≤1(S)	≤1(S)	≤1(S)
F12	<8-64	≤1 (S)	≤1 (S)	≥64 (R)	≤1 (S)	8 (S)	≤1 (S)	≤1 (S)	≤1 (S)	≤1 (S)	≤1 (S)	≤1 (S)
F25		0	0	0	0	0	0	0	0	0	0	0
F26	0.06-4	≤0.06(S)	0.25 (S)	> 4 (R)	0.25 (S)	> 4 (R)	0.12 (S)	≤0.06(S)	≤0.06(S)	0.12 (S)	0.5 (S)	≤ 0.06
F28		-	-	-	-	-	-	-	-	-	-	-
F33	0.016-256	0.047(S)	0.019(S)	>256(R)	0.25 (S)	8 (S)	0.032(S)	0.064S)	0.064(S)	0.047(S)	0.19 (S)	0.064 (S)
F34	0.002-32	0.06 (S)	0.25 (S)	256(R)	0.5(S)	16(R)	0.125(S)	1.0(S)	0.125(S)	0.125(S)	0.5(S)	0.125 (S)
QC-range												0.03 – 0.125
Disk load		Inhibition zones in mm										
F1	30	32(S)	33(S)	6 (R)	27(S)	13 (R)	34(S)	32(S)	32(S)	32(S)	34(S)	33(S)
F2	30	30-S	28-S	6-R	30-S	18-I	34-S	28-S	30-S	30-S	30-S	34
F3	30	37(S)	36(S)	6(R)	32(S)	19(I)	40(S)	33(S)	37(S)	35(S)	37(S)	35
F6	30	31 (S)	28 (S)	7 (R)	29 (S)	16 (I)	36 (S)	30 (S)	30 (S)	31 (S)	32 (S)	32 (S)
F8	30	30/S	32/S	6/R	30/S	17/I	32/S	29/S	30/S	31/S	27/S	29
F10		-	-	-	-	-	-	-	-	-	-	-
F11	30	34-S	32-S	10-R	32-S	24-S	34-S	30-S	28-S	28-S	34-S	30-S
F13	30	30 (S)	32 (S)	6(R)	30 (S)	9 (R)	36 (S)	31 (S)	30 (S)	31 (S)	30 (S)	32
F14	30	37.27(S)	35.08(S)	0(R)	33.83(S)	18.6 (I)	40.99(S)	35.85(S)	37.56(S)	36.03(S)	27.92(S)	34.9(S)
F15	30	33 (S)	32 (S)	6 R)***	27 (S)	16(R)***	35 (S)	31 (S)	32 (S)	33 (S)	34 (S)	32 (S)
F17	30	30 S	27 S	8 R	27 S	20*	34 S	25 S	30 S	30 S	34 S	32
F18	30	33 (S)	30 (S)	6 (R)	32 (S)	17 (I)	34 (S)	33 (S)	33 (S)	34 (S)	31 (S)	33
F19	30	35 (S)	31 (S)	6 (R)	29 (S)	16 (I)	37 (S)	31 (S)	30 (S)	32 (S)	34 (S)	31
F20	30	32 (S)	30 (S)	6 (R)	29 (S)	13 (R)	33 (S)	30 (S)	32 (S)	32 (S)	33 (S)	29 (S)
F22	30	27 (S)	15 (I)	6 (R)	18 (S)	6 (R)	26 (S)	26 (S)	26 (S)	22 (S)	6 (R)	18 (S)
F23	30	33 (S)	30 (S)	6 (R)	31 (S)	18 (I)	35 (S)	32 (S)	32 (S)	34 (S)	35 (S)	31
F24												
F29												
F30	30	34(S)	30(S)	6(R)	28(S)	17(I)	34(S)	32(S)	34(S)	32(S)	32(S)	32(S)
F31	30	33(S)	32(S)	0(R)	30(S)	18(I)	38(S)	32(S)	32(S)	33(S)	35(S)	35(S)
QC-range												29-35
Breakpoint												
F5	1	S	S	R	S	R	S	S	S	S	S	
F9	1	<1 (S)	<1 (S)	>1 (R)	<1 (S)	>1 (R)	<1 (S)	<1 (S)	<1 (S)	<1 (S)	<1(S)	
F35	1	S	S	R	S	R	S	S	S	S	S	S
Combination												
F7	0.25-32	≤0,25(S)	≤0,25(S)	>32(R)	≤0,25(S)	16 (R)	≤0,25(S)	≤0,25(S)	≤0,25(S)	≤0,25(S)	1 (S)	≤0,25(S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

CIPROFLOXACIN												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		0.5	0.25	2	1	2	0.5	≤ 0.03	0.25	≤ 0.03	1	
F4		0,5(S)	0,5(S)	2(I)	1(S)	2(I)	0,25 (S)	≤0,0625 S	0,25 (S)	≤0,0625 (S)	1(S)	≤0,06(S)
F12	<1->4	0.5 (R)	≤0.25 (R)	1 (R)	1 (R)	1 (R)	≤0.25 (R)	≤0.25 (S)	≤0.25 (R)	≤0.25 (I)	1 (R)	≤0.25 (S)
F25	0.015-4	0.25(S)	0.25 (S)	1(S)	0.5(S)	1(S)	0.25(S)	≤0.015(S)	0.25 (S)	≤0.015(S)	0.5 (S)	≤0.015
F26	0.008-8	0.5 (R)	0.25 (R)	2 (R)	0.5 (R)	2 (R)	0.25 (R)	0.015 (S)	0.25 (R)	0.03 (S)	1 (R)	0.015
F28	0.03-4	0.25 (R)	0.5 (R)	1 (R)	0.5 (R)	1 (R)	0.25 (R)	0.03 (S)	0.25 (R)	0.03 (S)	0.5 (R)	≤0.01 (S)
F33	0.002-32	0.25 S	0.25 (S)	0.5 (S)	0.5 (S)	0.75 (S)	0.19 (S)	0.023 (S)	0.19 (S)	0.032 (S)	0.38 (S)	0.016 (S)
F34	0.002-32	0.25(S)	0.25 (S)	0.5(S)	0.5(S)	1.0(S)	0.125(S)	0.015 (S)	0.125 (S)	0.015 (S)	0.5 (S)	0.008(S)
QC-range												0.004 – 0.015
Disk load		Inhibition zones in mm										
F1	5	32(S)	28/0,25 S	23/1 (S)	23/0,5(S)	22/1 (S)	32/0,125(S)	36 (S)	30/0,19 S	36(S)	28/0,75 S	36/0,012 S
F2	5	23-S	24-S	21-S	23-S	22-S	27-S	28-S	25-S	28-S	28-S	32
F3	5	29(S)	30(S)	22(S)	28(S)	24(S)	31(S)	36(S)	31(S)	38(S)	27 (S)	39
F6	5	23 (S)	22 (I)	21 (I)	25 (I)	21 (I)	30 (I)	30 (S)	25 (I)	31 (S)	24 (I)	33 (S)
F8	5	26/S	25/S	19/I	23/S	20/I	27/S	32/S	25/S	35/S	23/S	31
F10	5	28 (S)	30 (S)	25 (S)	26 (S)	25 (S)	30 (S)	35 (S)	28 (S)	37 (S)	25 (S)	35 (S)
F11	5	30-S	30-S	24-S	29-S	26-S	30-S	32-S	24-S	34-S	30-S	34-S
F13	5	24 (S)/ 0,25 RS	25 (S)/ 0,19 (S)	22 (S)/ 0,5 (RS)	21 S)/ 0,38 RS	23 S)/ 0,75 RS	31 S)/ 0,125 (S)	32(S)/ 0,012 (S)	26(S)/ 0,125 (S)	33 (S)/ 0,012 (S)	24 (S)/ 0,5 RS	36/0,08
F14	5	29.73 S	30.58(S)	24.47 (S)	27.43 S)	25.67(S)	34.37 (S)	37.53 (S)	32.44 (S)	39.41(S)	26.14(S)	34.36(S)
F15	5	25 (S)*	22 (R)**	15 (R)*	20 (R)**	16 (R)**	25 (R) **	34 (S)	28 (R) **	33 (S)	23 (R)**	32 (S)
F17	5	24 S	27 R	23 R	23 R	22 R	26 R	30 S	26 R	36 S	28 R	31
F18	5	30 (S)	29 (S)	23 (S)	27 (S)	24 (S)	30 (S)	35 (S)	30 (S)	37 (S)	25 (S)	35
F19	5	25 (S)	25 (S)	22 (S)	25 (S)	24 (S)	31 (S)	33 (S)	26 (S)	33 (S)	26 (S)	35
F20	5	23 (S)	26 (S)	22 (S)	24 (S)	23 (S)	29 (S)	30 (S)	27 (S)	33 (S)	26 (S)	32 (S)
F22	5	0,25 (R)	0, 19 (R)	0,5 (R)	0,38 (R)	0.5 (R)	0.094 (S)	33 (S)	0.094 (S)	30 (S)	0,38 (R)	35 (S)
F23	5	27 (S)	27 (S)	24 (S)	25 (S)	25 (S)	30 (S)	33 (S)	29 (S)	34 (S)	26 (S)	33
F24	5	31/S	27/R*	22/R*	28/R*	23/R*	31/R*	33/S	28/R*	34/S	25/R*	32,5/S
F29	5	27 (I)	27 (I)	24 (I)	26 (I)	24 (I)	32 (S)	36 (S)	28 (I)	36 (S)	28 (I)	36 (S)
F30	5	26(S)	26(S)	21(S)	22(S)	22(S)	30(S)	32(S)	32(S)	36(S)	23 (S)	38(S)
F31	5	0,25	0,19	0,75	0,38	0,75	0,125	32(S)	0,19	34(S)	0,38	36(S)
QC-range												30-40
Breakpnt												
F5	0.06, 2	I#	I#	I#	I#	I#	I#	S	I#	S	I#	
F9	0.125-1.1	<0.125 S	>0.125/ <1 I	>0.125/ <1 I	>0.125/ <1 I	>0.125/ <1 I	>0.125/ <1 I	<0.125 (S)	>0.125/ <1 I	<0.125 (S)	>0.125/ <1 I	
F35	0.125/0.5	S/S	R/S	R/R	R/R	R/R	R/S	S/S	R/S	S/S	R/R	S/S
Combi												
F7	0.063-8	0,25 (I)	0,125 (I)	0,5 (I)	0,5 (I)	0,5 (I)	0,125 (I)	≤0,063 (S)	0,125 (I)	≤0,063 (S)	1 (I)	≤0,063(S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

FLORFENICOL												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		4	16	16	> 64	8	4	8	4	8	16	
F4												
F12												
F25												
F26	2-64	4 (S)	16 (S)	16 (S)	>64 (R)	16(S)	4 (S)	8 (S)	4 (S)	4 (S)	16 (S)	4
F28	2-64	4 (S)	16 (I)	8 (S)	>64 (R)	8 (S)	≤2 (S)	4 (S)	4 (S)	4 (S)	4 (S)	4 (S)
F33												
F34		-	-	-	-	-	-	-	-	-	-	-
QC-range												2-8
Disk load		Inhibition zones in mm										
F1		-	-	-	-	-	-	-	-	-	-	-
F2												
F3												
F6												
F8												
F10		-	-	-	-	-	-	-	-	-	-	-
F11		-	-	-	-	-	-	-	-	-	-	-
F13												
F14												
F15		-	-	-	-	-	-	-	-	-	-	-
F17	30	24 S	19 I	21 I	≤6 R	21 I	26 S	23 S	23 S	23 S	22 S	23
F18												
F19												
F20												
F22												
F23		-	-	-	-	-	-	-	-	-	-	-
F24												
F29												
F30												
F31		-	-	-	-	-	-	-	-	-	-	-
QC-range												22-28
Breakpoint												
F5												
F9												
F35												
Combination												
F7		-	-	-	-	-	-	-	-	-	-	-

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

GENTAMICIN												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		0.5	32	0.5	0.5	≤ 0.25	1	1	1	0.5	16	
F4		≤0,5(S)	>8(R)	≤0,5(S)	≤0,5 (S)	≤0,5 (S)	≤0,5(S)	≤0,5(S)	≤0,5(S)	≤0,5(S)	>8(R)	
F12	<4- >8	≤1 (R)	≥16(R)	≤1 (R)	≤1 (R)	≤1 (R)	≤1 (R)	≤1 (R)	≤1 (R)	≤1 (R)	8 (R)	≤1 (S)
F25	0.25-16	0.5(S)	>16(R)	≤0.25(S)	0.5 (S)	0.5(S)	0.5(S)	0.5(S)	0.5(S)	≤0.25(S)	8(I)	0.5
F26	0.25-32	0.5 (S)	>32(R)	0.5 (S)	0.5 (S)	0.5 (S)	0.5 (S)	0.5 (S)	0.5 (S)	0.5 (S)	16 (R)	0.5
F28	1-32	≤0.5 (S)	>16(R)	≤0.5 (S)	≤0.5 (S)	≤0.5 (S)	≤0.5 (S)	≤0.5(S)	≤0.5(S)	≤0.5 (S)	4 (S)	≤0.5 (S)
F33	0.016-256	1.5 (S)	96 (R)	1.0 (S)	1.0 (S)	0.75 (S)	1.0 (S)	1.5 (S)	1.5 (S)	1.0 (S)	8 (R)	1.5 (S)
F34		-	-	-	-	-	-	-	-	-	-	-
QC-range												0.25 - 1
Disk load		Inhibition zones in mm										
F1	10	26(S)	6 (R)	21 (S)	22(S)	24(S)	21(S)	19 (S)	22(S)	23(S)	15(S)	21(S)
F2	10	21-S	6-R	23-S	23-S	24-S	22-S	19-S	21-S	21-S	21-S	22
F3	10	22(S)	6(R)	22 (S)	22(S)	26(S)	27(S)	22 (S)	24(S)	22(S)	13(I)	21
F6	10	21 (S)	7 (R)	22 (S)	23 (S)	25 (S)	25 (S)	20 (S)	21 (S)	23 (S)	11 (R)	21 (S)
F8	10	21/S	6/R	24/S	24/S	26/S	23/S	22/S	24/S	23/S	14/I	23
F10	10	23 (S)	6 (R)	27 (S)	29 (S)	30 (S)	29 (S)	25 (S)	26 (S)	26 (S)	19 (S)	25 (S)
F11	10	24-S	6-R	28-S	28-S	28-S	28-S	22-S	24-S	24-S	18-S	26-S
F13	10	19 (S)	6 (R)	20 (S)	20 (S)	22 (S)	22 (S)	18 (S)	20 (S)	20 (S)	13 (I)	21
F14	10	22.21(S)	0(R)	23.8 (S)	25.02(S)	27.02(S)	25.31(S)	22.5(S)	24.8(S)	24.04(S)	15.34(S)	22.22(S)
F15	10	20 (S)	6 (R)	21 (S)	21 (S)	23 (S)	21 (S)	19 (S)	20 (S)	21 (S)	11 (R)	19 (S)
F17	10	22 S	10 R	24 S	25 S	26 S	27 S	20 S	24 S	24 S	18 S	25
F18	10	25 (S)	8-R	26 (S)	26 (S)	27 (S)	26 (S)	23 (S)	24 (S)	25 (S)	15 (S)	24
F19	10	22 (S)	6 (R)	24 (S)	24 (S)	27 (S)	25 (S)	21 (S)	22 (S)	23 (S)	16 (S)	23
F20	10	19 (S)	6 (R)	21 (S)	22 (S)	24 (S)	24 (S)	20 (S)	22 (S)	22 (S)	13 (I)	20 (S)
F22	10	20 (S)	6 (R)	22 (S)	21 (S)	23 (S)	22 (S)	19 (S)	19 (S)	22 (S)	15 (S)	23 (S)
F23	10	22 (S)	7 (R)	22 (S)	24 (S)	25 (S)	24 (S)	21 (S)	23 (S)	22 (S)	15 (I)	20
F24	10	24/S*	11/R	25/S*	25/S*	26/S*	26/S*	22/S*	23/S*	24/S*	14/I*	24/S
F29												
F30	10	20(S)	6(R)	21 (S)	22 (S)	22 (S)	21 (S)	20 (S)	22(S)	20(S)	13(I)	21(S)
F31	10	23(S)	0(R)	25 (S)	25 (S)	26 (S)	26 (S)	22 (S)	23(S)	23(S)	14(I)	23(S)
QC-range												19-26
Breakpoint												
F5	8	S	R	S	S	S	S	S	S	S	S	
F9												
F35												
Combination												
F7	20/10 Disk	29 (S)	22 (S)	18 (S)	19 (S)	11 (S)	34 (S)	29 (S)	30 (S)	23 (S)	14 (R)	24 (S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

KANAMYCIN												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		≤ 4	> 128	≤ 4	≤ 4	≤ 4	> 128	≤ 4	≤ 4	≤ 4	> 128	
F4		4(S)	>32 (R)	≤2(S)	≤2 (S)	≤2(S)	>32(R)	≤2(S)	≤2(S)	≤2(S)	>32 (R)	≤0,5 (S)
F12		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F25	8-64	≤8(S)	>64 (R)	≤8(S)	≤8 (S)	≤8(S)	>64(R)	≤8(S)	≤8(S)	≤8(S)	32(I)	≤8
F26	4-128	≤ 4 (S)	>128(R)	≤ 4 (S)	≤ 4 (S)	≤ 4 (S)	>128(R)	≤ 4 (S)	≤ 4 (S)	≤ 4 (S)	64 (R)	≤ 4
F28		-	-	-	-	-	-	-	-	-	-	-
F33												
F34	0.016-256	2(S)	256 (R)	2(S)	2(S)	2(S)	256(R)	4(S)	2(S)	2(S)	16(S)	2(S)
QC-range												1-4
Disk load		Inhibition zones in mm										
F1	30	23(S)	6 (R)	23 (S)	23(S)	26(S)	6 (R)	22 (S)	23(S)	23(S)	15(I)	21(S)
F2	30	21-S	6-R	23-S	23-S	24-S	6-R	19-S	21-S	21-S	21-S	21
F3	30	22(S)	6(R)	23 (S)	24(S)	26(S)	6(R)	22 (S)	24 (S)	23(S)	14(I)	21
F6	30	20 (S)	7 (R)	22 (S)	23 (S)	24 (S)	7 (R)	21 (S)	21 (S)	21 (S)	10 (R)	20 (S)
F8	30	21/S	6/R	24/S	24/S	25/S	6/R	21/S	23/S	22/S	13/R	22
F10	30	12 (R)	6 (R)	24 (S)	25 (S)	26 (S)	6 (R)	22 (S)	24 (S)	24 (S)	13 (R)	22 (S)
F11	30	24-S	6-R	24-S	26-S	27-S	6-R	22-S	22-S	24-S	18-S	24-S
F13	30	20 (S)	6 (R)	22 (S)	21 (S)	23 (S)	6 (R)	21 (S)	22 (S)	21 (S)	12 (R)	22
F14	30	22.53(S)	0(R)	24.82(S)	26.97(S)	27.03(S)	0(R)	22.89(S)	25.66(S)	24.34(S)	15.27(I)	23.68(S)
F15	30	19 (S)	6 (R)	21 (S)	21 (S)	22 (S)	6 (R)	19 (S)	20 (S)	20 (S)	11 (R)	21 (S)
F17	30	22 S	≤6 R	25 S	25 S	25 S	≤6 R	20 S	24 S	26 S	18 S	23
F18	30	25 (S)	6 (R)	26 (S)	27 (S)	25 (S)	6 (R)	22 (S)	24 (S)	24 (S)	15 (I)	23
F19	30	23 (S)	6 (R)	24 (S)	25 (S)	26 (S)	6 (R)	21 (S)	22 (S)	23 (S)	13 (R)	22
F20												
F22	30	21 (S)	6 (R)	23 (S)	22 (S)	24 (S)	6 (R)	21 (S)	23 (S)	21 (S)	11 (R)	21 (S)
F23	30	22 (S)	6 (R)	23 (S)	25 (S)	26 (S)	6 (R)	22 (S)	24 (S)	23 (S)	15 (I)	21
F24	30	25/S*	0/R	26/S*	25/S*	26/S*	0/R	27/S*	24/S*	24/S*	17/I*	24/S
F29												
F30	30	20(S)	6(R)	21 (S)	22 (S)	24 (S)	6(R)	20(S)	22 (S)	22(S)	13 (R)	22(S)
F31		-	-	-	-	-	-	-	-	-	-	-
QC-range												17-25
Breakpoint												
F5	32	S	R	S	S	S	R	S	S	S	S	
F9												
F35												
Combination												
F7	20/10 Disk	29 (S)	22 (S)	18 (S)	19 (S)	11 (S)	34 (S)	29 (S)	30 (S)	23 (S)	14 (R)	24 (S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

NALIDIXIC ACID												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		16	> 64	> 64	> 64	> 64	> 64	≤ 4	> 64	8	> 64	
F4		>32(R)	>32 (R)	>32 (R)	>32 (R)	>32(R)	>32(R)	8(S)	>32 (R)	8(S)	>32 (R)	4(S)
F12	30µg (disk?)	0 (R)	0 (R)	0 (R)	0 (R)	0 (R)	0 (R)	19 (S)	0 (R)	15 (I)	0 (R)	21(S)
F25	0.5-32	8(S)	>32 (R)	>32 (R)	>32 (R)	>32(R)	>3 2(R)	2(S)	>32 (R)	4(S)	>32 (R)	1
F26	4-64	8 (S)	>64 (R)	>64 (R)	>64 (R)	>64 (R)	>64 (R)	≤ 4 (S)	>64 (R)	≤ 4 (S)	>64 (R)	≤ 4
F28	8-128	8 (S)	>64 (R)	>64 (R)	>64 (R)	>64 (R)	>64 (R)	≤4 (S)	>64 (R)	≤4 (S)	>64 (R)	≤4 (S)
F33	0.016-256	8 (S)	>256 (R)	>256 (R)	>256 (R)	>256 (R)	>256 (R)	2 (S)	>256 (R)	4 (S)	>256 (R)	2 (S)
F34	0.016-256	8(S)	256 (R)	256 (R)	256 (R)	256(R)	256 (R)	4(S)	256 (R)	4(S)	256 (R)	4(S)
QC-range												1-4
Disk load		Inhibition zones in mm										
F1	30	19(S)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	28 (S)	6 (R)	25(S)	6(R)	26(S)
F2	30	17-R	6-R	6-R	6-R	6-R	6-R	23-S	6-R	21-S	21-S	27
F3	30	18(I)	6(R)	6(R)	6(R)	6(R)	6(R)	24 (S)	6(R)	21(S)	6(R)	25
F6	30	14 (I)	7 (R)	7 (R)	7 (R)	7 (R)	7 (R)	22 (S)	7 (R)	16 (I)	7 (R)	22 (S)
F8	30	15/I	6/R	6/R	6/R	6/R	6/R	21/S	6/R	17/I	6/R	22
F10	30	-	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	22 (S)	6 (R)	21 (S)	6 (R)	24 (S)
F11	30	-	-	-	-	-	-	-	-	-	-	-
F13	30	19 (S)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	25 (S)	6 (R)	22 (S)	6 (R)	28
F14	30	20.35(S)	0(R)	0(R)	0(R)	0(R)	0(R)	26.97(S)	0(R)	25.93(S)	34.87(S)	29.8(S)
F15	30	15(I)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	24 (S)	6 (R)	21 (S)	6 (R)	26 (S)
F17	30	19 S	≤6 R	≤6 R	≤6 R	≤6 R	≤6 R	22 S	≤6 R	23 S	≤6 R	25
F18	30	19 (S)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	24 (S)	6 (R)	21 (S)	6 (R)	25
F19	30	15 (I)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	26 (S)	6 (R)	23 (S)	6 (R)	27
F20	30	10 (R)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	24 (S)	6 (R)	23 (S)	6 (R)	26 (S)
F22	30	13 (R)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	20 (S)	6 (R)	19 (S)	6 (R)	26 (S)
F23	30	20 (S)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	27 (S)	6 (R)	25 (S)	6 (R)	27
F24	30	18,5/S	0/R	0/R	0/R	0/R	0/R	21/S	0/R	20/S	0/R	22/S
F29	30	16 (R)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	24 (S)	6 (R)	23 (S)	6 (R)	29 (S)
F30	30	19(S)	6(R)	6(R)	6(R)	6(R)	6(R)	25 (S)	6(R)	24(S)	6(R)	28(S)
F31	30	16(I)	0(R)	0(R)	0(R)	0(R)	0(R)	25 (S)	0(R)	21(S)	0(R)	28(S)
QC-range												22-28
Breakpoint												
F5	16	S	R	R	R	R	R	S	R	S	R	
F9	16	<16 (S)	>16(R)	>16(R)	>16(R)	>16(R)	>16(R)	<16(S)	>16(R)	<16 (S)	>16 (R)	
F35	16	S	R	R	R	R	R	S	R	S	R	S
Combination												
F7	1-64 MIC	8 (S)	>64(R)	>64(R)	>64(R)	>64(R)	>64(R)	2 (S)	>64(R)	4 (S)	>64 (R)	2 (S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

NEOMYCIN												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		1	> 16	1	1	0.5	> 16	1	1	1	1	
F4												≤4(S)
F12												
F25												
F26												
F28	2-32	≤2 (S)	>32 (R)	≤2 (S)	≤2 (S)	≤2 (S)	>32 (R)	≤2 (S)	≤2 (S)	≤2 (S)	≤2 (S)	≤2 (S)
F33												
F34		-	-	-	-	-	-	-	-	-	-	-
QC-range												NA
Disk load		Inhibition zones in mm										
F1		-	-	-	-	-	-	-	-	-	-	-
F2												
F3	30	20	9	20	20	22	7	21	22	19	22	19
F6		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
F8												
F10		-	-	-	-	-	-	-	-	-	-	-
F11		-	-	-	-	-	-	-	-	-	-	-
F13												
F14												
F15	30	19	6	20	20	21	6	18	19	19	23	18
F17	30	20	10	21	20	24	10	18	20	21	24	20
F18												
F19												
F20												
F22												
F23		-	-	-	-	-	-	-	-	-	-	-
F24												
F29												
F30	30	18(S)	6(R)	18 (S)	20 (S)	20 (S)	6(R)	18 (S)	18 (S)	18(S)	20 (S)	18 (S)
F31		-	-	-	-	-	-	-	-	-	-	-
QC-range												17-23
Breakpoint												
F5												
F9	8	<8 (S)	>8 (R)	<8 (S)	<8 (S)	<8 (S)	>8 (R)	<8 (S)	<8 (S)	<8 (S)	<8 (S)	
F35												
Combination												
F7	MIC (mg/L)	1	> 16	1	1	0.5	> 16	1	1	1	1	

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

STREPTOMYCIN												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		4	> 128	128	128	32	> 128	16	4	> 128	128	
F4		≤4(S)	>64 (R)	32(R)	64(R)	32(R)	>64 (R)	16(I)	≤4(S)	>64(R)	>64 (R)	
F12		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F25	32-64	≤32 (S)	>64 (R)	≤32(S)	>64(R)	64(R)	64(R)	≤32(S)	≤32(S)	>64(R)	>64 (R)	≤32
F26	2-128	4 (S)	>128 (R)	32 (R)	64 (R)	32 (R)	128 (R)	8 (S)	4(S)	>128 (R)	64 (R)	4
F28	4-64	≤8 (S)	>128 (R)	16 (I)	64 (R)	32 (R)	64 (R)	≤8 (S)	≤8 (S)	>128 (R)	32 (R)	≤8 (S)
F33												
F34	0.064-1024	2(S)	256 (R)	32(S)	64(S)	32(S)	64(S)	8(S)	2(S)	128(R)	128 (R)	4(S)
QC-range												NA
Disk load		Inhibition zones in mm										
F1	10	15(S)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	16 (S)	18 (S)	6(R)	6(R)	15 (S)
F2	10	17-S	6-R	10-R	8-R	9-R	7-R	15-S	17-S	6-R	6-R	15
F3	10	22(S)	6(R)	12(I)	9(R)	10 (R)	9(R)	16 (S)	21 (S)	6(R)	11 (R)	18
F6	10	16 (S)	7 (R)	7 (R)	7 (R)	7 (R)	7 (R)	15 (S)	18 (S)	7 (R)	7 (R)	16 (S)
F8	10	19/S	6/R	11/R	9/R	9/R	8/R	15/S	21/S	6/R	7/R	20
F10	10	26 (S)	6	9	7	7	6	16	19	6	6	16
F11		-	-	-	-	-	-	-	-	-	-	-
F13	10	17 (S)	6 (R)	11 (R)	8 (R)	8 (R)	6 (R)	16 (S)	18 (S)	6 (R)	7 (R)	17
F14	10	18.37(S)	0(R)	11.0 (I)	7.33(R)	9.83(R)	0(R)	16.92 (S)	20.54(S)	0(R)	9.13 (R)	18.14(S)
F15	10	15 (S)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	12 (I)	16 (S)	6 (R)	6 (R)	15 (S)
F17	10	20 S	≤6 R	15 S	13 I	14 I	12 I	16 S	20 S	≤6 R	14 I	18
F18	10	19 (S)	6 (R)	11(R)	8 (R)	8 (R)	6 (R)	15 (S)	20 (S)	6 (R)	9 (R)	16
F19	10	17 (S)	6 (R)	8 (R)	6 (R)	6 (R)	6 (R)	15 (S)	17 (S)	6 (R)	6 (R)	16
F20												
F22	10	16 (S)	6 (R)	6 (R)	6 (R)	6 (R)	6 (R)	13 (I)	18 (S)	6 (R)	6 (R)	15 (S)
F23	10	18 (S)	5 (R)	8 (R)	7 (R)	8 (R)	6 (R)	16 (S)	19 (S)	6 (R)	8 (R)	16
F24	10	19,5/S*	0/R	17/S*	14/I*	15/S*	13/I*	18/S*	19/S*	8/R	9/R	18,3/S
F29	10	20 (S)	6 (R)	9 (R)	7 (R)	8 (R)	6 (R)	18 (S)	22 (S)	6 (R)	8 (R)	19 (S)
F30	10	17(S)	6(R)	11(R)	6(R)	6(R)	7(R)	14(I)	17 (S)	6(R)	9(R)	17 (S)
F31	10	17(S)	0(R)	0(R)	0(R)	0(R)	0(R)	14(I)	17 (S)	0(R)	0(R)	17 (S)
QC-range												12 – 20
Breakpoint												
F5												
F9												
F35												
Combination												
F7	20/10 Disk	29 (S)	22 (S)	18 (S)	19 (S)	11 (S)	34 (S)	29 (S)	30 (S)	23 (S)	14 (R)	24 (S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

SULFAMETHOXAZOLE + TRIMETHOPRIM												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		≤ 0.12	>16	> 16	0.25	1	≤0.12	≤0.12	≤0.12	≤0.12	>16	
F4		≤4(S)	>128(R)	>128 (R)	8(I)	>128(R)	≤4(S)	≤4(S)	≤4(S)	≤4(S)	>128 (R)	≤4(S)
F12	<2/38- >8/152	≤20 (S)	≥320 (R)	≥320 (R)	≤20 (S)	≤20 (S)	≤20 (S)	≤20 (S)	≤20 (S)	≤20 (S)	≥320 (R)	≤20 (S)
F25	0.12/2-4/76	≤0.12/2(S)	>4/76(R)	>4/76(R)	0.5/9.5(S)	4/76(R)	≤0.12/2(S)	≤0.12/2(S)	≤.012/2(S)	≤0.12/2(S)	>4/76(R)	≤0.12/2
F26												
F28		-	-	-	-	-	-	-	-	-	-	-
F33	0.002-32	0.064 (S)	>32 (R)	>32 (R)	0.38 (S)	1.5 (S)	0.094 (S)	0.094 (S)	0.125 (S)	0.25 (S)	>32 (R)	0.064 (S)
F34	0.002-32	16(S)	32 (R)	32(R)	0.5 (S)	1.0(S)	0.06 (S)	0.125(S)	0.125 (S)	0.125(S)	32(R)	0.125(S)
QC-range												<= 0.5/9.5
Disk load		Inhibition zones in mm										
F1	25	30(S)	6 (R)	6 (R)	24(S)	6 (R)	29(S)	30(S)	32 (S)	23(S)	6(R)	27 (S)
F2	1.25/23.75	27-S	6-R	6-R	21-S	15-R	27-S	25-S	27-S	20-S	20-S	29
F3	23.75/1.25	28(S)	6(R)	6(R)	20(S)	14(I)	27(S)	23(S)	23 (S)	23(S)	6(R)	25
F6	23.75/1.25	25 (S)	7 (R)	7 (R)	16 (S)	7 (R)	26 (S)	25 (S)	23 (S)	18 (S)	7 (R)	24 (S)
F8	23.75+1.25	22/S	6/R	6/R	15/I	18/S	24/S	21/S	21/S	18/S	6/R	24
F10	1.25/23.75	27 (S)	6 (R)	6 (R)	17 (S)	8 (R)	28 (S)	27 (S)	25 (S)	23 (S)	6 (R)	23 (S)
F11	23.75/1.25	24-S	6-R	6-R	16-S	22-S	27-S	24-S	24-S	20-S	6-R	28-S
F13	23.75+1.25	29 (S)	6 (R)	6 (R)	23 (S)	6 (R)	34 (S)	28 (S)	28 (S)	26 (S)	6 (R)	29
F14	25	30.97(S)	0(R)	0(R)	23.7 (S)	18.14(I)	35.29 (S)	32.15 (S)	32.1 (S)	28.49(S)	0(R)	28.12(S)
F15	25	31 (S)	6 (R)	6 (R)	21 (S)	12 (S)	30 (S)	29 (S)	29 (S)	28 (S)	6 (R)	27 (S)
F17	23.75/1.25	30 S	≤6 R	≤6 R	20 S	22 S	32 S	26 S	28 S	22 S	≤6 R	26
F18	1.25/23.75	24 (S)	6 (R)	6 (R)	6 (R)	25 (S)	25 (S)	20 (S)	24 (S)	6 (R)	6 (R)	19
F19												
F20	25	27 (S)	6 (R)	6 (R)	19 (S)	6 (R)	28 (S)	26 (S)	27 (S)	24 (S)	6 (R)	27 (S)
F22	25	32 (S)	6 (R)	6 (R)	24 (S)	6 (R)	31 (S)	31 (S)	31 (S)	28 (S)	6 (R)	27 (S)
F23		-	-	-	-	-	-	-	-	-	-	-
F24	23.75+1.25	26,2/S	0/R	0/R	17/S	19/S	29/S	24/S	25/S	18/S	0/R	25,4/S
F29	23.75+1.25	32 (S)	6 (R)	6 (R)	22 (I)	6 (R)	34 (S)	31 (S)	30 (S)	26 (S)	6 (R)	30 (S)
F30	23.75+1.25	30(S)	6(R)	6(R)	22(S)	10 (R)	28(S)	32(S)	28 (S)	24(S)	6(R)	28 (S)
F31		-	-	-	-	-	-	-	-	-	-	-
QC-range												23-29
Breakpoint												
F5												
F9												
F35												
Combination												
F7	0.063/1.19-4/76 MIC	≤0,063/1,19 (S)	>8/152 (R)	>8/152 (R)	0,25/4,75 (S)	4/76 (R)	≤0,063/1,19 (S)	≤0,063/1,19 (S)	0,125/2,38 (S)	0,25/4,75 (S)	>8/152 (R)	≤0,063/1,19 (S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).

SULPHONAMIDE												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		16	>1024	>1024	>1024	≤8	≤8	≤8	32	≥ 1024	≥1024	
F4												≤4(S)
F12												
F25	16-256	32(S)	>256 (R)	>256 (R)	>256(R)	32(S)	32(S)	64(S)	32(S)	>256 (R)	>256 (R)	32
F26	8-1024	≤ 8 (S)	>1024 (R)	>1024 (R)	>1024 (R)	≤ 8 (S)	≤ 8 (S)	≤ 8 (S)	32 (S)	>1024 (R)	>1024 (R)	≤ 8
F28		-	-	-	-	-	-	-	-	-	-	-
F33												
F34	0.064-1024	12(S)	1024 (R)	1024 (R)	1024(R)	32(S)	64(S)	128 (S)	64(S)	1024 (R)	1024 (R)	32 (S)
QC-range												8-32
Disk load		Inhibition zones in mm										
F1	300	21(S)	6 (R)	6 (R)	6 (R)	24(S)	22(S)	24(S)	18(S)	6(R)	6(R)	25 (S)
F2	250/300	26-S	6-R	6-R	6-R	27-R	26-S	24-S	24-S	6-R	6-R	23
F3												
F6	300	25 (S)	7 (R)	7 (R)	7 (R)	25 (S)	16 (I)	16 (I)	16 (I)	7 (R)	7 (R)	22 (S)
F8	250	19/S	6/R	6/R	6/R	22/S	19/S	20/S	18/S	6/R	6/R	20/S
F10	200	29 (S)	6 (R)	6 (R)	6 (R)	28 (S)	29 (S)	22 (S)	25 (S)	6 (R)	6 (R)	21 (S)
F11		-	-	-	-	-	-	-	-	-	-	-
F13	0.25	20(S)	6 (R)	6 (R)	6 (R)	20(S)	22(S)	17(S)	20(S)	6 (R)	6 (R)	23
F14	300											
F15	300	26 (S)	6 (R)	6 (R)	6 (R)	24 (R)	25 (S)	20 (S)	22 (S)	6 (R)	6 (R)	23 (S)
F17	300	27 S	≤6 R	≤6 R	≤6 R	26 S	26 S	20 S	25 S	≤6 R	≤6 R	22
F18	300	28 (S)	6 (R)	6 (R)	20 (S)	21 (S)	30 (S)	27 (S)	26 (S)	25 (S)	6 (R)	26
F19	300	23 (S)	6 (R)	6 (R)	6 (R)	25 (S)	24 (S)	21 (S)	21 (S)	6 (R)	6 (R)	19
F20												
F22	200	28 (S)	6 (R)	6 (R)	6 (R)	25 (S)	22 (S)	20 (S)	26 (S)	6 (R)	6 (R)	18 (S)
F23	300	26 (S)	6 (R)	6 (R)	6 (R)	26 (S)	20 (S)	18 (S)	23 (S)	6 (R)	6 (R)	23
F24	250	16/I	0/R	0/R	0/R	23/S	25/S	13/I	16/I	0/R	0/R	20,7/S
F29	250	30 (S)	6 (R)	6 (R)	6 (R)	28 (S)	23 (S)	20 (S)	23 (S)	6 (R)	6 (R)	23 (S)
F30												
F31	300	25(S)	0(R)	0(R)	0(R)	28(S)	28(S)	23(S)	24 (S)	0(R)	0(R)	23 (S)
QC-range												15-23
Breakpoint												
F5												
F9	64	<64 (S)	>64 (R)	>64 (R)	>64 (R)	<64 (S)	<64 (S)	<64 (S)	<64 (S)	>64 (R)	>64 (R)	
F35	64	S	R	R	R	S	S	S	S	R	R	S
Combination												
F7	300 disk											

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S)

TRIMETHOPRIM												
Labcode	Method	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	ATCC 25922
MIC		MIC values in mg/l										
CVI		≤0.5	>32	>32	≤0.5	>32	≤0.5	≤0.5	≤0.5	≤0.5	>32	
F4												
F12		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F25												
F26	0.5-32	≤ 0.5 (S)	>32 (R)	>32 (R)	≤ 0.5 (S)	>32 (R)	≤ 0.5(S)	≤ 0.5 (S)	≤0.5 (S)	≤0.5 (S)	>32 (R)	≤ 0.5
F28	4-32	≤1 (S)	>32 (R)	>32 (R)	≤1 (S)	>32 (R)	≤1 (S)	≤1 (S)	4 (S)	≤1 (S)	>32 (R)	≤1 (S)
F33												
F34	0.002-32	0.25 (S)	32(R)	32(R)	1.0(S)	32(R)	0.25 (S)	0.5(S)	0.5(S)	0.25 (S)	32(R)	0.5 (S)
QC-range												0.5 – 2
Disk load		Inhibition zones in mm										
F1	5	30(S)	6 (R)	6 (R)	22(S)	6 (R)	26(S)	26(S)	26(S)	27(S)	6(R)	21(S)
F2	5	27-S	6-R	6-R	23-S	6-R	28-S	24-S	26-S	25-S	25-S	28
F3	5	29(S)	6(R)	6(R)	26(S)	6(R)	26(S)	25(S)	23(S)	30(S)	6(R)	25
F6	5	26 (S)	7 (R)	7 (R)	22 (S)	7 (R)	27 (S)	26 (S)	25 (S)	27 (S)	7 (R)	22 (S)
F8	5											
F10	5		6 (R)	6 (R)	23 (S)	6 (R)	30 (S)	28 (S)	26 (S)	30 (S)	6 (R)	25 (S)
F11		-	-	-	-	-	-	-	-	-	-	-
F13	5	29 (S)	6 (R)	6 (R)	25 (S)	6 (R)	32 (S)	28 (S)	28 (S)	30 (S)	6(R)	28
F14												
F15	5	31 (S)	6 (R)	6 (R)	26 (S)	6 (R)	31 (S)	29 (S)	30 (S)	33 (S)	6 (R)	27 (S)
F17	5	27 S	≤6 R	≤6 R	25 S	≤6 R	29 S	25 S	25 S	30 S	≤6 R	23
F18	5	28 (S)	6 (R)	6 (R)	23 (S)	6 (R)	28 (S)	27 (S)	26 (S)	27 (S)	6 (R)	25
F19	5	27 (S)	6 (R)	6 (R)	24 (S)	6 (R)	30 (S)	26 (S)	25 (S)	28 (S)	6 (R)	23
F20	5	27 (S)	6 (R)	6 (R)	24 (S)	6 (R)	30 (S)	26 (S)	27 (S)	28 (S)	6 (R)	24 (S)
F22	5	32 (S)	6 (R)	6 (R)	27 (S)	6 (R)	31 (S)	32 (S)	32 (S)	32 (S)	6 (R)	27 (S)
F23	5	32 (S)	6 (R)	6 (R)	6 (R)	6 (R)	32 (S)	29 (S)	29 (S)	31 (S)	6 (R)	25
F24	5	24/S	0/R	0/R	19/S	0/R	26/S	24/S	23/S	24/S	0/R	23/S
F29												
F30												
F31	5	30(S)	0(R)	0(R)	24(S)	0(R)	31(S)	28(S)	28(S)	31(S)	0(R)	36(S)
QC-range												21-28
Breakpoint												
F5	8	S	R	R	S	R	S	S	S	S	R	
F9	2	<2 (S)	>2 (R)	>2 (R)	>2 (R)	>2 (R)	<2(S)	<2 (S)	<2 (S)	<2 (S)	>2 (R)	
F35	2	S	R	R	S	R	S	S	S	S	R	S
Combination												
F7	0.25-32	≤0,5 (S)	>32 (R)	>32 (R)	≤0,5 (S)	>32 (R)	≤0,5 (S)	≤0,5 (S)	≤0,5 (S)	≤0,5 (S)	>32 (R)	≤0,5 (S)

Dark grey cells = Resistant (R); Light grey cells = Intermediate (I); White cells = Susceptible (S).