Emergence of Multidrug-Resistant Salmonella Concord Infections in Europe and the United States in Children Adopted From Ethiopia, 2003–2007

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Background: Multidrug-resistant *Salmonella* serovar Concord infections have been reported from children adopted from Ethiopia. We interviewed patients, characterized the isolates, and gathered information about adoptions from Ethiopia to assess public health implications.

Methods: Information about *Salmonella* Concord cases and adoptions were provided from Austria, Denmark, England (and Wales), Ireland, the Netherlands and the United States. Patients from Denmark and the United States were interviewed to determine the orphanages of origin; orphanages in Ethiopia were visited. Isolates were subtyped by pulsed-field gel electrophoresis and antimicrobial susceptibility; specific antimicrobial resistance genes were characterized.

Results: *Salmonella* Concord was isolated from 78 persons from 2003 to 2007. Adoption status was known for 44 patients ≤3 years of age; 98% were adopted from Ethiopia. The children adopted from Ethiopia were from several orphanages; visited orphanages had poor hygiene and sanitation and frequent use of antimicrobial agents. The number of children adopted from Ethiopia in the participating countries increased 527% from 221 in 2003 to 1385 in 2007. Sixty-four *Salmonella* Concord isolates yielded 53 pulsed-field gel electrophoresis patterns including 6 patterns with >2 indistinguishable isolates; one isolate from an Ethiopia adoptee. Antimicrobial susceptibility was performed on 43 isolates; 81% were multidrug-resistant (≥3 agents). Multidrug-resistant isolates were from Ethiopian adoptees and were resistant to third and fourth generation cephalosporins and 14% had decreased susceptibility to ciprofloxacin.

Conclusions: Improved hygiene and sanitation and more appropriate use of antimicrobial agents are needed in orphanages in Ethiopia. Culturing of stool specimens of children adopted from Ethiopia and appropriate hygiene may prevent further disease transmission.

Key Words: *Salmonella*, Ethiopia, adoptees, ESBL, multi-drug resistance

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Salmonella enterica is a common cause of human gastroenteritis worldwide.[1–3] Although most *Salmonella* infections are self-limiting, severe infections resulting in bacteremia, meningitis, and death may occur. Antimicrobial agents may be life-saving in severe infections. Third generation cephalosporins and fluoroquinolones are commonly used for the treatment of *Salmonella* infections in children and adults, respectively.[4,5] Infections caused by antimicrobial-resistant *Salmonella* are more likely to require hospitalization, and may result in more severe outcomes.[6–8]

In 2007, infections caused by *Salmonella* serovar Concord, a rare *Salmonella* serotype, were reported in several countries among children adopted from Ethiopia; the isolates from these infections were resistant to numerous antimicrobial agents including third generation cephalosporins.[9,10] To prevent further infections, we conducted a multinational investigation, in collaboration with the Ethiopia Ministry of Health, to determine the likely sources of the infections.

PATIENTS AND METHODS

Epidemiologic Information

Public health institutes in Europe and the United States which identified human *Salmonella* Concord infections in 2003 to 2007 were invited to participate in the study. Participating countries sent isolates to the National Food Institute (DTU-Food) in Denmark and provided information about patients including those ≤3 years of age. Adoption status and country of origin were provided if available. Patients, or parents of patients <18 years of age, in Denmark and the United States were interviewed to determine the orphanage of origin for adopted patients and if the patient had international travel before illness onset or used antimicrobial agents before specimen collection. Information about adoptions from Ethiopia was sought from national agencies in participating countries. In collaboration with the Ethiopian Nutrition and Health Research Institute, orphanages in Ethiopia were visited in February 2008.

Laboratory

Isolates were serotyped at public health laboratories and confirmed at DTU-Food.[11] Isolates were subtyped by pulsed-field gel electrophoresis (PFGE) at state public health laboratories in the United States and DTU-Food according the PulseNet protocol

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using *Xba I* digestion.[12] PFGE patterns were compared using BioNumerics 4.6 (Applied Maths, Sint- Martens-Latem, Belgium). Minimum inhibitory concentrations (MICs) to 25 antimicrobial agents were determined using Sensititre microbroth dilution.[13] CLSI interpretive criteria were used for amikacin, ampicillin, aztreonam, cefazolin, cefepime, cefpodoxime, ceftazidime, ceftriaxone, cefuroxime, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, imipenem, nalidixic acid, sulfamethoxazole, tetracycline, and trimethoprim[14–16]; and DTU-Food-defined resistance breakpoints were used for apramycin (>16 mg/L), ceftiofur (>4 mg/L) (a third generation cephalosporin used in veterinary medicine), colistin (>8 mg/L), florfenicol (>16 mg/L) (a phenicol used in veterinary medicine), neomycin (>8 mg/L), spectinomycin (>64 mg/L), and streptomycin (>16 mg/L) (http://www.crl-ar.eu/_pdf/monitoring_reports/Danmap%202006.pdf).
Decreased susceptibility to ceftriaxone and ciprofloxacin was defined as an MIC ≥2 mg/L and MIC ≥0.125 mg/L, respectively. Resistance to ≥3 antimicrobial agents of different classes was defined as multidrug-resistant.

Multidrug-resistant strains were further characterized using a polymerase chain reaction (PCR) assay with primers specific for 8 antimicrobial resistance genes[13] (Table, Supplemental Digital Content 1, http://links.lww.com/INF/A144). PCR products were purified (GFX PCR DNA kit Amersham Biosciences), and submitted to Macrogen Inc. for sequencing. Sequence analysis and alignment was performed using Vecton NTI suite 9 (InforMax, Inc.). Resulting nucleotide sequences were compared with sequences obtained from GenBank (available at: http://www.lahey.org/studies/webt.html). Conjugation of selected multidrug-resistant isolates was performed using previously described methods.[17,18] Transconjugation was verified by PCR using primers specific for $bla_{\text{CTX-M-15}}$ and $bla_{\text{SHV-12}}$. Plasmid analysis was performed on selected transconjugants and their respective donors by S1-nuclease digestion and PFGE.

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RESULTS

Public health institutes in Austria, Denmark, England (and Wales), Ireland, the Netherlands and the United States reported 78 cases of laboratory-confirmed *Salmonella* Concord infections from 2003 to 2007. In the United States, *Salmonella* Concord was isolated from 48 persons; 3 in 2003, 4 in 2004, 5 in 2005, 12 in 2006, and 24 in 2007. In the 5 participating European countries, *Salmonella* Concord was isolated 30 persons; 1 in 2003, 9 in 2004, 10 in 2005, 8 in 2006 and 2 in 2007 (Fig. 1). During the study period, *Salmonella* Concord was isolated from 12 persons in Austria, 3 in Denmark, 9 in England (and Wales), 2 in Ireland, and 4 in the Netherlands. Gender were known for 67 patients; 41 (61%) were female. Age was known for 75 patients. The median age was

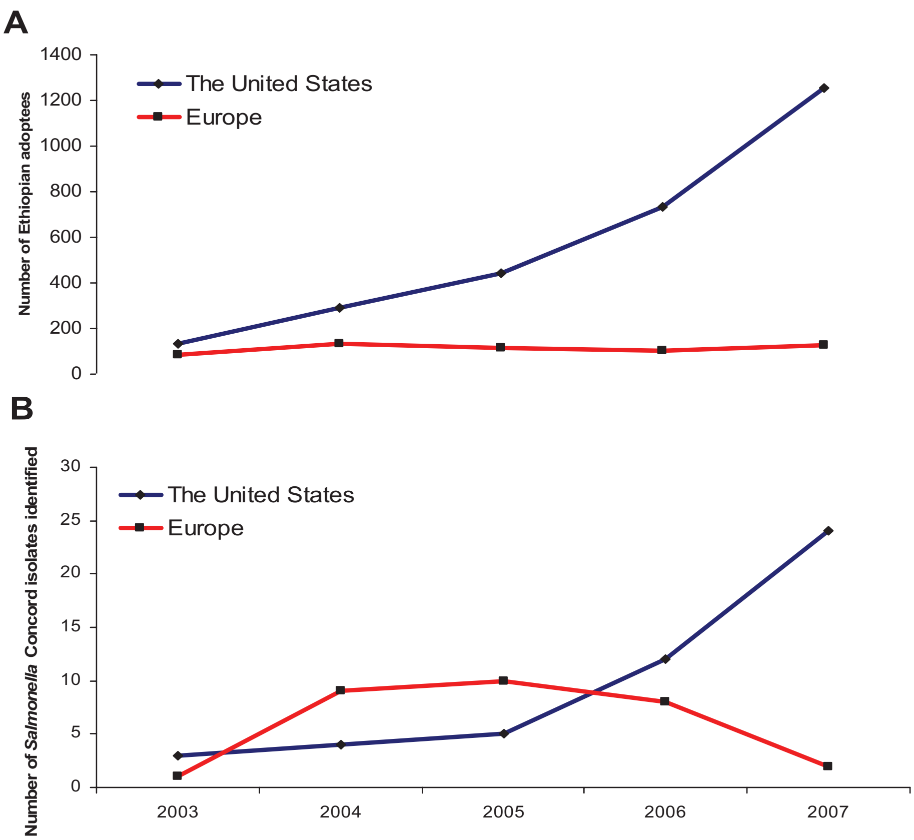

FIGURE 1. Number of children adopted from Ethiopia (A) and number of reported laboratory-confirmed cases of *Salmonella* serotype Concord (B) per year in participating countries in Europe* and the United States, 2003–2007. *No adoption data were available for Austria. References: http://www.adoptionsnaevnet.dk/; http://travel.state.gov/family/adoption/notices/notices_473.html; http://www.adoptie.nl/; http://www.adoptionboard.ie/; http://www.dfes.gov.uk/intercountryadoption/general.shtml.

12 months (range: 2 months–76 years); 56 (75%) were ≤3 years of age and 11 (15%) were >18 years of age. Adoption status was known for 44 (79%) of the patients ≤3 years of age; of these, 43 (98%) were adopted. The patient who was ≤3 years of age and was not adopted was a sibling of a child adopted from Ethiopia. All 43 adopted children were from Ethiopia except for 1 child who was adopted from an unspecified African country. Of the 43 adopted children, 10 adopted children were brought to Austria and 33 to the other participating countries (29 to the United States, 3 to Denmark, and 1 to England). Six (54%) patients >18 years of age were female; of these, 2 were mothers of children adopted from Ethiopia.

We interviewed patients or parents for 31 (61%) of the 51 patients in Denmark and the United States. Among the 25 interviewed patients ≤3 years of age, 24 (96%) were adopted from Ethiopia. For the children adopted from Ethiopia, the median time in one or more orphanages in Ethiopia was 3 months (range: 1–6.5 months). Stool specimens which yielded *Salmonella* Concord from the children adopted from Ethiopia were collected an average of 32 days following adoption (range: 2–185 days). Six (25%) of the children adopted from Ethiopia were asymptomatic at the time of adoption and specimen collection; 1 asymptomatic child had a stool specimen cultured because of an ill sibling, and 5 asymptomatic children had stool specimens cultured resulting from recommendations by his or her pediatrician. Eighteen (75%) of the children adopted from Ethiopia were symptomatic at the time of adoption; all had diarrhea, 7 (39%) had fever; 4 (22%) had bloody diarrhea, and 3 (17%) were hospitalized. Median duration of illness was 11 days (range: 5–90 days). One child received antimicrobial agents after illness onset and before specimen collection. Information regarding the adoption agency in Ethiopia was reported for 18 (75%) of the adopted children; the children were adopted from 8 different orphanages in Addis Abba, Ethiopia.

A total of 3419 children were adopted from Ethiopia from 2003 to 2007 and brought to countries participating in this study (no adoption information was available from Austria); during this 5-year period, the number of children adopted from Ethiopia increased 527% from 221 adoptions in 2003 to 1385 in 2007. Of the 2852 children adopted from Ethiopia and brought to the United States, 1987 (70%) occurred in the last 2 years. Of the 567 children adopted from Ethiopia and brought to 1 of the 4 European countries with adoption information participating in this study, 233 (41%) occurred in the last 2 years. During the study period, 188 children adopted from Ethiopia were brought to Denmark, 14 to England (and Wales), 66 to Ireland, and 299 to the Netherlands (Fig. 1).

Two orphanages in Ethiopia from where at least 3 patients were adopted were visited. Children at the orphanages were most commonly abandoned at police stations shortly after birth. Family or medical history before arrival at the orphanage was seldom known. Children typically stayed at the orphanages for at least 3 months before being adopted or sent to another agency. Poor hygiene and sanitation was observed at the orphanages. Cases of dehydration and diarrhea were reported among the children in the orphanages. According to physicians at the orphanages, young children in the orphanages were typically treated for diarrhea with ceftriaxone, gentamicin and sulfamethoxazole, or with trimethoprim and sulfamethoxazole; older children received ciprofloxacin.

Laboratory

Salmonella Concord isolates from 64 (82%) of the 78 patients were subtyped by PFGE. Fifty-three unique *Xba*I PFGE patterns were observed (Fig., Supplemental Digital Content 2, http://links.lww.com/INF/A145). There were 6 PFGE patterns with ≥2 indistinguishable isolates. The pattern with the most indistinguishable isolates included those from 7 children of which at least 5 isolates were from children adopted from Ethiopia. Each of the remaining 5 patterns with ≥2 indistinguishable isolates included at least 1 isolate from a child adopted from Ethiopia including 1 pattern with indistinguishable isolates from a child adopted from Ethiopia and his adopted mother.

Isolates were available for antimicrobial susceptibility testing for 43 (55%) of the 78 patients; 8 (19%) were susceptible to all agents and 35 (81%) were multidrug-resistant. Travel history was known for 4 of the patients infected with pansusceptible *Salmonella* Concord. None reported associations with Ethiopia but all were adults who traveled to Kenya before illness onset; one adult also traveled to South Africa, Zambia, and Malawi. Travel or adoption status was known for 30 of the 35 patients infected with multidrug-resistant isolates. All were either from or associated with a child adopted from Ethiopia. All multidrug-resistant isolates were resistant to ampicillin, aztreonam, cefazolin, cefepime, cefpodoxime, ceftazidime, ceftiofur, cefuroxime, cephalothin chloramphenicol, streptomycin, sulfamethoxazole, and trimethoprim. All multidrug-resistant isolates also had decreased susceptibility to ceftriaxone; 34 (97%) were ceftriaxone-resistant. Of the multidrug-resistant isolates, 34 (97%) were resistant to gentamicin, 24 (69%) were resistant to tetracycline, and 6 (14%) showed decreased susceptibility to ciprofloxacin.

At least 1 isolate was available for antimicrobial susceptibility testing from 3 of the 6 PFGE patterns with ≥2 indistinguishable isolates; each of these available isolates was multidrug-resistant and was from a child adopted from Ethiopia.

All 35 multidrug-resistant isolates harbored a bla_{TEM} gene and bla_{CTX} gene; sequence analysis of the PCR products showed 100% identity to $bla_{\mathrm{TEM\text{-}1b}}$ and $bla_{\mathrm{CTX\text{-}M\text{-}15}}$, respectively. Of the multidrug-resistant isolates, 13 (37%) also harbored the bla_{SHV} gene; sequence analysis revealed 100% identity to $bla_{\mathrm{SHV\text{-}12}}$. Nine multidrug-resistant isolates were selected for conjugation studies. Five transconjugants were successfully recovered yielding the same susceptibility pattern as the donors. After digestion with S1 enzyme and PFGE, a plasmid of approximately 380 kb. was observed. Two isolates yielded transconjugants with less resistance than the donors (resulted in limited resistance to ampicillin, cephalothin, cefpodoxime, and ceftiofur). After digestion with S1 and PFGE, a single plasmid of approximately 80 kb was observed in these 2 isolates. PCR confirmed the presence of the genes bla_{CTX} and the bla_{SHV} in all transconjugants.

The 6 multidrug isolates with decreased susceptibility to ciprofloxacin were characterized. Three isolates were indistinguishable by PFGE and contained the plasmid mediated quinolone resistance gene *qnr*B; these isolates were isolated from children adopted from Ethiopia and brought to the United States. Two isolates with different PFGE patterns contained the quinolone resistance gene *qnr*A gene; these isolates were isolated from children adopted from Ethiopia and brought to Austria. The remaining isolate had a single base substitution in the *gyr*A gene at codon 83 ([TCC {Ser} → TTC {Phe}]); this isolate was from a 1-year old child in the United Kingdom with an unknown adoption history.

DISCUSSION

In this multinational study, we demonstrate that multidrug-resistant *Salmonella* Concord infections are common among children adopted from Ethiopia. We found that from 2003 to 2007, at least 33 (1.0%) of the 3419 children adopted from Ethiopia and brought to the United States and 4 European countries had a laboratory-confirmed *Salmonella* Concord infection. In the United

States alone the number was 24 cases of 2852 (0.8%) Ethiopian adoptees. Most of these infected children were symptomatic, some with severe symptoms. Since only a fraction of *Salmonella* infections are laboratory-confirmed, these data suggest a remarkably high incidence of *Salmonella* infection among children in orphanages in Ethiopia. It is not known how long this *Salmonella* strain has been present in these orphanages, but the diversity of PFGE patterns (no indication of temporal evolution among the patterns) among the children adopted from Ethiopia and the adoption of infected children from at least 8 orphanages in Ethiopia indicates an endemic problem in Ethiopian orphanages. The increasing isolation of this strain in the United States and Europe likely reflects that increasing frequency of adoption of children from Ethiopia. Ethiopia was the fourth most common country of origin for adoptions in Denmark and the United States in 2007 following China, Vietnam and South Africa in Denmark (Available at: http://www.adoptionsnaevnet.dk), and China, Guatemala and Russia in the United States (Available at: http://travel.state.gov/family/adoption/stats/stats_451.html).

The highly resistant nature of the *Salmonella* Concord isolates from children adopted from Ethiopia makes antimicrobial treatment difficult. Although antimicrobial agents are not necessary for the treatment of most *Salmonella* infections, antimicrobial treatment can be life-saving in severe infections.[4,5] All of the isolates from children adopted from Ethiopia were resistant to 19 antimicrobial agents including all antimicrobial agents commonly used to treat *Salmonella* infections in children. Furthermore, some of the isolates from children adopted from Ethiopia had decreased susceptibility to ciprofloxacin; treatment of such infections with fluoroquinolones is not advised because such treatment has been associated with treatment failures.[19,20]

The highly resistant isolates from children adopted from Ethiopia illuminates the need for more appropriate use of antimicrobial agents in orphanages in Ethiopia. The empiric treatment of children with diarrhea at the orphanages with a combination of ceftriaxone, gentamicin, and sulfamethoxazole is particularly worrisome. It is not known if other countries have similar endemic *Salmonella* problems in orphanages but the transmission of multidrug-resistant Salmonella has been reported in orphanages in other countries in Africa; in a similar study of multidrug-resistant *Salmonella* Babelsberg and *Salmonella* Enteritidis infections in France among children adopted from Mali, the highly resistant nature of the isolates was thought to be due to the heavy use of antimicrobial agents in orphanages in Mali.[21] Preventing further infections in orphanages in Ethiopia and elsewhere should focus on improvements in hygiene and sanitation. The highly resistant nature of *Salmonella* Concord in the orphanages in Ethiopia demonstrates the difficulties in controlling such infections using antimicrobial agents. Treatment of children with diarrhea should focus on supportive care particularly rehydration. Antimicrobial agents should be reserved for treatment of patients at risk for serious infections or with systemic symptoms.

This study provides useful information for parents adopting children from Ethiopia and perhaps elsewhere. The American Academy of Pediatrics recommends that a stool specimen be collected from all adopted children and cultured for bacterial pathogens including *Salmonella*.[22–24] Adherence to this recommendation identified *Salmonella.* Concord infections in several asymptomatic children adopted from Ethiopia. The utility of this recommendation was highlighted in this study since we identified several instances in which family members were infected with *Salmonella* Concord which was apparently introduced into the family from an adopted child. Furthermore, considering the alarmingly high frequency of antimicrobial resistance among the *Salmonella* Concord isolates from adopted children in this study including resistance to third and fourth generation cephalosporins and ciprofloxacin, it may be useful to test *Salmonella* isolates isolated from adopted children for antimicrobial susceptibility.

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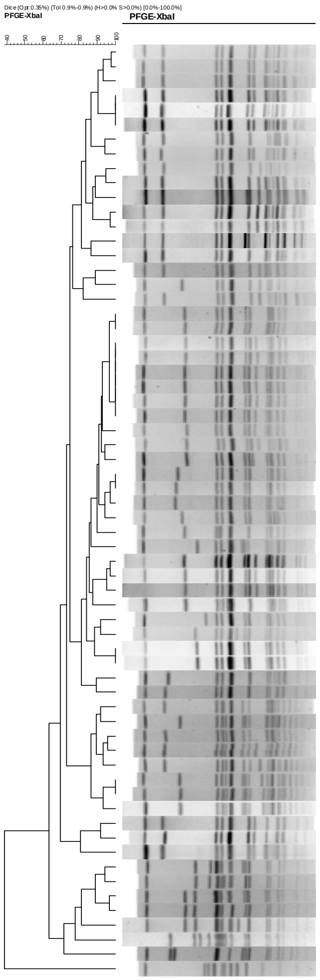
Table 1. Oligonucleotide primer sequences used for the amplification of the various resistance genes.

Resistant gene	Sequence	Anneling temp.(°C)	Amplicon size (bp)
bla $_{CTX}$	5'-CCGTTTCCSCTATTACAAACCG-3' 5'-GATCCGCGTGATACCACTTCA-3'	65	354
bla $_{CTX}$	5'-CCATGGTTAAAAAATCACTGCG-3' 5'-TGGGTRAARTARGTSACCAGAAYSAGCGG-3'	60	805
bla $_{TEM}$	5'-ACCAATGCTTAATCAGTGAG-3' 5'-GCGGAACCCCTATTTG-3'	55	1017
bla $_{SHV}$	5'-TTATCTCCCTGTTAGCCACC-3' 5'-GATTTGCTGATTTCGCTCGG-3'	60	797
qnrA	5'-GGATGCCAGTTTCGAGGA-3' 5'-TGCCAGGCACAGATCTTG-3'	59	492
qnrB	5'-ATGACGCCATTACTGTATAA-3' 5'-GATCGCAATGTGTGAAGTTT-3'	53	562
qnrS	5'-CGACGTGCTAACTTGCGTGATA-3' 5'-TACCCAGTGCTTCGAGAATCAG-3'	57	538
aac(6')Ib	5'-TTGCGATGCTCTATGAGTGGCTA-3' 5'-CTCGAATGCCTGGCGTGTTT-3'	55	482
gyr A	5'-TAC CGT CAT AGT TAT CCA CGA-3' 5'-GTA CTT TAC GCC ATG AAC GT-3'	60	313

Figure 2. Dendrographic analysis of PFGE (*Xba*I) of *Salmonella* Concord isolates (n=64) from Austria, Denmark, Ireland, the Netherlands, England including Wales and the United States.



Travel / Origin	Age	Country of isolation	Year of isolation	AR. genes	Resistance profile
Ethiopian Adoptee	21m	USA	2007	TEM-1b, CTX-M15, SHV-12, qnrB	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CIP,CHL,FFN,GEN,STR,SMX,TET,TMP
Ethiopian Adoptee	1y	USA	2007	TEM-1b, CTX-M15, SHV-12, qnrB	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CIP,CHL,FFN,GEN,STR,SMX,TET,TMP
Ethiopian Adoptee	1y	USA	2007	TEM-1b, CTX-M15, SHV-12, qnrB	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CIP,CHL,FFN,GEN,STR,SMX,TET,TMP
Unknown	1y	USA	2007		
Ethiopian Adoptee	5m	USA	2007		
African Adoptee (country not specified)	1y	USA	2007		
Ethiopian Adoptee	1y	USA	2007	TEM-1b, CTX-M15, SHV-12	AMP,ATZ,CEP,FAZ,POD,CAZ,XNL,FUR,CHL,FFN,GEN,STR,SMX,TET
Ethiopian Adoptee	4m	Austria	2005	TEM-1b, CTX-M15, SHV-12	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,FFN,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	2m	Austria	2005	TEM-1b, CTX-M15, SHV-12	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	2y	USA	2007		
Ethiopian Adoptee	9m	USA	2007		
Ethiopian Adoptee, sibling to BAC0700004311	3y	USA	2007		
Ethiopian Adoptee, sibling to BAC0700003260	5y	USA	2007		
Ethiopian Adoptee	8m	USA	2006		
Unknown	7m	USA	2007		
Ethiopian Adoptee	3m	Austria	2005	TEM-1b, CTX-M15, SHV-12	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Sibling of 1404/05	1y	Austria	2005	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	1y	Denmark	2005	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,FFN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	6m	Austria	2004	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Unknown	<1y	The Netherlands	2004	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	infant	Ireland	2005	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	infant	Ireland	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	1y	USA	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	<1y	USA	2007	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Unknown	<2y	The Netherlands	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	5m	Austria	2005	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Unknown	<1y	The Netherlands	2005	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	6m	Denmark	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	4y	USA	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	6m	USA	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	10m	Austria	2004	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,STR,SMX,TET,TMP
Ethiopian Adoptee	1y	Austria	2004	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Unknown	<1y	The Netherlands	2003	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	6m	USA	2007	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	1y	USA	2007	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	4m	USA	2005		
Ethiopian Adoptee	5m	USA	2005		
Mother of Ethiopian adoptee	33y	USA	2006		
Ethiopian Adoptee	3m	USA	2005		
Ethiopian Adoptee	7m	Denmark	2005	TEM-1bCTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TET,TMP
Ethiopian Adoptee	6m	USA	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,SPE,STR,SMX,TMP
Ethiopian Adoptee	1y	USA	2007		
Unknown	1y	USA	2007		
Unknown	20y	England & Wales	2004		Susceptible
Unknown	53y	England & Wales	2005		Susceptible
Ethiopian Adoptee	4m	Austria	2007	TEM-1b, CTX-M15, SHV-12, qnrA	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CIP,CHL,GEN,STR,SMX,TET,TMP
Ethiopian Adoptee	1y	England & Wales	2006	TEM-1b, CTX-M15, SHV-12	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,STR,SMX,TET,TMP
Ethiopian Adoptee	3m	Austria	2006	TEM-1b, CTX-M15, SHV-12, qnrA	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CIP,CHL,GEN,STR,SMX,TET,TMP
Ethiopian Adoptee	7m	Austria	2006	TEM-1b, CTX-M15	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,STR,SMX,TET,TMP
Unknown	1y	England & Wales	2007	TEM-1b, CTX-M15, SHV-12, GyrA-mut	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CIP,CHL,GEN,NAL,STR,SMX,TET,TMP
Ethiopian Adoptee	3m	USA	2007	TEM-1b, CTX-M15, SHV-12	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,STR,SMX,TET,TMP
Mother of Ethiopian adoptee	39y	Austria	2006	TEM-1b, CTX-M15, SHV-12	AMP,AZT,CEP,FAZ,FEP,POD,CAZ,XNL,CRO,FUR,CHL,GEN,STR,SMX,TET,TMP
Ethiopian Adoptee	8m	USA	2007		
Travel to Israel	33y	USA	2003		
Unknown	3y	USA	2003		
Ethiopian Adoptee	1y	USA	2007		
Travel S.Africa, Zambia, Malawi	21y	USA	2007		Susceptible
Kenya	25y	England & Wales	2006		Susceptible
Unknown	58y	England & Wales	2004		Susceptible
Kenya	8y	England & Wales	2004		Susceptible
Domestic travel to Calfornia, US	76y	USA	2005		
Unknown	Unknown	USA	2004		
Kenya	26y	England & Wales	2004		Susceptible
Unknown	1y	England & Wales	2004		Susceptible

amikacin, AMI; ampicillin, AMP; apramycin, APR; aztreonam, AZT, cefalothin, CEP; cefazolin, FAZ; cefepime, FEP; cefpodoxime, POD; ceftazidime, CAZ; ceftiofur, XNL; ceftriaxone, CRO; cefuroxime, FUR; chloramphenicol, CHL; ciprofloxacin, CIP; colistin COL; florfenicol, FFN; gentamicin, GEN; imipenem, IMI; nalidixic acid, NAL; neomycin, NEO; spectinomycin, SPE; streptomycin, STR; sulphamethoxazole, SMX; tetracycline, TET and trimethoprim, TMP.