Antibiotic Resistant *Escherichia coli* in Uncooked Meat Purchased from Large Chain Grocery Stores and in Raw Dog Food Purchased From Pet Stores in the Same City.

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Abstract

Although previous studies have associated feeding dogs uncooked meat with their carriage and excretion of antibiotic resistant (ABR) *Escherichia coli*, this practice remains popular amongst dog owners in some countries, including the UK. Uncooked meat fed to dogs is purchased from stores selling meat primarily for human consumption, or it is a brand of commercial raw dog food (RDF), which is commonly sold frozen and thawed prior to feeding. We tested 58 packets of uncooked meat (beef, chicken, lamb and pork) purchased from large chain grocery stores (15 stores) and 15 packets of thawed, chicken-based RDF (11 brands) for the presence of ABR *E. coli*. All samples were purchased from the city of Bristol, UK. Among grocery store-purchased meat, chicken samples were significantly more likely to be positive for *E. coli* resistant to amoxicillin, spectinomycin, streptomycin, and the critically important antibiotics cefotaxime and ciprofloxacin, than other types of meat. When comparing grocery store chicken to chicken-based RDF we found no significant difference in sample-level positivity for resistant *E. coli*, which, for RDF was 80% (amoxicillin), 80% (spectinomycin), 87% (streptomycin), 27% (amoxicillin-clavulanate), 27% (cefotaxime) and 47% (ciprofloxacin). We conclude that despite it having been purchased frozen and thawed prior to testing according to the manufacturer's instructions, contamination of RDF with ABR *E. coli* is similar to that of uncooked meat primarily intended for human consumption after cooking, and so the same strict hygiene practices are advised when handling RDF as uncooked meat. Our findings provide a rationale to explain why feeding uncooked meat or RDF to dogs in the city of Bristol is associated with them excreting *E. coli* resistant to critically important antibiotics.

32 **Introduction**

33 Many food and health agencies promote safe handling and thorough cooking of meat
34 to kill bacteria and reduce the risk of foodborne illness (FSA 2023, CDC 2023, WHO
35 2001). In this regard, *E. coli* is a commensal residing in the intestines of humans and
36 other warm-blooded animals, but it is also an important acute and opportunistic
37 pathogen (Kaper *et al* 2004). For example, pathogenic *E. coli* are the second most
38 common causal species for food-borne diarrhea outbreaks worldwide and are
39 responsible for 100% of haemolytic uraemic syndrome cases (Warmate & Onarinde
40 2023). In terms of opportunistic human infections derived from fecal colonizing flora,
41 *E. coli* is also the leading cause of urinary tract infections, can cause respiratory tract
42 infections and meningitis, and is one of the most common causes of potentially life
43 threatening bloodstream infections (Jang *et al* 2017). Antibiotic resistant (ABR)
44 opportunistic *E. coli* infections are commonly reported in both human and veterinary
45 medicine, posing a serious threat to health (Poirel *et al* 2018).

46 Meat products become contaminated with bacteria, including *E. coli,* from faeces
47 during slaughter and processing (FSA 2022). Faecal matter on feet, hide and from the
48 intestines of animals can transfer onto meat during evisceration and processing in the
49 abattoir. Cross-contamination can occur via workers, equipment, tools, surfaces and
50 aerosols, and through direct contact between pieces of meat (FSA 2022). Regulations
51 are in place to mitigate faecal contamination in the UK and meat sold for consumption
52 by humans and domestic pets is regulated to ensure it falls within certain
53 bacteriological limits. For commensal/opportunistic *E. coli*, these acceptable limits vary
54 but can be hundreds of colony forming units per gram of meat. Hence, unhygienic
55 practices whilst handling, storing and preparing uncooked meat in the home, and
56 eating undercooked meat, may lead to unwanted ingestion of *E. coli* derived from

57 farmed animal feces. If these are ABR *E. coli*, there is the potential for this to increase
58 the burden of ABR opportunistic infections in humans.

59 In addition to these relatively well understood risks associated with meat preparation
60 and cooking when destined for human consumption, it has become apparent in recent
61 years that such risks are amplified when people choose to feed domestic pets
62 uncooked meat. For example, in a study of 600 adult dogs from the city of Bristol, UK,
63 and surrounding counties, we found positive associations between dogs being fed
64 uncooked meat and the likelihood that samples of feces from these dogs were positive
65 for third generation cephalosporin resistant (3GC-R) or fluoroquinolone resistant (FQ-
66 R) *E. coli* (Sealey *et al* 2022, Sealey *et al* 2023). These are considered critically
67 important antibiotics by the World Health Organisation (WHO 2019). In a separate UK-
68 wide study, we demonstrated that feeding uncooked meat was positively associated
69 with the excretion of ABR *E. coli*, including FQ-R *E. coli* in dogs of less than 16 weeks
70 of age (Mounsey et al, 2022). Other studies have also reported an association
71 between excretion of ABR bacteria by dogs and them being fed uncooked meat (Groat
72 *et al* 2022, Runesvard *et al* 2020, Lefebvre *et al* 2008). Therefore, it is clear that people
73 who feed uncooked meat are not only exposed to the potential hazards of handling
74 meat contaminated with ABR *E. coli* more often than those who do not chose this
75 practice, but that they are further exposed by interactions with dogs more likely to
76 excrete ABR *E. coli*. This so far unquantified risk potentially extends to other members
77 of the household, and even outside the household, for example, affecting people that
78 interact with environments contaminated with canine faeces (Schlesinger & Joffe
79 2011, Damborg *et al* 2016).

80 Though there is a body of evidence that feeding uncooked meat increases the risk of
81 dogs encountering pathogenic and ABR bacteria, this practice remains popular

amongst dog owners in some countries (Morgan et al 2024, Davies et al 2019). A recent survey in the UK reported that around 50% of those who feed dogs uncooked meat prepare this food themselves, suggesting that the meat comes from sources primarily sold for human consumption after cooking (Morgan et al 2024). The remainder fed commercial raw dog food (RDF). There have been many studies worldwide showing that uncooked meat sold for human consumption is contaminated with ABR *E. coli*, including 3GC-R or FQ-R *E. coli* and some confirming this is also true for RDF (Lee et al 2023, Kim et al 2020, Davies *et al* 2019, Schlesinger & Joffe 2011). In the UK, a comprehensive study of uncooked meat for human consumption sold in large chain grocery stores identified that sample-level positivity for 3GC-R *E. coli* producing extended-spectrum β-lactamases (ESBLs; a common mechanism of 3GC resistance) was 65.4%, 2.5% and 1.9% among samples of uncooked chicken, pork and beef meat, respectively (Randall *et al* 2017). In another UK-based study (Morgan et al. 2024) 99% of RDF (n=110 packets, with meat from various animal sources) were positive for *E. coli*, of which 39% were positive for *E. coli* resistant to at least one class of antibiotic, including 3GC-R (16%) or FQs (8% of samples). A study in Italy investigating meat that was intended for human consumption but destined for RDF reported most poultry, pork, and beef packets tested positive for *E. coli* (100%, 100% and 93.3%, respectively), and identified 18.2% of *E. coli* were ESBL producers (Bacci *et al* 2019). In contrast, a study in the USA on chicken, turkey, beef, and pork retail meat reported 68%, 70%, 20% and 32% of samples tested positive for *E. coli*, 2% were positive for 3GC-R *E. coli*, being from poultry only (Lee et al 2023). The variation seen in levels of *E. coli* and ABR *E. coli* in meat from different studies could be due to a range of factors depending on country and/or how the studies were carried out, though most studies use a standardized method which uses 25 g of sample.

107 Due to the popularity of and potential ABR *E. coli* transmission risks associated with
108 feeding uncooked meat to dogs, and because we have identified associations between
109 this practice and the excretion of ABR *E. coli* by dogs within the city of Bristol, UK, our
110 aim was to compare sample-level positivity rates for *E. coli* resistant to a variety of
111 antibiotics in uncooked meat of different animal sources bought from large chain
112 grocery stores and that sold as RDF within Bristol.

113

114 **Results**

115 *Sample-level positivity for ABR* E. coli *in meat sold for human consumption*

116 Of 58 packets of meat sampled, purchased from large chain grocery stores across 5
117 postal districts with in the city of Bristol, 47 were positive for *E. coli* (81%). This was
118 highest for chicken (100%), being significantly higher (Fishers exact test $p < 0.05$) than
119 for pork, which had the lowest sample-level positivity for *E. coli* (69%) (**Table 1**). We
120 next tested samples for *E. coli* resistant to specific antibiotics or representatives of
121 antibiotic classes that have historically been and in some cases are currently used to
122 treat farmed animals: spectinomycin and streptomycin (both aminoglycosides), the β-
123 lactams amoxicillin, amoxicillin-clavulanate and cefotaxime (representative of the
124 3GCs) and ciprofloxacin (representative of FQs). Chicken meat samples from large
125 chain grocery stores were found to have the highest sample-level positivity for ABR *E.*
126 *coli*, being 100% for spectinomycin and streptomycin, 93% for amoxicillin, which were
127 significantly higher than found for these antibiotics in beef, lamb or pork (Fishers exact
128 test $p < 0.05$) (**Table 1, Table 2**). Resistance to amoxicillin-clavulanate was also
129 highest in chicken, 33%, however the difference was not significant compared with
130 other types of meat. Furthermore, 47% of chicken samples were positive for *E. coli*

131 resistant to critically important ciprofloxacin. Whilst FQ-R *E. coli* positivity was
132 observed in meat from all animal sources, lamb and pork had significantly lower
133 positivity rates than chicken (Fishers exact test $p < 0.05$). Positivity for FQ-R *E. coli* in
134 beef was not significantly lower than chicken (**Table 1, Table 2**). Seven percent of
135 chicken samples were positive for cefotaxime resistant (3GC-R) *E. coli*. Beef was the
136 only other type of meat positive for 3GC-R (13% of samples), not significantly different
137 from that found in chicken. We did not detect 3GC-R *E. coli* in samples of lamb or pork.
138 Sample-level positivity for streptomycin resistant *E. coli* was the most frequent
139 resistance type for beef and lamb, whereas pork samples had the same sample-level
140 positivity for these two agents and amoxicillin (38%) (**Table 1, Table 2**).

141

142 *Prevalence of Resistant* E. coli *in RDF*

143 We chose to sample RDF purchased at specialist pet stores from one protein source,
144 chicken, for comparison with chicken sold for human consumption, given that it had
145 the highest levels of sample-level positivity for *E. coli* resistant to all but one test
146 antibiotic. We found that 13 (87%) of RDF samples were positive for *E. coli*, which is
147 not significantly lower than that found for chicken meat sold at large chain grocery
148 stores (Fishers exact test $p=0.48$). Overall, we found no statistically significant
149 difference between sample-level positivity in RDF compared with uncooked chicken
150 meat purchased at large chain grocery stores for *E. coli* resistant to amoxicillin,
151 amoxicillin-clavulanate spectinomycin, streptomycin, cefotaxime and ciprofloxacin
152 (Fishers exact test $p > 0.05$, **Table 1, Table 3**).

153

154

155 **Discussion**

156 The first aim of this study was to test for ABR *E. coli* in samples of uncooked meat sold
157 primarily for human consumption at large chain grocery stores, and also RDF sold by
158 specialist pet stores in the same city, Bristol, UK. Secondly, to determine whether
159 sample-level positivity for ABR *E. coli* differs between uncooked meat from different
160 animal origins, and in the case of chicken meat, between meat sold at a large chain
161 grocery stores, primarily for human consumption after cooking (but also fed to dogs
162 without cooking), and RDF sold for consumption by dogs. This is the first study to
163 compare ABR *E. coli* in meat sold for consumption to the local human and canine
164 populations within a city or other confined geographical location. Of the different
165 animal sources of meat sold primarily for human consumption, we found that chicken
166 had greater sample-level positivity for ABR *E. coli* than beef, lamb or pork. But there
167 was no significant difference between sample-level positivity for *E. coli* in chicken meat
168 sold for human consumption and RDF stated as being from chicken. Whilst we tested
169 for ABR *E. coli* in samples of packaged meat from large chain grocery stores rather
170 than smaller butchers shops, it has previously been reported that there is no significant
171 difference in *E. coli* counts for meat from stores packed in a modified atmosphere
172 verse those freshly butchered (Diaz-Jimenez *et al* 2021). So we are reasonably
173 confident that our survey is one representative of most meat sold for human
174 consumption in our study region.

175 Our overall finding of little significant difference between sample-level positivity for
176 resistant *E. coli* in chicken meat sold for human consumption and RDF is not surprising
177 as both types of product sold in the UK are produced from the same source; RDF in
178 the UK is regulated to 'category 3' classification, meat intended for human
179 consumption but has been removed from production for reasons other than being a

public or animal health risk. For example, parts of slaughtered animals not popular for human consumption are frequently used to make RDF (FSA 2024, EC 2018).

Reports concerning sample-level positivity for ABR in meat sold primarily for human consumption vary between studies. In a large survey in the USA, 43% of retail meat samples were contaminated with bacteria (Innes et al 2023), which is lower than reported here. However, as we found, chicken meat was reported as having the highest positivity for bacterial contamination (Innes et al 2023). More in keeping with the results presented here, however, a Spanish survey testing chicken and turkey meat products for *E. coli* found 92% of each were positive (Díaz-Jiménez et al 2021). Sample-level positivity rates for ABR *E. coli* in chicken meat was 72%, 16%, 42%, and 70% for ampicillin, amoxicillin-clavulanate, cefotaxime and ciprofloxacin, respectively. Resistance to critically important antibiotics was therefore more common than reported here.

Our study was rather unusual in including the measurement of sample level positivity for *E. coli* resistant to antibiotics only used to treat farmed animals (in the UK), including streptomycin and spectinomycin. Many studies have only investigated ESBL producing *E. coli* in uncooked meat because these cause resistance to the critically important 3GCs. In a large UK study (Randall *et al* 2017), ESBL *E. coli* were found considerably more often in samples of chicken meat than beef or pork (65%, vs ~2%), 85.6% of the ESBL positive *E. coli* from chicken meat carried resistance gene $bla_{CTX-M-1}$, which is found only rarely among ESBL *E. coli* from human infections, for example in the city of Bristol (Findlay et al 2020). In comparison, in Singapore, ESBL-producing *E. coli* were found in 51.2%, 26.9% and 7.3% of chicken, pork and beef meat samples (Guo et al 2021). A UK-based study comparing UK-reared and imported uncooked chicken products for FQ-R, ESBL-producing *E. coli*, found 2% and 37% of samples

were positive, respectively (Warren *et al* 2008). Another study found ESBL-producing *E. coli* from uncooked chicken imported into the UK was caused by CTX-M groups 2 and 8 (Dhanji et al 2010), which are very rare in clinical *E. coli* from the UK (Findlay et al., 2000).

For RDF, a study in the USA reported 10% of samples positive for ESBL-producing Enterobacterales, of which 76% were *E. coli*. Pork RDF had the highest sample-level positivity (38%) for ESBL-producers, followed by beef (10%), and chicken (7%) (Cole et al 2022). A recent survey in the UK on RDF report 14% of samples were positive for ESBL-producing *E. coli*, 47% of these positive samples were RDF stated as being made from offal/tripe, 33% from chicken, 17% beef, and 17% lamb, though it should be noted most samples were mixed protein sources with 67% of the offal based RDF contained chicken (Morgan *et al* 2024). Contrastingly, in Switzerland 61% RDF samples were positive for ESBL Enterobacterales, of which 85% were *E. coli*. Sample-level positivity for ESBL producers was highest in beef 87%, versus 62% and 17% in chicken and lamb, respectively (Nüesch-Inderbinen et al 2019). Interestingly, both Morgan *et al* (2024) and Nüesch-Inderbinen et al (2019) reported 76% and 73% of samples, respectively, did not meet the bacterial limit by UK and EU regulatory standards for RDF.

RDF sold in the UK is mostly stored frozen prior to preparation for consumption, and most owners believe that the freezing process kills bacteria (Morgan *et al* 2022). However, as is clearly evident from this study and others (Morgan *et al* 2024, Cole et al 2022, Davies *et al* 2019) ABR *E. coli* are present in defrosted RDF, which likely explains epidemiological findings that feeding RDF is associated with an increased likelihood that dogs excrete ABR bacteria (Groat *et al* 2022, Runesvard *et al* 2020, Davies et al 2019, Lefebvre *et al* 2008, Sealey *et al* 2022, Sealey *et al* 2023).

230 To conclude, uncooked meat contains ABR *E. coli*, including those resistant to critically
231 important antibiotics, whether they are intended for consumption by humans (once
232 cooked) or dogs (uncooked). Although strict regulations and procedures are in place
233 to reduce contamination with highly pathogenic bacteria such as *Salmonella* and
234 enteropathogenic *E. coli*, contamination with faecal commensals such as *E. coli*
235 cannot be avoided, and a certain amount of contamination with *E. coli* is accepted
236 within the regulations. This is because there is little acute threat to health, and because
237 practices of thoroughly cooking meat, decontaminating of surfaces that have come
238 into contact with uncooked meat and thoroughly washing hands after handling it will
239 minimise accidental ingestion of such ABR *E. coli*. However, the practice of feeding
240 RDF (or uncooked meat of any source) provides a strong One Health transmission
241 link for ABR *E. coli* between farmed and domestic animals because of the degree of
242 ABR *E. coli* contamination identified here and elsewhere. Enhanced hygiene practices
243 when serving RDF and interacting with dogs fed RDF are advised, since, whilst
244 commensal *E. coli* pose little acute health risk following ingestion, most urinary tract
245 and bloodstream *E. coli* infections are opportunistic, and come from commensal
246 bacteria carried in the intestines of the infected person, and so any ABR *E. coli* stably
247 entering the intestinal microbiome carries with it the risk of a resistant opportunistic
248 infection at some point in the future.

249

250 **Methodology**

251 *Sample collection*

252 We identified five sampling areas by postcode region (mean population per region is
253 approximately 25,000) within the city of Bristol. For each region, we chose three large

254 chain grocery stores to gain a representative sample of the meat available from such
255 stores in the city of Bristol. Four types of uncooked meat: beef, chicken, lamb and
256 pork, sold for human consumption after cooking were purchased from each store. The
257 cuts of meat were as follows; minced beef, minced lamb, chicken thighs and pork
258 chops. Samples were collected from all three stores in a postcode region, with each
259 region visited sequentially, one region per week, during October and November 2022.
260 A total of fifteen samples per type of meat were collected, except for pork where 13
261 samples were collected because there was no availability at the time of visiting two
262 stores. Samples were kept at 4°C and processed within the "use by" date.

263 RDF stores were identified within the City of Bristol. Using a convenience based
264 strategy, we purchased one of each brand of chicken-based RDF available in stores
265 at each visit. A total of 15 packets of RDF were collected in September 2023, covering
266 11 brands across five stores. As RDF is sold frozen, on the day of purchase RDF
267 samples were left at 4°C overnight to thaw and processed the next day.

268

269 *Sample processing and microbiology*

270 Under sterile conditions, packets were opened, and 200 g of meat was placed into a
271 stomacher bag (Stomacher® 400 Classic Standard Bag) with 200 mL of *E. coli*
272 enrichment broth (Oxoid LTD). Bags were sealed and placed into screw-top plastic
273 jars for incubation for 5 h, 37°C, with shaking at 180 rpm. The liquid culture was aliquot
274 into Eppendorf tubes and mixed with glycerol to achieve 25% v/v, and stored at -75°C.
275 Twenty microliters of each stock was then plated and spread onto Tryptone Bile X-
276 Glucuronide (TBX) agar to test for the presence of *E. coli*, and onto TBX with
277 antibiotics: amoxicillin (8 mg/L), spectinomycin (32 mg/L), streptomycin (32 mg/L),

278 amoxicillin-clavulanate (8 mg/L), cefotaxime (2 mg/L), and ciprofloxacin (0.5 mg/L)
279 according to EUCAST (2023) breakpoints to select for resistant *E. coli*. Plates were
280 incubated at 37°C for 18 h, and sample-level positivity was measured. For positivity,
281 at least one blue colony must have grown on the plate. Up to 10 colonies were replated
282 onto antibiotic-containing TBX agar to confirm resistance.

283

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291

292 **Transparency declaration**

293 M.B.A. is married to the owner of a veterinary practice that sells various mass-
294 manufactured dog foods amounting to a value less than 5% of total turnover.
295 Otherwise, the authors declare no competing interests.

296

297 **Author Contributions**

298 Conceived the Study: J.E.S., M.B.A.

299 Collection of Data: J.E.S.

Cleaning and Analysis of Data: J.E.S.

Initial Drafting of Manuscript: J.E.S., M.B.A.

Corrected and Approved Manuscript: All authors

Table 1. Sample-level positivity for *E. coli* in meat sold primarily for human consumption at large chain grocery stores and in chicken-based RDF sold at specialist pet stores. Total samples tested in brackets.

	Samples positive for *E. coli* in									
Selection	**Beef (15)**		**Chicken (15)**		**Lamb (15)**		**Pork (13)**		**RDF (15)**	
TBX only	12	80%	15	100%	11	73%	9	69%	13	87%
AMX	5	33%	14	93%	5	33%	5	38%	12	80%
SPC	4	27%	15	100%	4	27%	5	38%	12	80%
STR	7	47%	15	100%	6	40%	5	38%	13	87%
AMC	2	13%	5	33%	3	20%	2	15%	4	27%
CTX	2	13%	1	7%	0	0%	0	0%	4	27%
CIP	2	13%	7	47%	1	7%	1	8%	7	47%

Table 2. Samples of meat sold for primarily for human consumption positive for *E. coli* on TBX without antibiotics and with the 6 test antibiotics.

	Positive for *E. coli* selected on						
SampleID	**TBX only**	**AMX**	**SPC**	**STR**	**AMC**	**CTX**	**CIP**
B1.A	+	+	+	+	+	+	-
B1.B	+	+	+	+	-	-	-
B1.C	+	+	-	+	-	-	+
B2.A	+	-	-	-	-	-	-
B2.B	+	+	-	+	-	-	+
B2.C	+	+	+	-	+	+	-
B3.A	-	-	-	-	-	-	-
B3.B	-	-	-	-	-	-	-
B3.C	+	-	+	+	-	-	-
B4.A	+	-	-	+	-	-	-
B4.B	+	-	-	+	-	-	-
B4.C	-	-	-	-	-	-	-
B5.A	+	-	-	-	-	-	-
B5.B	+	-	-	-	-	-	-
B5.C	+	-	-	-	-	-	-
C1.A	+	+	+	+	+	-	-
C1.B	+	+	+	+	+	-	+
C1.C	+	+	+	+	+	-	+
C2.A	+	+	+	+	-	-	+
C2.B	+	+	+	+	-	-	-

C2.C	+	+	+	+	+	+	+
C3.A	+	+	+	+	-	-	-
C3.B	+	+	+	+	-	-	+
C3.C	+	+	+	+	+	-	+
C4.A	+	+	+	+	-	-	-
C4.B	+	+	+	+	-	-	-
C4.C	+	+	+	+	-	-	-
C5.A	+	+	+	+	-	-	+
C5.B	+	-	+	+	-	-	-
C5.C	+	+	+	+	+	-	-
L1.A	+	+	-	+	+	-	-
L1.B	+	+	+	+	+	-	-
L1.C	+	-	-	-	-	-	-
L2.A	+	-	+	+	-	-	-
L2.B	-	-	-	-	-	-	-
L2.C	+	+	+	+	+	-	+
L3.A	-	-	-	-	-	-	-
L3.B	+	+	-	+	-	-	-
L3.C	+	-	-	-	-	-	-
L4.A	+	-	-	-	-	-	-
L4.B	-	-	-	-	-	-	-
L4.C	+	+	+	+	-	-	-
L5.A	-	-	-	-	-	-	-
L5.B	+	-	-	-	-	-	-
L5.C	+	-	-	-	-	-	-
P1.C	+	+	+	-	+	-	-
P2.A	+	+	+	+	-	-	-
P2.B	-	-	-	+	-	-	-
P2.C	+	+	+	+	+	-	+
P3.A	-	-	-	-	-	-	-
P3.B	-	-	-	-	-	-	-
P3.C	-	-	-	-	-	-	-
P4.A	+	-	-	+	-	-	-
P4.B	+	+	+	-	-	-	-
P4.C	+	-	-	-	-	-	-
P5.A	+	+	+	+	-	-	-
P5.B	+	-	-	-	-	-	-
P5.C	+	-	-	-	-	-	-

Table 3. Sample positivity for *E. coli* in chicken-based RDF. Sample ID with symbols *, #, ^ denote multiple instances of the same brand of RDF.

	Positive for *E. coli* in						
Sample ID	**TBX**	**AMX**	**SPC**	**STR**	**AMC**	**CTX**	**CIP**
RDF1*	+	+	+	+	-	+	+
RDF2#	+	-	+	+	-	-	-
RDF3	+	+	+	+	-	-	-
RDF4	+	+	+	+	-	-	+
RDF5^	-	-	-	-	-	-	-
RDF6*	+	+	+	+	+	+	+
RDF7#	+	+	+	+	-	-	-
RDF8	-	-	-	-	-	-	-
RDF9	+	+	+	+	+	+	+
RDF10	+	+	+	+	-	-	+
RDF11*	+	+	+	+	+	+	+
RDF12	+	+	+	+	-	-	-
RDF13	+	+	+	+	-	-	-
RDF14^	+	+	-	+	-	-	-
RDF15	+	+	+	+	+	-	+
Positivity rate (%)	13 87%	12 80%	12 80%	13 87%	4 27%	4 27%	7 47%

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