Table 1: Most recent published reports of *in vitro* third generation cephalosporin gonococcal susceptibility by region

PubMed search terms: (gonorrhea or gonorrhoeae or gonorrhoea or gonococcus or gonococcal) AND (treatment or therapy or resistance or antibiotics or failure) AND ("2008"[Date - Publication] : "3000"[Date - Publication]).

Author	Year published	Year collected	Country	Number of isolates tested	Susceptibility (S) Threshold, Method	Reported findings
NORTH AMERICA						
Allen	2013	2010-2011	Canada (Toronto clinic)	291	S ≤0.06 mcg/mL	**Cefixime:** 79.7% susceptible.
Allen	2011	2008	Canada (Ontario Public Health Laboratory)	149	S ≤0.25 mcg/mL	**Cefixime:** 100% susceptible; 9.4% with "reduced susceptibility" (MICs 0.125-0.25). **Ceftriaxone:** 100% susceptible; 9.4% with "reduced susceptibility" (MICs 0.032-0.125).
Hottes	2013	2006-2011	Canada (British Columbia)	1,837	S ≤0.25 mcg/mL	**Cefixime:** 100% susceptible; percent with elevated MICs (≥0.064) increased from 2% to 43% 2006-2010, decreased to 27% in 2011. **Ceftriaxone:** 100% susceptible; percent with elevated MICs (≥0.064) increased from 1% to 33% 2006-2010, decreased to 16% in 2011.
Martin	2012, 2011	2001-2010	Canada (National Microbiology Lab)	10,301	S ≤0.25 mcg/mL	**Cefixime:** 99.97% susceptible (3 isolates with MIC 0.5: 1 each in 2004, 2007, and 2008); right shift in modal MIC from 0.016 to 0.125 from 2001-2010. **Ceftriaxone:** 100% susceptible; right shift in modal MIC from 0.016 to 0.063 from 2001-2010.
CDC (GISP)	2012, 2013	2011	USA	5,467	S ≤0.25 mcg/mL	**Cefixime:** 99.95% susceptible in 2011; percent with elevated MICs (≥0.25) increased from 0.1% in 2006 to 1.4% in 2010 and 2011, was 1.1% in 1st 6 months of 2012. **Ceftriaxone:** 100% susceptible in 2011; percent with elevated MICs (≥0.125) increased from 0.05% in 2006 to 0.3% in 2009-2010 and 0.4% in 2011, was 0.3% in 1st 6 months of 2012.
LATIN AMERICA/CARIBBEAN						
Méndez	2008	1997-2004	Argentina	434	agar dilution	**Ceftriaxone:** 100% susceptible (MIC range 0.001-0.032); paper in Spanish.
Starnino	2012	2000-2009	Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Ecuador, Peru, Uruguay, Venezuela	9,231	multiple	**Ceftriaxone:** 99.0% susceptible in Brazil (7 isolates with MIC >0.25 and zone diameter <35 mm, all from Manaus, Brazil in 2007); 100% susceptible in other countries.
EUROPE						
Lis-Tønder	2009	2003-2007	Denmark	62	disc diffusion	**Ceftriaxone:** 100% susceptible.
Health Protection Agency (GRASP)	2012	2011	England and Wales	1,359?	S ≤0.06 mcg/mL	**Cefixime:** 89.0% susceptible among GUM patients (82.6% in 2010); 96.2% susceptible among non-GUM patients (89.4% in 2010). **Ceftriaxone:** 100% susceptible (100% in 2010); increase in percent with highly sensitive isolates (MIC ≤0.002) since 2010, decrease in percent with an MIC ≥0.03 (6.9% in 2011 vs. 13.7% in 2010).
Manavi	2010	2001-2008	England (pharyngeal isolates at one clinic)	128	S <0.125	**Ceftriaxone:** 100% susceptible.
ECDC (GASP-Europe)	2012	2010	21 EU/EEA countries	1,766	S ≤0.125 mcg/mL	**Cefixime:** 91% susceptible (96% in 2009); 11 countries had <95% susceptible, 5 countries had <85% susceptible. **Ceftriaxone:** 100% susceptible; percent with "higher MICs" increased compared with 2009.
Farhi	2009	2005-2007	France	115	S ≤0.12 mcg/mL	**Ceftriaxone:** 100% susceptible.
Abraham	2013	2001-2010	Germany	50 49	S ≤0.5 mcg/mL S ≤0.25 mcg/mL	**Cefotaxime:** 100% susceptible. **Ceftriaxone:** 100% susceptible.
Tzelepi	2010	2005-2008	Greece	635	S ≤0.5 mcg/mL	**Cefotaxime:** 100% susceptible in 2005-2006, 98.8% susceptible in 2007, 100% susceptible in 2008; percent with MIC ≥0.25 increased from 0.6% in 2005 to 20.7% in 2008.
Carannante	2012	2006-2010	Italy	586	S ≤0.5 mcg/mL	**Ceftriaxone:** 100% susceptible; MIC range 0.002-0.125.
Carannante	2011	2006-2010	Italy	293	S ≤0.12 mcg/mL	**Cefixime:** 88% susceptible; MIC range <0.016-0.38; 99% with MIC ≤0.25 mcg/mL. **Ceftriaxone:** 100% susceptible; MIC range 0.002-0.094; may be included in Carannante 2012.
de Vries	2009	2006-2008	Netherlands	1,596	S ≤0.125 mcg/mL	**Cefotaxime:** percent susceptible decreased from 95.2% in Q4 2006 to 87.9% in Q4 2008; all MICs were <0.5.

Hjelmevoll	2012	2009	Norway	114	S ≤0.12 mcg/mL	**Cefixime:** 96.5% susceptible (3.5% isolates with MIC 0.19-0.38). **Ceftriaxone:** 98.2% susceptible to ceftriaxone (1.8% with MIC 0.19).
Florindo	2010	2006-2009	Portugal	187	S ≤0.06 mcg/mL	**Ceftriaxone:** 97.9% susceptible (2.1% isolates with MICs 0.125-0.25, all in 2007).
Golparian	2010	2009	Sweden	230	S ≤0.125 mcg/mL	**Cefixime:** 94.8% susceptible; shift towards higher MICs compared with 2003. **Ceftriaxone:** 99.6% susceptible; shift towards higher MICs compared with 1998.

EASTERN EUROPE/CENTRAL ASIA

Glazkova	2011	2009	Belarus	80	S ≤0.12 mcg/mL	**Cefixime:** 100% susceptible. **Ceftriaxone:** 100% susceptible.
Filipiuc	2010	2009-2010	Romania	32	?	**Ceftriaxone:** "96.9% strains were sensitive for ceftriaxone and spectinomycin"; article in Romanian, minimal information available from English abstract.
Kubanova (RU-GASP)	2010	2007-2008	Russia	1,560	S ≤0.25 mcg/mL	**Ceftriaxone:** 100% susceptible (also 100% susceptible 2005-2006).

MIDDLE EAST

Dan	2010	2002-2007	Israel	406	S ≤0.25 mcg/mL	**Ceftriaxone:** 100% susceptible, overall MIC range 0.002-0.19.

AFRICA

Cao	2008	2004-2006	Cameroon	50	disc diffusion	**Ceftriaxone:** 100% susceptible.
Cao	2008	2004-2006	Central African Republic	28	S ≤0.25 mcg/mL	**Ceftriaxone:** 100% susceptible; MIC range 0.002-0.016.
Olsen	2012	2006-2008	Guinea-Bissau	31	S ≤0.125 mcg/mL	**Cefixime:** 100% susceptible. **Ceftriaxone:** 100% susceptible.
Lagace-Wiens	2012	2009-2010	Kenya	108 154	multiple	**Cefixime:** 100% susceptible. **Ceftriaxone:** 100% susceptible.
Mehta	2011	2002-2009	Kenya	105	S ≤0.25 mcg/mL	**Cefixime:** 100% susceptible; MICs increased over time. **Ceftriaxone:** 100% susceptible; MICs increased over time.
Cao	2008	2004-2006	Madagascar	68	S ≤0.25 mcg/mL	**Ceftriaxone:** 100% susceptible to ceftriaxone, MIC range 0.001-0.03
Brown	2010	2007	Malawi	100	S ≤0.25 mcg/mL	**Cefixime:** 99% susceptible (1 isolate with MIC of 1). **Ceftriaxone:** 100% susceptible; MIC range 0.002-0.031.
Apalata	2009	2005	Mozambique	55	S ≤0.25 mcg/mL	**Cefixime:** 100% susceptible; all MICs ≤0.015. **Ceftriaxone:** 100% susceptible; all MICs ≤0.015.
Lewis	2008	2007	South Africa	272	S ≤0.25 mcg/mL	**Ceftriaxone:** 100% susceptible.

ASIA/PACIFIC

Lahra (AGSP)	2012	2011	Australia	4,129	S <0.06 mcg/mL	**Ceftriaxone:** 96.8% susceptible in 2011; percent with decreased susceptibility (MICs 0.06-0.125) increased from 0.6% in 2006 to 4.8% in 2010, but decreased to 3.2% in 2011; no MIC >0.125 reported in Australia.
Ahmed	2010	1997-2006	Bangladesh	1,767	S ≤0.25 mcg/mL	**Ceftriaxone:** 100% susceptible; no increase in MIC50 or MIC90 over time.
Lo	2012	2005-2010	Hong Kong	7,154 8,123	disc diffusion S ≤0.25 mcg/mL	**Ceftibuten:** 96.3%-99.1% susceptible; stable over time. **Ceftriaxone:** 100% susceptible; MICs stable over time.
Bala	2008	2002-2004	India	191	multiple	**Ceftriaxone:** 2.1% "less sensitive" (not defined).
Bala	2011	2000-2009	India	764	mulitple	**Cefixime and ceftriaxone:** 1.6% "were less susceptible" (not defined).
Kulkarni	2012	2007-2008	India	64	S ≤0.25 mcg/mL	**Cefixime:** 100% susceptible to cefixime. **Ceftriaxone:** 98.1% susceptible (1.8% "intermediate", not defined).
Sethi	2013	2007-2011	India, Pakistan, Bhutan	65	S ≤0.12 mcg/mL	**Cefixime:** 100% susceptible; MIC range <0.016-0.064. **Ceftriaxone:** 100% susceptible; MIC range <0.002-0.064.
Shilpee	2008	?	India	10	disc diffusion	**Ceftriaxone:** 100% susceptible.
Matsumoto	2008	?	Japan	?	?	**Cefozopran:** "The incidence rate of [cefozopran-resistant *N. gonorrhoeae,* 4th generation ceph] is now 40%..."
Takahashi	2012	2007-2009	Japan	51	S ≤0.25 mcg/mL S ≤2 mcg/mL S ≤0.25 mcg/mL	**Cefixime:** 92.2% susceptible; MIC range ≤0.008-0.5. **Cefodizime:**100% susceptible; MIC range ≤0.008-0.016. **Ceftriaxone:** 100% susceptible; MIC range ≤0.008-0.06.

Tanaka	2011	2008-2009	Japan	494	?	**Cefixime:** 62.5% susceptible (38.1% intermediate, 0.4% resistant, not defined). Article in Japanese. **Ceftriaxone:** 99.8% susceptible. Article in Japanese, minimal information from English abstract. **Cefodozime:** 86.6% susceptible (13.4% intermediate, not defined). Article in Japanese.
Lee	2011	2000-2006	Korea	145 977	agar dilution disc diffusion	**Cefixime:** 99.3% susceptible (1 isolate with MIC 0.5 in 2004). **Ceftriaxone:** 100% susceptible; 145 randomly selected isolates had agar dilution, all MICs ≤0.25.
Jabeen	2011	1992-2009	Pakistan	100 100 804?	disc diffusion	**Cefixime:**100% susceptible. **Cefotaxime:** 100% susceptible. **Ceftriaxone:** 100% susceptible.
Chen	2009	1999-2004	Taiwan (Southern)	65	S ≤0.25 mcg/mL	**Cefixime:** 100% susceptible. **Ceftriaxone:** 100% susceptible.
Huang	2010	2006-2009	Taiwan (Northern)	254	S ≤0.25 mcg/mL	**Cefixime:** 92.5% susceptible; MIC 0.016-0.5. **Ceftriaxone:** 100% susceptible; MIC range 0.002-0.19.
Wong	2008	2006-2007	Taiwan (Taipei)	146	disc diffusion	**Cefixime:** 83.6% susceptible. **Ceftriaxone:** 100% susceptible.
Srifeungfung	2009	2005-2007	Thailand	122	disc diffusion	**Cefotaxime:** 100% susceptible. **Ceftriaxone:** 100% susceptible.
Cao	2008	2004-2006	Vietnam	177	S ≤0.25 mcg/mL	**Ceftriaxone:** 99.4% susceptible (1 isolate with MIC 0.5); MIC range 0.003-0.5.
Olsen	2013	2011	Vietnam	108	S ≤0.125 mcg/mL	**Cefixime:** 99% susceptible. **Ceftriaxone:** 95% susceptible.
Lahra (WHO WPR and SEAR GASP)	2012	2010	19 WHO WPR and SEAR countries/jurisdictions	9,282	varied	**Ceftriaxone:** 44.2%-98.7% susceptible depending on country; 44.2% susceptible in China, 70.7% susceptible in Korea, 76.7% susceptible in Hong Kong SAR, 79.7% susceptible in Japan, 89.2% susceptible in India, 95.2% susceptible in Australia, 98.7% susceptible in Singapore.

Table 2: Most recent published reports of *in vitro* azithromycin gonococcal susceptibility by region

PubMed search terms: (gonorrhea or gonorrhoeae or gonorrhoea or gonococcus or gonococcal) AND (treatment or therapy or resistance or antibiotics or failure) AND ("2008"[Date - Publication] : "3000"[Date - Publication]). *Run on March 9, 2013.

Author	Year published	Year collected	Country	Number of isolates tested	Susceptibility (S) Threshold, Method	Reported findings
NORTH AMERICA						
Allen	2011	2008	Canada (Ontaria Public Health Laboratory)	149	Etest	77.2% susceptible to **erythromycin**; 34 (22.8%) with erythro MIC ≥2, also had azithro MICs 0.25-0.5.
Hottes	2013	2006-2011	Canada (British Columbia)	1,837	≤1 mcg/mL	99% with MIC ≤1; percent with elevated MICs (≥0.5) incresed from 26% in 2006 to 82% in 2011.
Martin	2011	2000-2009	Canada (National Microbiology Lab)	40,875	S ≤1 mcg/mL	99.8% susceptible; modal MIC shifted from 0.25 in 2001 to 0.5 by 2007-2009.
CDC (GISP)	2012	2011	USA	5,467	≤1 mcg/mL	99.7% with MIC ≤1; no temporal trend in MICs.
LATIN AMERICA/CARIBBEAN						
Méndez	2008	1997-2004	Argentina	434	≤1 mcg/mL	99.8% with MIC ≤1 (1 isolate with MIC 16 in 2004). Paper in Spanish.
Starnino	2012	2000-2009	Argentina	3,894	S ≤1 mcg/mL	95% susceptible overall (90% in 2000, 84% in 2001, 94% in 2002-2003, 99% in 2004, 96% in 2005-2006, 99% in 2007, 96% in 2008, 97% in 2009).
Starnino	2012	2001-2004, 2007, 2009	Brazil	635	S ≤1 mcg/mL	97% susceptible overall (100% in 2001-2003, 78% in 2004, 94% in 2007, 99% in 2009).
Starnino	2012	2000-2009	Chile	3,116	S ≤1 mcg/mL	73% susceptible overall; percent susceptible decreased from 97% in 2000 to 54% in 2009.
Starnino	2012	2000-2009	Colombia	134	S ≤1 mcg/mL	100% susceptible.
Starnino	2012	2000-2002, 2005-2006	Peru	351	S ≤1 mcg/mL	100% susceptible.
Starnino	2012	2000-2009	Uruguay	243	S ≤1 mcg/mL	92% susceptible overall (100% in 2000, 94% in 2001, 100% in 2002, 94% in 2003, 79% in 2004, 84% in 2005, 88% in 2006, 87% in 2007, 96% in 2008, 91% in 2009).
EUROPE						
Health Protection Agency (GRASP)	2012	2011	England and Wales	1,359?	S ≤0.5 mcg/mL	99.5% susceptible in GUM clinics, 100% susceptible in non-GUM clinics (same as 2010); no high-level resistance (MIC ≥256); weighted analysis.
	2010	2001-2008	England (pharyngeal isolates at one clinic)	128	S <1 mcg/mL	100% susceptible.
ECDC (GASP-Europe)	2012	2010	21 EU/EEA countries	1766	S ≤0.5 mcg/mL	93% susceptible overall; countries ranged from 70%(Slovakia) susceptible to 100% susceptible (Cyprus, France, Hungary, Malta, and UK); no apparent trend from 2004 to 2010, no high-level resistance (MIC >256).
Starnino	2009	2007-2008	Italy	219	S ≤0.5 mcg/mL	90.0% susceptible; 7.8% with MIC 1-8; 0.5% with MIC 128, 1.8% with MIC 256.
Hjelmevoll	2012	2009	Norway	114	S ≤0.25 mcg/mL	89% susceptible.
Palmer	2008	2004-2007	Scotland	3,326	S ≤0.5 mcg/mL	97.6% susceptible in 2004, 98.1% susceptible in 2005, 97.3% susceptible in 2006, 94.8% susceptible in 2007; high-level resistance (MIC ≥256) increased from 0.3% in 2004 to 3.9% in 2007.
EASTERN EUROPE/CENTRAL ASIA						
Glazkova	2011	2009	Belarus	80	S ≤0.25 mcg/mL	55.5% susceptible, 27.2% with MIC 0.5, 17.3% with MIC >0.5.
Kubanova (RU-GASP)	2010	2007-2008	Russia	1,560	S ≤0.25 mcg/mL	90.3% susceptible in 2007, 94.8% susceptible in 2008; 4.8% with MIC ≥1.0 in 2007, 0.4% with MIC ≥1.0 in 2008.
MIDDLE EAST						
Dan	2010	2002-2007	Israel	406	S ≤0.5 mcg/mL	82.6% susceptible in 2002, 88% susceptible in 2003, 62% susceptible in 2004, 90.75% susceptible in 2005, 88.4% susceptible in 2006, 91.8% susceptible in 2007; overall MIC range 0.008-12.0.
AFRICA						
Olsen	2012	2006-2008	Guinea-Bissau	31	S ≤0.25 mcg/mL	100% susceptible.
Lagace-Wiens	2012	2009-2010	Kenya	108	multiple	100% susceptible; 7 (6.5%) isolates with MIC 0.5 or inhibition diameters 25-28 mm.

Mehta	2011	2002-2009	Kenya	105	S ≤1 mcg/mL	100% susceptible; "marginally" significant increase in MICs over time (p = 0.097).
Brown	2010	2007	Malawi	100	S ≤0.5 mcg/mL	100% susceptible.

ASIA/PACIFIC

Lahra (AGSP)	2012	2011	Australia	4,129	S <1.0 mcg/mL	98.9% susceptible; azithro data not included in previous reports.
Ahmed	2010	1997-2006	Bangladesh	1,767	S ≤1 mcg/mL	99.9% susceptible (1 isolate in 2002 with MIC >1);MIC50 and MIC90 increased over time.
Yuan	2011	2008-2009	China	318	S ≤1 mcg/mL	94.7% susceptible overall (96.9% susceptible in 2008, 92.4% susceptible in 2009).
Lo	2012	2010	Hong Kong	485	S ≤0.25 mcg/mL	69.7% susceptible, 22.3% intermediate (MIC 0.5), 8% resistant (MIC ≥1). 1.6% had MIC ≥256.
Bala	2011	2004-2009	India	274	S <1 mcg/mL	99.6% susceptible (1 isolate with MIC ≥1 in 2009).
Sethi	2013	2007-2011	India, Pakistan, Bhutan	65	S ≤0.25	76.9% susceptible, 15.4% intermediate (MIC = 0.5), 7.7% resistant (MIC >0.5); MIC range 0.016-4.
Tanaka	2011	2008-2009	Japan	494	?	96.6% susceptible. Paper in Japanese, minimal information from English abstract.
Jabeen	2011	2007-2009	Pakistan	100	disc diffusion	100% susceptible.
Chen	2009	1999-2004	Taiwan (Southern)	65	<1 mcg/mL	100% had MIC <1.
Olsen	2013	2011	Vietnam	108	S ≤0.25 mcg/mL	62% susceptible, 27% intermediate (MIC=0.5), 11% resistant (MIC>0.5).
Lahra (WHO WPR and SEAR GASP)	2012	2010	6 WHO WPR and SEAR countries/jurisdictions	5,295	varied	"There was no resistance (0%) reported from Cambodia; Vietnam and India and very low rates (<1%) from Australia. In contrast, 34% resistance was reported from Mongolia."

Table 3: Cephalosporin treatment failure - any year

Author	Year published	Year collected	Country	Drug	# Failed	Site of infection	MIC's (mcg/ml)	Resolution	Comments
Allen	2013	2010-2011	Canada	cefixime 400 mg (n=7) or 800 mg (n=2) PO	9	4 urethral, 2 pharyngeal, 3 rectal	cefixime MIC 0.12 (n=7), 0.06 (n=1), ≤0.03 (n=1)	ceftriaxone 250 mg IM (n=6) or cefixime 800 mg PO (n=3)	Denied re-exposure; pre- and post-treatment strains identical by molecular typing, all but 1 had penA mosaic allele XXXIV. 5 pts who failed were co-treated with doxy, 1 with azithro.
Chen	2013	2010	Australia	ceftriaxone 500 mg IM	1	pharyngeal	ceftriaxone MIC 0.03-0.06	azithromycin 2 g PO	NG-MAST of pre- and post-treatment strains identical (ST1407), penA mosaic allele XXXIV; denied re-exposure.
Lewis	2013	2012	South Africa	2 courses of cefixime 400 mg PO	1	urethral	cefixime MIC 0.25, ceftriaxone MIC 0.064	Treated with ceftriaxone 2 gm IV x 1, lost to follow-up	2nd related isolate also identified in Joburg (cefixime MIC 0.25, ceftriaxone MIC 0.125, treated with azithro 1 gm x 1 and lost to f/u); both with penA mosaic allele XXXIV, NG-MAST ST4822 and MLST ST1901.
Lo	2012	?	Hong Kong	ceftibuten 400 mg PO	30	?	?	?	"Among 35 patients who received oral ceftibuten treatment and returned for follow-up with TOC specimens, only five were documented to have cleared the infection."
Unemo	2012	2011	Slovenia	ceftriaxone 250 mg IM	1	pharyngeal	cefixime MIC 0.25, ceftriaxone MIC 0.125	ceftriaxone 250 mg IM + azithromycin 1 g PO	NG-MAST of pre- and post-treatment strains identical (ST1407), penA mosaic allele XXIV; denied re-exposure.
Unemo	2012	2010	France	cefixime 200 mg PO x 2 (6 hrs apart)	1	urethral	cefixime MIC 4, ceftriaxone MIC 1-2	gentamicin 160 mg IM	MSM, no travel, denied re-exposure; strain F89; PBP 2 XXXIV mosaic allele with A501P alteration.
Ohnishi x 2	2011	2009	Japan	ceftriaxone 1 g IV	1	pharyngeal	cefixime MIC 8, ceftriaxone MIC 2-4	2nd dose of ceftriaxone (dose not specified)	FSW, H041, MLST ST7363, NG-MAST ST4220, unique penA mosaic allele (highly similar to X).
Unemo	2011	2011	Austria	cefixime 400 mg PO QD x 7 days, then cefixime 400 mg PO QD x 14 days	1	urethral	cefixime MIC 1.0, ceftriaxone MIC 0.5	azithromycin 2 g PO	MSM, denied re-exposure; MLST ST1901, NG-MAST ST1407, novel penA mosaic allele (XXXIV with T534A alteration).
Forsyth	2011	?	UK	cefixime 400 mg PO + azithro 1 gm PO	1	urethral	cefixime MIC ≥0.25, ceftriaxone MIC ≤0.12, azithro MIC ≤1	ceftriaxone 500 mg IM	MSM, denied re-exposure.
Ison	2011	2010	England	cefixime 400 mg PO, then 2 courses of azithromycin 2 g PO	1	urethral	cefixime MIC 0.19, ceftriaxone MIC 0.047-0.064, azithro 0.25-->1.0	ceftriaxone 250 mg IM	MSW, reported sex between 1st and 2nd courses of azithro.
Ison	2011	2010	England	cefixime 400 mg PO x 1 + doxy 100 mg PO BID x 7 days	1	urethral	Pre-treatment: cefixime and ceftriaxone "sensitive" by disc diffusion; post-treatment: cefixime 0.25, ceftriaxone 0.064	ceftriaxone 250 mg IM	MSM, denied re-exposure.
Unemo	2011	2010	Sweden	ceftriaxone 250 mg IM, then ceftriaxone 500 mg IM	1	pharyngeal	cefixime MIC 0.5, ceftriaxone MIC 0.125-0.25	ceftriaxone 1 g IV	MSW, exposure to female partner from Japan, denied re-exposure; pre- and post-treatment isloates indistinguishable by NG-MAST (ST2958).

Unemo	2010	2010	Norway	cefixime 400 mg PO	2	urethral	cefixime MICs 0.25-0.5, ceftriaxone MIC 0.125	ceftriaxone 500 mg IM	Both MSW, denied re-exposure, one with exposure in Philippines; NG-MAST ST1407, mosaic penA (not specified).
Tapsall	2009	2007	Australia	ceftriaxone 250 mg IM	2	pharyngeal	ceftriaxoneMICs 0.016 and 0.03	azithro 1 g PO then ceftriaxone 500 mg IM (n=1), ceftriaxone 1 g IM (n=1)	No mosaic PBP2 present. Pre- and post-treatment isolates indentical by NG-MAST.
Ota	2009	1995-2007	Canada	cefixime 400 mg PO (n=10), ofloxacin 400 mg PO (n=1)	10	pharyngeal	all were "susceptible" to cefixime	cefixime 400 mg PO (n=4), ofloxacin 400 mg PO (n=4), 3rd dose of cefixime 400 mg PO (n=1).	Two didn't follow up.
Lo	2008	2006-2007	Hong Kong	ceftibuten 400 mg PO	42	urogenital	ceftibuten MICs 0.06-8, cefixime MICs ≤0.016-0.25, ceftriaxoneMICs ≤0.016-0.125	"virtually all" resolved with spectinomycin 2 g IM	NG-MAST used to ensure pre- and post-treatment strains similar. Overall, 3.4% (42/1228) treatment failure rate.
Yokoi	2007	2002-2003	Japan	cefixime 200 mg PO BID x 3 days	4	urethral	cefixime MICs 0.5-1.0, ceftriaxone MICs 0.125-0.5	ceftriaxone 1 gm IV (n=3)	One treated with ceftriaxone but did not follow-up.
Deguchi	2003	1999-2001	Japan	cefixime 200 mg PO x 2 (6 hrs apart)	8	urethral	cefixime MICs 0.125-0.25	ceftriaxone or spectinomycin (doses not specified)	No treatment failures for MICs <0.125.
Wang	2003	2001	US	cefixime 400 mg PO + azithro 1 gm PO	1	urethral	cefixime MIC 0.5, ceftriaxone MIC 0.125	spectinomycin 2 g IM x 1 + doxy 100 mg BID x 7 days	Reported re-exposure, unclear if truly treatment failure or re-infection.
Muratani, Akasaka	2001	1999	Japan	cefdinir 100 mg PO TID x 3 days	2	urogenital	cefdinir MIC 1 (n=1), cefixime MICs 0.25-0.5, both ceftriaxone MICs 0.125	ceftriaxone 1 gm IV x 1 + sparfloxacin 100mg QD x 3 days (n=1), spectinomycin 2 g IM (n=1)	Also reported on an aztreonam treatment failure.

Additional reports of high-level cephalosporin resistance, not associated with cephalosporin treatment failure

Author	Year published	Year collected	Country	MIC's (mcg/ml)	#	Site of infection	Resolution	Comments
Carnicer-Pont; Cámara	2012	2011	Spain	cefixime MIC 1.5, cefotaxime MIC 1, ceftriaxone MIC 1.5	1	Rectal	Initially treated with levofloxacin 500 mg/d x 7 days (Cipro R), sx resolved but retreated with azithro 500 mg/d x 3 days, TOC day 51 negative.	2 MSM, sex partners. NG-MAST ST1407; mosaic penA related to genotype XXXIV with single amino acid substitution (A501P), identical to French isolate (F89).
					1	Urethral	doxycycline 100 mg BID x 7d (initial tx)	

Table 4: Azithromycin treatment failure - any year

Author	Year published	Year collected	Country	Drug	# Failed	Site of infection	MIC's (mcg/ml)	Resolution	Comments
Allen	2013	2010-2011	Canada	cefixime 400 mg + azithromycin 1 g PO	1	pharyngeal	cefixime MIC 0.12, azithromycin MIC ≤0.25	ceftriaxone 250 mg IM	Denied re-exposure; pre- and post-treatment strains identical by molecular typing, penA mosaic allele XXXIV.
Soge	2012	2011	USA (Oregon)	azithromycin 2 g PO	1	urethral	azithro MIC 1.0 pre-treatment --> 8.0 post-treatment	cefpodoxime 400 mg PO + azithro 1 g PO	Emergence of resistance following initial tx with azithro 2gm (same NG-MAST pre and post-treatment).
Ison	2011	2010	England	cefixime 400 mg PO, then 2 courses of azithromycin 2 g PO	1	urethral	azithro MIC 0.25-->1.0, cefixime MIC 0.19, ceftriaxone MIC 0.047-0.064	ceftriaxone 250mg IM	
Dan	2006	2001	Israel	azithromycin 2 g PO	1	pharyngeal	azithro MIC 0.5 pre- and post-treatment	?	
Habib	2004	2000-2001	UK	azithromycin 1 g PO	2	?	1 was "athromycin-resistant"	spectinomycin	
Rustomjee	2002	1999	South Africa	azithromycin 1 g PO	1	endocervical	?	?	
Swanston	2001		Trinidad and Tobago	azithromycin 1 g PO	2	urogenital	azithro MIC 0.064, 0.094		
Tapsall	1998	?	Australia	azithromycin 1 g PO	5	urogenital	azithro MICs 0.125-0.25	ciprofloxacin 500 mg PO (n=2), ceftriaxone 250 mg IM (n=2)	5th patient retreated with amox 3 g + azithro 1 g PO, lost to follow-up.
Young	1997	1996	Scotland	azithromycin 1 g PO	1	urethral	azithro MIC 0.125 pre-treatment --> 3 post-treatment	ampicillin 2 g x 1 + probenicid 1 g x 1 + oxytetracycline 250 mg PO q 6 hrs x 7 days	
Gruber	1997		Croatia	azithromycin 1 g PO	2	urogenital			
Handsfield	1994	1991-1992	USA	azithromycin 2 g PO	4	urogenital (n=3), urethral/rectal (n=1)	?	?	
Odugbemi	1993		Nigeria	azithromycin 1 g PO	6	urogenital			cure = clinical + bacteriological
Waugh	1993	1990-1991	UK	azithromycin 1 g PO	4	urethral	azithro MICs 0.25	?	
Steingrimsson	1990	?	Iceland	azithromycin 1 g PO (n=1), azithromycin 500 mg PO x 2 in same day (n=1)	2	urogenital	azithro MICs 0.125-0.5	spectinomycin (n=1)	Resolution for 2nd patient not specified.

Additional reports of high-level azithromycin resistance, not associated with azithromycin treatment failure

Author	Year published	Year collected	Country	MIC's (mcg/ml)	#	Site of infection	Resolution	Comments
Katz	2012	2011	USA (Hawaii)	>512	1	cervical	treated susccessfully with ceftriaxone 250 mg and azithro 1 gm	
Lo	2012	2010	Hong Kong	≥256	8	?	?	
Yuan	2011	2008-2009	China	>64	2	?	?	
Chisholm	2009	2007	England and Wales	4096	6	?	?	NG-MAST ST649
Galarza	2009	2001	Argentina	>2048	1	?	?	NG-MAST ST696
Starnino	2009	2007-2008	Italy	128-256	5	?	?	
Palmer	2008	2004-2007	Scotland	≥256	47	?	?	High-level resistance (MIC ≥256) increased from 0.3% in 2004 to 3.9% in 2007.

Table 5: New data on clinical effectiveness of treatment for uncomplicated urogenital/rectal gonorrhea (and older summed clinical trials data)

PubMed search terms: (gonorrhea or gonorrhoeae or gonorrhoea or gonococcus or gonococcal) AND (treatment or therapy or resistance or antibiotics or failure) AND ("2008"[Date - Publication] : "3000"[Date - Publication]). *Run on March 9, 2013.

Author	Year published	Country, Year of study	Drug	Site of infection	Study design	Percentage cured	Comments
Kirkcaldy	2014	USA, 2010-2012	dual treatment with gemifloxacin 320 mg PO + azithromycin 2 g PO	urogenital	randomized clinical trial	99.5% (198/199; lower 1-sided exact 95% CI bound 97.6%)	Gastrointestinal adverse events common
Kirkcaldy	2014	USA, 2010-2012	dual treatment with gentamicin 240 IM + azithromycin 2 g PO	urogenital	randomized clinical trial	100% (202/202; lower 1-sided exact 95% CI bound 98.5%)	Gastrointestinal adverse events common
Kirkcaldy	2014	USA, 2010-2012	dual treatment with gemifloxacin 320 mg PO + azithromycin 2 g PO	rectal	randomized clinical trial	5/5 rectal infections cured	Gastrointestinal adverse events common
Kirkcaldy	2014	USA, 2010-2012	dual treatment with gentamicin 240 IM + azithromycin 2 g PO	rectal	randomized clinical trial	1/1 rectal infections cured	Gastrointestinal adverse events common
Allen	2013	Canada, 2010-2011	cefixime 400 mg or 800 mg PO +/- doxy or azithro	urogenital, rectal, or pharyngeal	retrospective analysis	93.0% (120/129) (excluding those with possible re-exposure)	133/291 returned for TOC, 13 had positive TOC, 4 with possible re-exposure. Of pts with TOC: Tx failure in 9/133 (6.8%) overall, 25.0% if MIC 0.12, 1.9% if MIC <0.12. Of all pts: Tx failure in 9/291 (3.1%) overall, 11.9% if MIC ≥0.12, 0.9% if MIC <0.12
Bai	2012		ceftriaxone 250 mg vs. ceftotaxime 500 mg	urogenital, rectal, or pharyngeal	systematic review and meta-analysis of randomized control trials	ceftriaxone: 78.9% (476/603); cefotaxime 74.6% (452/606); OR 1.25 (95% CI 0.95-1.66)	denominator was patients enrolled
Bai	2012		ceftriaxone 250 mg vs. cefixime 400 mg	urogenital, rectal, or pharyngeal	systematic review and meta-analysis of randomized control trials	ceftriaxone: 87.4% (202/234); cefixime 78.1% (272/348); *OR 1.77 (95% CI 1.11-2.80)	denominator was patients enrolled
Bai	2012		ceftriaxone 250 mg vs. cefixime 800 mg	urogenital, rectal, or pharyngeal	systematic review and meta-analysis of randomized control trials	ceftriaxone: 88.5% (139/157); cefixime: 90.1% (128/142); OR 1.19 (95% CI 0.19-7.39)	denominator was patients enrolled
Bai	2012		ceftriaxone 125 mg vs. cefixime 400 mg	urogenital, rectal, or pharyngeal	systematic review and meta-analysis of randomized control trials	ceftriaxone 95.3% (41/43); cefixime 96.2% (50/52); OR 0.82 (95% CI 0.11-6.08)	denominator was patients enrolled
Bai	2012		ceftriaxone 125 mg vs. spectinomycin 2 g	urogenital, rectal, or pharyngeal	systematic review and meta-analysis of randomized control trials	ceftriaxone 88.5% (85/96); spectinomycin 69.2% (72/104); *OR 3.44 (95% CI 1.08-10.90)	denominator was patients enrolled
Bai	2012		ceftriaxone 250 mg vs. spectinomycin 2 g	urogenital, rectal, or pharyngeal	systematic review and meta-analysis of randomized control trials	ceftriaxone 92.3% (204/221); spectinomycin 88.1% (223/253); OR 1.25 (95% CI 0.64-2.42)	denominator was patients enrolled
Dowell	2012		gentamicin 240 mg or 280 mg IM x 1	urogenital	systematic review and meta-analysis of clinical trials	pooled cure rate 91.5%, 95% CI 88.1%-94.0%	based on 3 studies, 26 studies excluded
Bignell	2010		azithromycin 1 g	urogenital	systematic review and meta-analysis of clinical studies	pooled cure rate 97.0% (688/709), 95% CI 95.2%-97.9%	based on 10 clinical trials; if exclude retrospective data (Habib), cure rate 96.5% (520/539), 95% CI 94.3%-97.6%)
Bignell	2010		azithromycin 2 g	urogenital	systematic review and meta-analysis of clinical studies	pooled cure rate 99% (392/396), 95% CI 97.5%-99.6%	based on 2 clinical trials, included patients infected at multiple sites
Bignell	2010		azithromycin varied	rectal	systematic review and meta-analysis of clinical studies	pooled cure rate 97.1% (34/35) - failure in 1 patient receiving 2g dose	based on 3 clinical trials
Shams-ur-Rehman	2009	Saudi Arabia, 2003-2004	ciprofloxacin 500 mg PO	urogenital	randomized clinical trial	80% (80/100)	Failure defined as persistence of symptoms with presence of gram-negative diplococci and pus on day 5 following treatment; no comment on re-exposure.

Shams-ur-Rehman	2009	Saudi Arabia, 2003-2004	ceftriaxone 500 mg IM	urogenital	randomized clinical trial	90% (90/100)	Failure defined as persistence of symptoms with presence of gram-negative diplococci and pus on day 5 following treatment; no comment on re-exposure.
Shams-ur-Rehman	2009	Saudi Arabia, 2003-2004	spectinomycin 2 g IM	urogenital	randomized clinical trial	94% (94/100)	Failure defined as persistence of symptoms with presence of gram-negative diplococci and pus on day 5 following treatment; no comment on re-exposure.
Muratani	2008	Japan, 2004-2006	ceftriaxone 1 g IV	urogenital	clinical trial	100% (48/48)	20/48 (41.7%) of isolates were CZRNG. All CZRNG isolates had chimera PBP-2.
Kojima	2008	Japan, 2004-2006	spectinomycin 2 g IM	urethral	clinical trial	96.7% (203/210)	MIC data available for 4 of the failures: MIC 16 (n=3), MIC 128 (n=1). Authors conclude failure due to PK rather than resistance.

Older summed clinical trials data

Newman	2007		azithromycin 1 g PO	urethra, cervix, or rectum	aggregate results of clinical trials	97.6% (411/421), 95% CI 95.7%-98.9%	urogenital updated in Bignell 2010
Newman	2007		azithromycin 2 g PO	urethra, cervix, or rectum	aggregate results of clinical trials	99.2% (262/264), 95% CI 97.3%-99.9%	based on 1 study: Handsfield 1994; urogenital updated in Bignell 2010
Newman	2007		cefixime 400 mg PO	urethra, cervix, or rectum	aggregate results of clinical trials	97.5% (386/396), 95% CI 95.4%-98.8%	
Newman	2007		cefixime 800 mg PO	urethra, cervix, or rectum	aggregate results of clinical trials	98.0% (241/246), 95% CI 95.3%-99.3%	
Moran	2007		ceftriaxone 125 mg IM	single urogenital or rectal site	aggregate results of clinical trials	98.9%, 95% CI 97.9%-99.8%	
Moran	2007, 1995		ceftriaxone 250 mg IM	single urogenital or rectal site	aggregate results of clinical trials	99.2% (2,248/2,267), 95% CI 98.8%-99.5%	

Table 6: New data on clinical effectiveness of treatment for pharyngeal gonorrhea (and older summed clinical trials data)

PubMed search terms: (gonorrhea or gonorrhoeae or gonorrhoea or gonococcus or gonococcal) AND (treatment or therapy or resistance or antibiotics or failure) AND ("2008"[Date - Publication] : "3000"[Date - Publication]). *Run on March 9, 2013.

Author	Year published	Country, Year of Study	Drug	Site of infection	Study design	Percentage cured	Comments
Kirkcaldy	2014	USA, 2010-2012	dual treatment with gemifloxacin 320 mg PO + azithromycin 2 g PO	pharyngeal	randomized clinical trial	15/15 pharyngeal infections cured	Gastrointestinal adverse events common
Kirkcaldy	2014	USA, 2010-2012	dual treatment with gentamicin 240 IM + azithromycin 2 g PO	pharyngeal	randomized clinical trial	10/10 pharyngeal infections cured	Gastrointestinal adverse events common
Barbee	2013	USA,1993-2011	cefixime/cefpodoxime + azithro	pharyngeal	retrospective analysis	93.0% (107/115)	Based on 360/1,440 (25%) with re-test at 7-180 days.
Barbee	2013	USA,1993-2011	cefixime/cefpodoxime + doxy	pharyngeal	retrospective analysis	66.7% (28/42)	*RR of positive re-test: 4.18, 95% CI 1.64-10.7 (vs. oral ceph + azithro)
Barbee	2013	USA,1993-2011	cefixime/cefpodoxime monotherapy	pharyngeal	retrospective analysis	70.2% (40/57)	*RR of positive re-test: 3.98, 95% CI 1.70-9.36 (vs. oral ceph + azithro)
Barbee	2013	USA,1993-2011	ceftriaxone + azithro/doxy	pharyngeal	retrospective analysis	88.7% (55/62)	RR of positive re-test: 1.20, 95% CI 0.43-3.33 (vs. oral ceph + azithro)
Barbee	2013	USA,1993-2011	ceftriaxone monotherapy	pharyngeal	retrospective analysis	90.9% (40/44)	RR of positive re-test: 0.81, 95% CI 0.18-3.60 (vs. oral ceph + azithro)
Bignell	2010		azithromycin varied	pharyngeal	systematic review and meta-analysis of clinical studies	pooled cure rate 97.9% (46/47) - failure in 1 patient receiving 2g dose (MIC 0.5)	Based on 6 clinical trials. By my calculation, cure rate for 2 g: 97.5% (39/40), 95% CI 87.1%-99.4%; cure rate for 1 g: 100% (5/5), 95% CI 54.1%-99.6%.
Manavi	2010	England, 2001-2008	cefixime 400 mg PO	pharyngeal	retrospective analysis	100% (27/27)	Based on 27/46 who returned for TOC. Diagnosis, TOC by culture only.
Ota	2009	Canada, 1995-2007	cefixime 400 mg or ofloxacin 400 mg	pharyngeal	retrospective analysis	91% (111/122)	MSM only. 10 of the failures were treated with cefixime, 1 was treated with ofloxacin.
Muratani	2008	Japan, 2004-2006	ceftriaxone 1 g IV	pharyngeal	clinical trial	100% (25/25)	15/25 (60%) of isolates were CZRNG. All CZRNG isolates had chimera PBP-2.

Older summed clinical trials data

Moran	1995		azithromycin 1 g PO	pharyngeal	aggregate results of clinical trials	100% (3/3), 95% CI 29.2%-100%	updated in Bignell 2010
Moran	2007, 1995		azithromycin 2 g PO	pharyngeal	aggregate results of clinical trials	100% (19/19), 95% CI 82.3%-100%	updated in Bignell 2010
Moran	2007		cefixime 400 mg PO	pharyngeal	aggregate results of clinical trials	92.3%, 74.9%-99.1%	
Moran	2007, 1995		cefixime 800 mg PO	pharyngeal	aggregate results of clinical trials	80.0% (12/15), 95% CI 51.9%-95.7%	
Moran	2007		ceftriaxone 125 mg IM	pharyngeal	aggregate results of clinical trials	94.1%, 95% CI 85.6%-98.4%	
Moran	2007		ceftriaxone 250 mg IM	pharyngeal	aggregate results of clinical trials	99.0%, 95% CI 94.4%-100%	

Recent (2005-present) retrospective studies of dual treatment for pharyngeal infection, by regimen

Barbee	2013	USA	azithromycin 1 or 2 g	pharyngeal	retrospective analysis	86.9% (13/15)	
Barbee	2013	USA	cefixime 400 mg PO	pharyngeal	retrospective analysis	79.2% (19/24)	
Sathia	2007	UK	cefixime 400 mg PO	pharyngeal	retrospective analysis	87.6% (14/16)	
Barbee	2013	USA	cefixime 400 mg PO + doxycycline	pharyngeal	retrospective analysis	71.0% (22/31)	

Sathia	2007	UK	cefixime 400 mg + doxycycline 100 mg PO BID x 7 days	pharyngeal	retrospective analysis	73.3% (11/15)	
Barbee	2013	USA	cefixime 400 mg PO + azithromycin	pharyngeal	retrospective analysis	94.0% (47/50)	
McMillan	2007	UK	cefixime 400 mg +/- azithromycin 1 g	pharyngeal	retrospective analysis	97.8% (44/45)	83% of 53 treated patients received cefixime + azithro, unclear which treatment failed.
Sathia	2007	UK	cefixime 400 mg + azithromycin 1 g PO	pharyngeal	retrospective analysis	100% (24/24)	
Barbee	2013	USA	ceftriaxone 125/250 mg IM	pharyngeal	retrospective analysis	90.9% (40/44)	
Sathia	2007	UK	ceftriaxone 250 mg IM	pharyngeal	retrospective analysis	88.2% (15/17)	
Barbee	2013	USA	ceftriaxone 125/250 mg IM + doxycycline	pharyngeal	retrospective analysis	100% (2/2)	
Sathia	2007	UK	ceftriaxone 250 mg IM + doxycycline 100 mg PO BID x 7 days	pharyngeal	retrospective analysis	90.9% (10/11)	
Barbee	2013	USA	ceftriaxone 125/250 mg IM + azithromycin PO	pharyngeal	retrospective analysis	88.3% (53/60)	
Sathia	2007	UK	ceftriaxone 250 mg IM + azithromycin 1 g PO	pharyngeal	retrospective analysis	100% (5/5)	

Table 7: New in vitro data for other antimicrobial therapy for gonorrhea

PubMed search terms: (gonorrhea or gonorrhoeae or gonorrhoea or gonococcus or gonococcal) AND (treatment or therapy or resistance or antibiotics or failure) AND ("2008"[Date - Publication] : "3000"[Date - Publication]). *Run on March 9, 2013.

Author	Year published	Country	Drug	Study design	Findings	Comments
Arruda	2011	Brazil	3 extracts from *Jacaranda cuspidifolia* Mart.	in vitro	2/3 with antigonococcal activity by disc diffusion, MICs 25.2 **mg**/mL	
Biedenbach	2012	USA	JNJ-Q2 (novel fluoroquinolone)	in vitro	MIC50/90 = 0.03/0.25 mcg/mL (range 0.004-0.25)	MIC50s: ceftriaxone (0.015 mcg/mL) < JNJ-Q2 (0.03 mcg/mL) < ciprofloxacin (0.25 mcg/mL) = azithromycin (0.25 mcg/mL) < tetracycline (1 mcg/mL) < penicillin (2 mcg/mL)
Chomnawang	2009	Thailand	22 plant extracts and purified berberine	in vitro	4/22 with high antigonococcal activity by disc diffusion, MICs 47-253 mcg/mL; purified berberine MICs 13-21 mcg/mL	
Cybulska	2011	Canada	14 plant extracts, berberine	in vitro	4/14 with MIC50 16-64; berberine had high antigonococcal activity by disc diffusion	
De Villiers	2010	South Africa	extracts of 15 *Cussonia* and related species	in vitro	methanolic extracts: MICs 20-400 mcg/mL; aqueous extracts: MICs 100-700 mcg/mL	
Fedarovich	2012	US	50,000 compound library	in vitro	7 with antigonococcal activity, MICs 2-32 mcg/mL	
Fujimoto	2013	Japan	SM-295291 (novel parenteral 2-aryl carbapenem)	in vitro	MIC 50/90 = 0.5/1 mcg/mL, range 0.0313-1	MIC50s: cefditoren (0.0313 mcg/mL) < SM-369926 (0.25 mcg/mL) = tebipenem (0.25 mcg/mL) < SM-295291 (0.5 mcg/mL) = Clarithromycin (0.5 mcg/mL) < faropenem (2 mcg/mL) < levofloxacin (4 mcg/mL)
Fujimoto	2013	Japan	SM-369926 (novel parenteral 2-aryl carbapenem)	in vitro	MIC 50/90 = 0.25/0.25 mcg/mL, range 0.0156-0.25	MIC50s: cefditoren (0.0313 mcg/mL) < SM-369926 (0.25 mcg/mL) = tebipenem (0.25 mcg/mL) < SM-295291 (0.5 mcg/mL) = Clarithromycin (0.5 mcg/mL) < faropenem (2 mcg/mL) < levofloxacin (4 mcg/mL)
Golparian	2012		solithromycin (CEM-101)	in vitro	MIC50/90 = 0.125/0.25 mcg/mL (range 0.001-32 mcg/mL)	MIC50s: ceftriaxone (0.016 mcg/mL) < cefixime (0.032 mcg/mL) < solithromycin (0.125 mcg/mL) < telithromycin (0.25 mcg/mL) < azithromycin (0.5 mcg/mL) < ampicillin (1 mcg/mL) < ciprofloxacin (4 mcg/mL) = tetracycline (4 mcg/mL) < spectinomycin (15 mcg/mL)
Jones	2008	US	DC-159a (new fluoroquinolone)	in vitro	MIC50/90 = 1/1 mcg/mL in cipro-resistant strains	MIC50s: ceftriaxone (0.06 mcg/mL) < DC-159a (1 mcg/mL) < ciprofloxacin (4 mcg/mL) = penicillin (4 mcg/mL) = tetracycline (4 mcg/mL) < levofloxacin (8 mcg/mL).
Jones	2009	US	iclaprim	in vitro	MIC 50/90 = 4/8 mcg/mL	dihydrofolate reductase inhibitor, mode of action similar to trimethoprim
Jones	2010	US	fusidic acid (CEM-102)	in vitro	MIC 50/90 = 0.5/1 mcg/mL	MIC50s: ceftriaxone (≤0.008 mcg/mL) < ciprofloxacin (0.015 mcg/mL) < azithromycin (0.25 mcg/mL) <fusidic acid (0.5 mcg/mL) <penicillin (1 mcg/mL) = tetracycline (1 mcg/mL)
Jones	2008	US	zabofloxacin (DW-224a)	in vitro	MIC 50/90 = 0.016/0.5 mcg/mL	MIC50s: ceftriaxone (≤0.008 mcg/mL) < zabifloxacin (0.016 mcg/mL) < ciprofloxacin (0.06 mcg/mL) <azithromycin (0.25 mcg/mL) = penicillin (0.25 mcg/mL) < tetracycline (1 mcg/mL)
Kuete	2009	Cameroon	diospyrone, crassiflorone, and plumbagin	in vitro	MICs 1->39 mcg/mL	
Kuete	2010	Cameroon	5 flavonoids from *Dorstenia barteri*	in vitro	MICs 1->39 mcg/mL	

Lauderdale	2010	Taiwan	nemonoxacin (novel nonfluorinated quinolone)	in vitro	MICs 0.25-1 mcg/mL in cipro-resistant strains	
Mbaveng	2011	Cameroon	extracts from 4 plants	in vitro	extracts from 2 plants had "good" antigonoccal activity, with MICs 16-256 mcg/mL	
Mulaudzi	2011	South Africa	extracts of 12 medicinal plants	in vitro	extracts from 4 plants had good activity by disc diffusion	
Muratani	2009	Japan	tebipenem	in vitro	"potent activity against NG", "activity comparable to cefixime"	Article in Japanese, minimal data available from English abstract.
Putnam	2010	US	solithromycin (CEM-101)	in vitro	MIC50/90 = 0.06/0.25 mcg/mL (range 0.03-0.25)	MIC50s: ceftriaxone (≤0.015 mcg/mL), ciprofloxacin (0.008 mcg/mL) < CEM-101 (0.06 mcg/mL) < azithromycin (0.25 mcg/mL) < penicillin (1 mcg/mL) = tetracycline (1 mcg/mL)
Ruddock	2011	Canada	21 plant extracts	in vitro	4/21 with high antigonococcal activity by disc diffusion; only 1 had significant activity without UV light activation - MIC100 for 2 compounds from this extract were 64 mcg/mL and 128 mcg/mL	
Shokeen	2009	India	16 medicinal plants	in vitro	60% exhibited high activity	
Shokeen	2008	India	eugenol	in vitro	MICs 85-256 mcg/mL	
Unemo	2012	Sweden and Australia	ertapenem	in vitro	MIC50/90 = 0.032/0.064 mcg/mL	in vitro advantage over ceftriaxone for isolates with ceftriaxone resistance (MICs 0.016-0.064 vs. 0.5-4)
van Vuuren	2010	South Africa	extracts from 18 plants	in vitro	3 with noteworthy activity, MICs 300-1000 mcg/mL	