

Supplementary Information

Sample preparation

Water samples were first filtered through 0.45 μm glass fibre filters (Whatman, Maidstone, England). 0.5 g of Na_2EDTA was added to 1 L of filtrate and stirred. Solid-phase extraction (SPE) was performed using Oasis HLB cartridges (6 mL cartridge volume, 200 mg adsorbent; Waters, Milford, MA, USA). Before SPE, 50 ng internal standards were spiked into the filtrate. The Oasis HLB cartridges were first conditioned with 6 mL methanol and 6 mL ultrapure water. The water samples were then passed through the cartridges at a rate of 6 mL/min, and the cartridges were then washed with 10 mL ultrapure water and dried for 0.5 h. The target compounds were eluted into a glass test tube with 6 mL acetonitrile: methanol (v/v 1: 1) and then evaporated to near dryness under a gentle nitrogen flow. Then, 1 mL of the initial mobile phase was added to each test tube. All samples were filtered through 0.22 μm needle filters (Anpel, Shanghai, China) and stored in a dark environment at $-20\text{ }^\circ\text{C}$ before instrumental analysis.

Sludge samples were dried in a freeze-dryer for 48 h at $-60\text{ }^\circ\text{C}$, ground into uniform particles, and passed through a 2 mm mesh sieve. During the extraction, a 2.0 g sample was weighed into a glass tube, and methanol with 100 ng internal standards was added to immerse the samples therein. The samples were then kept in the dark and refrigerated overnight. The extractant was made by dissolving 10.5 g of citric acid and 10.2 g of magnesium chloride in 1.0 L of ultrapure water. The pH was adjusted to 4.0 by adding ammonia dropwise. Add 5 mL of the above extractant and 5 mL of acetonitrile to each tube. The mixture was sonicated for 10 min and then centrifuged at 8500 rpm for 10 min. The supernatant was transferred to a 500 mL glass bottle. The processes of extraction

were repeated 2-3 times, and dilute the supernatants to 500 mL with ultrapure water. Finally, solid-phase extraction is performed, and the operating steps and conditions are the same as the water sample.

Instrument analysis

The injection volume was 10 μ L, the flow rate was 0.4 mL/min, and the column temperature was 45 °C. The mobile phase A and B for PPCPs analysis were ultrapure water and acetonitrile: methanol (v/v 1:1) with 0.1% formic acid. The gradient program was set as follows: the initial mobile phase was 5% B and held for 0.2 min, rose to 90% B in 2.5 min, maintained for 0.5 min, and then returned to 5% B in 0.1 min, maintained for 0.9 min.

In OPFRs analysis, mobile phases A and B were ultrapure water and acetonitrile with 0.1% formic acid, respectively. The initial mobile phase was 40% B and held for 0.5 min, rose to 50% B in 2.5 min, then to 55% B in 1.5 min and to 100% B in 4 min, held for 2 min, returned to 40% B in 1 min and maintained for 1 min. Mass spectrometry parameters were as follows: multiple reaction detection mode (MRM), gas temperature 350 °C, gas flow rate 12 L/min, nebuliser pressure 40 psi, and capillary voltage 1000 v (ESI⁻) or 3000 v (ESI⁺).

qPCR: oligonucleotides, probes, and reaction conditions

All ARGs and *int1* qPCR reactions were conducted in 20 μ L, including IQTM SYBR green supermix BioRad 1x, and BSA 0.8 mg/mL (m/v) (Sigma Aldrich, NL). A total of 1 μ L of DNA template was added to each reaction, and the reaction volume was completed to 20 μ L with DNase/RNase free Gibcowater (Life technologies, Lithuania). All reactions were performed in an

ABI 7300 Real-Time PCR System (Applied Biosystems, USA) according to the following PCR cycles: 95°C for 5 min followed by 40 cycles at 95°C for 15 s and 60°C for 30 s. The annealing temperature for all genes were provided in Table S4.

In order to check the specificity of the reaction, the temperature was increased from 65°C to 95°C with a temperature gradient of 0.5°C/5s, and the melting curve was measured. A synthetic DNA fragment (IDT, US) containing each target gene was used as a positive control to create a standard curve. The dilution of gene fragments was performed in 5 µg/mL (m/v) (Thermofisher, LT) of salmon sperm DNA diluted in Tris-EDTA (TE) buffer (Sigma Aldrich, Switzerland) at pH 8.0. Each standard curve includes at least 5 serial dilution points, in triplicate.

Table S1 Physical and chemical properties of the target compounds

Chemical	Use	Abbr	CAS Number	Molecular weight (g/mol)	p <i>K</i> _a	Log <i>K</i> _{ow}
PPCP						
Diethyltoluamide	Insecticide	DEET	134-62-3	191.27	0.67	2.18
Caffeine	Stimulant	CAF	58-08-2	194.19	0.60	-0.60
Octocrylene	UV-filter	OCT	6197-30-4	361.48	NA	6.9
Triclocarban	Disinfectant	TCC	101-20-2	315.58	12.80	4.90
Carbamazepine	Psychiatric drugs	CMZP	298-46-4	236.27	13.19	2.45
Ketoprofen	Antiinflammatory	KTP	22071-15-4	254.28	5.94	3.12
Diclofenac		DF	15307-86-5	296.15	4.20	4.51
Indomethacin		IND	53-86-1	357.79	4.50	4.27
Metoprolol tartrate	β-blockers	MTP	56392-17-7	684.81	9.70	2.15
Bezafibrate	Lipid regulator	BF	41859-67-0	361.82	4.25	3.29
Gemfibrozil		GFL	25812-30-0	250.33	4.75	3.40
Sulfamethoxazole	Sulfonamides	SMX	723-46-6	253.3	1.85	0.89
Sulfadiazine		SDZ	68-35-9	250.28	2.21	-0.09
Sulfamerazine		SMZ	127-79-7	264.3	2.29	0.14
Ofloxacin	Quinolones	OFL	82419-36-1	361.37	5.97, 8.28	-0.39
Ciprofloxacin		CIP	86393-32-0	385.82	3.10, 6.14, 8.70, 10.58	0.28
Norfloxacin		NOR	70458-96-7	319.33	6.10, 8.60	-1.03
Tetracycline	Tetracyclines	TC	60-54-8	444.43	3.30, 8.30, 10.20	-1.30
Oxytetracycline		OTC	79-57-2	460.43	3.27, 7.32, 9.11,	-0.90
Erythromycin	Macrolides	ERY	114-07-8	733.93	8.90	3.06

Chloramphenicol	Chloramphenicols	CP	56-75-7	323.13	7.59, 13.55	1.14
Penicillin sodium	β -lactam	PIN	69-57-8	356.37	2.74	1.83
OPFR						
Trimethyl phosphate	Alkyl phosphates	TMP	512-56-1	140.07	NA	-0.65
Triethyl phosphate		TEP	78-40-0	182.15	NA	0.80
Tri-n-butyl phosphate		TNBP	126-73-8	266.32	NA	4.00
Tris(2-butoxyethyl) phosphate		TBOEP	78-51-3	398.48	NA	3.75
Tris(2-ethylhexyl) phosphate		TEHP	78-42-2	434.63	NA	9.49
Tris(2-chloroethyl) phosphate	Chlorinated alkyl phosphates	TCEP	115-96-8	285.49	NA	1.64
Tris(1 chloro-2-propyl) phosphate		TCPP	13674-84-5	327.57	NA	2.59
Tris(1,3-dichloroisopropyl)phosphate		TDCPP	13674-87-8	430.89	NA	3.65
2-ethylhexyl diphenyl phosphate	Aryl phosphates	EHDP	1241-94-7	362.41	NA	6.29
Triphenyl phosphate		TPHP	115-86-6	326.29	NA	4.70
Tricresyl phosphate		TMPP	1330-78-5	368.36	NA	5.11

NA: not available

Table S2 Panel of genes used in this study

Group	Gene	Function
All bacteria	16S rRNA	For normalization to the concentration of bacteria
	<i>sul 1</i>	Resistance to sulfonamides
	<i>sul 2</i>	Resistance to sulfonamides
	<i>tet A</i>	Resistance to tetracyclines
	<i>tet B</i>	Resistance to tetracyclines
ARGs	<i>tet C</i>	Resistance to tetracyclines
	<i>tet W</i>	Resistance to tetracyclines
	<i>tet M</i>	Resistance to tetracyclines
	<i>qnrS</i>	Resistance to quinolones
	<i>ermB</i>	Resistance to macrolides
MGEs	<i>int 1</i>	Integrase of type 1 integrons

ARGs: antibiotic resistance genes

MGEs: mobile genetic element

Table S3 Operational parameters of UPLC-ESI-MS and method detection limit (MDL) of target ECs.

Compound	Precursor ion (m/z)	Product ions (m/z)	Cone voltage (V)	Recovery (%)	RSD (%)	ML (ng/L)
PPCP						
DEET	193	117.5(6); 108.0(8)	22	65.68	3.02	2.67
CAF	194.9	138.0(15); 110.0(20)	42	114.21	4.28	4.31
OCT	363	278.1(8); 108.1(18)	26	62.00	7.91	7.73
TCC	314.9	159.8(12); 125.8(25)	30(-)	73.45	7.87	2.76
CMZP	237.2	192.0(8); 194.0(6)	30	98.47	7.04	8.00
KTP	255	237.1(7); 209.1(12)	35	79.36	5.10	3.01
DF	296.15	214.5(20); 250.0(12)	27	87.76	11.28	3.15
IND	357.8	174.0(10); 138.9(20)	30	85.87	8.01	4.26
MTP	684.2	267.0(37); 341.0(29)	46	92.11	5.42	3.33
BF	361	275.0(15); 127.2(40)	50(-)	71.83	4.55	1.51
GFL	249.5	121.1(16); 127.0(8)	25(-)	48.69	3.03	0.94
SMX	253.8	108.1(20); 156.5(16)	30	112.34	14.02	2.95
SDZ	250.3	108.1(26); 156.3(16)	36	77.40	15.30	1.98

RSD = relative standard deviations.

SMZ	264.3	156.1(15); 172.1(15)	40	89.98	1.07	3.33
OFL	361.4	261.4(28); 318.2(18)	43	57.50	5.69	0.72
CIP	332.1	288.1(18);314.1(22)	42	40.47	4.15	1.42
NOR	319.3	233.0(25); 276.1(20)	40	29.52	4.26	2.08
TC	444.4	410.0(35); 427.0(12)	35	76.45	9.41	14.10
OTC	460.4	426.2(18); 443.2(12)	34	86.37	10.04	7.21
ERY	733.9	158.1(30); 576.5(20)	30	156.48	5.28	3.73
CP	321	151.9(18); 256.9(10)	36(-)	69.72	14.01	4.54
PIN	354.8	126.8(40);208.9(40)	40(-)	46.89	5.11	1.74
OPFR						
TMP	141	79.0(20); 109.0(15)	33	35.00	2.39	0.64
TEP	183	99.0(19); 81.0(35)	23	37.50	1.75	0.44
TNBP	267.1	99.0(17); 155.1(9)	20	112.30	3.23	0.96
TBOEP	399.2	299.1(12); 199.0(13)	32	103.50	4.54	1.77
TEHP	435.2	113.0(9); 98.9(18)	24	154.20	13.44	5.82
TCEP	284.9	99.2(21); 63.3(29)	28	69.40	8.83	3.11
TCPP	326.9	98.9(21)	26	108.60	2.87	1.12
TDCPP	430.9	99.0(29); 75.0(20)	31	68.30	5.56	2.35

EHDP	385.2	273.1(13)	38	135.10	15.52	11.90
TPHP	327	152.5(39); 215.0(23)	52	67.70	2.49	0.75
TMPP	369.1	243.0(25); 166.1(30)	61	66.20	5.42	2.11

Table S4 Primer sequences of ARGs.

Name	Primer name	Sequence (5'to3')	Annealing temp (°C)	Reference
<i>sul1</i>	<i>sul1</i> -F	CACCGGAAACATCGCTGCA	65	Luo et al., 2010
	<i>sul1</i> -R	AAGTTCCGCCGCAAGGCT		
<i>sul2</i>	<i>sul2</i> -F	CTCCGATGGAGGCCGGTAT	62	Luo et al., 2010
	<i>sul2</i> -R	GGAATGCCATCTGCCTTGA		
<i>tetA</i>	<i>tetA</i> -F	GCTACATCCTGCTTGCCTTC	60	Tamminen et al., 2010
	<i>tetA</i> -R	CATAGATCGCCGTGAAGAGG		
<i>tetB</i>	<i>tetB</i> -F	CGAAGTAGGGGTTGAGACGC	60	Luo et al., 2010
	<i>tetB</i> -R	AGACCAAGACCCGCTAATGAA		
<i>tetC</i>	<i>tetC</i> -F	TGCGTTGATGCAATTTCTATGC	60	Tamminen et al., 2010
	<i>tetC</i> -R	GGAATGGTGCATGCAAGGAG		
<i>tetW</i>	<i>tet(W)</i> -FX	GAGAGCCTGCTATATGCCAGC	62	Luo et al., 2010
	<i>tet(W)</i> -FV	GGGCGTATCCACAATGTAAAC		
<i>tetM</i>	<i>tetM</i> -F	GCAATTCTACTGATTTCTGC	60	Tamminen et al., 2010
	<i>tetM</i> -R	CTGTTTGATTACAATTTCCGC		
<i>qnrS</i>	<i>qnrS</i> -F	GTGAGTAATCGTATGTACTTTTGC	62	Guillard et al., 2011
	<i>qnrS</i> -R	AAACACCTCGACTTAAGTCT		
<i>ermB</i>	<i>erm(B)</i> -91f	GATACCGTTTACGAAATTGG	58	Chen et al., 2007
	<i>erm(B)</i> -454r	GAATCGAGACTTGAGTGTGC		
<i>int1</i>	<i>int1</i> -F	GGCTTCGTGATGCCTGCTT	57	Luo et al., 2010
	<i>int1</i> -R	CATTCCTGGCCGTGGTTCT		
16S	16S-F	TCCTACGGGAGGCAGCAGT	60	Nadkarni et al., 2002
	16S-R	GGACTACCAGGGTATCTAATCCTGTT		

Table S5 Standard curves and amplification efficiency for ARGs.

Gene	Y-Intercept	Slope	Linear (r²)	Amplification efficiency
<i>sul1</i>	41.12	-3.85	0.9995	81.80%
<i>sul2</i>	48.7	-3.93	0.9962	79.60%
<i>tetA</i>	44.04	-4.01	0.9975	77.50%
<i>tetB</i>	39.95	-3.73	0.9965	85.30%
<i>tetC</i>	38.95	-3.77	0.9942	84.10%
<i>tetW</i>	39.51	-3.84	0.9986	82.20%
<i>tetM</i>	39.81	-3.77	0.9991	84.20%
<i>qnrS</i>	40.56	-3.85	0.9962	81.90%
<i>ermB</i>	41.24	-3.79	0.9942	83.50%
<i>int1</i>	39.01	-3.54	0.9992	91.70%
16S	41.42	-3.85	0.9994	82.00%

Table S6 Concentrations (mean \pm standard deviation, ng/L) of PPCPs in RWTPs in Beijing, China.

Compounds	RWTP1		RWTP2		RWTP3	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
DEET	4586 \pm 201	53.3 \pm 0.5	2459 \pm 240	395 \pm 20	140 \pm 2.3	127 \pm 1.5
CAF	15513 \pm 495	66.0 \pm 4.0	27103 \pm 469	74.0 \pm 3.0	36.5 \pm 2.8	25.3 \pm 2.0
OCT	96.3 \pm 15	42.8 \pm 9.4	32.3 \pm 5.2	nd	38.4 \pm 8.2	nd
TCC	nd	nd	nd	nd	nd	nd
CMZP	51.4 \pm 16	nd	24.4 \pm 0.1	9.1 \pm 0.3	29.0 \pm 1.2	23.3 \pm 1.5
KTP	107 \pm 21	27.1 \pm 0.9	107 \pm 5.7	19.0 \pm 2.0	50.2 \pm 6.3	27.9 \pm 4.6
DF	118 \pm 7.8	1.5 \pm 2.3	110 \pm 16	12.8 \pm 0.5	61.1 \pm 7.0	1.0 \pm 0.4
IND	21.6 \pm 3.9	nd	4.4 \pm 6.0	nd	4.3 \pm 1.2	nd
MTP	827 \pm 6.7	60.4 \pm 2.3	344 \pm 7.4	12.8 \pm 0.5	61.1 \pm 3.5	179 \pm 3.3
BF	23.9 \pm 4.6	0.6 \pm 0.2	146 \pm 50	19.9 \pm 1.8	29.1 \pm 3.1	22.1 \pm 1.2
GFL	nd	nd	nd	nd	nd	nd
SMX	18.7 \pm 12.7	nd	57.5 \pm 2.5	4.2 \pm 0.5	32.7 \pm 5.3	nd
SDZ	90.7 \pm 3.8	nd	30.8 \pm 4.6	nd	nd	nd
SMZ	nd	nd	nd	nd	nd	nd
OFL	35.5 \pm 1.5	nd	35.8 \pm 2.7	nd	4.9 \pm 8.5	nd
CIP	18.2 \pm 2.2	nd	3.3 \pm 0.4	nd	nd	nd
NOR	33.0 \pm 3.2	nd	nd	nd	nd	nd
TC	13.3 \pm 2.1	nd	nd	nd	nd	nd
OTC	nd	nd	nd	nd	nd	nd
ERY	60.5 \pm 2.7	nd	95.2 \pm 9.5	15.5 \pm 2.9	26.7 \pm 4.4	nd
CP	nd	nd	75.3 \pm 5.3	13.1 \pm 5.7	73.7 \pm 22	9.0 \pm 26
PIN	39.2 \pm 5.9	nd	89.7 \pm 5.9	10.5 \pm 1.7	2.6 \pm 1.1	nd

Table S7 Concentrations (mean \pm standard deviation, ng/L) of OPFRs in RWTPs in Beijing, China.

Compounds	RWTP1		RWTP2		RWTP3	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
TMP	nd	nd	nd	nd	0.7 \pm 0.6	nd
TEP	35.0 \pm 3.5	5.3 \pm 1.1	12.5 \pm 0.8	3.3 \pm 0.2	33.7 \pm 2.1	13.6 \pm 0.8
TNBP	45.3 \pm 2.3	21.1 \pm 4.2	48.2 \pm 0.1	72.3 \pm 0.3	61.0 \pm 4.0	40.6 \pm 1.2
TBOEP	45.4 \pm 1.8	105 \pm 10	872 \pm 107	42.2 \pm 1.3	45.8 \pm 1.7	41.6 \pm 3.5
TEHP	9.8 \pm 6.1	55.6 \pm 3.5	29.9 \pm 0.6	11.2 \pm 0.8	23.9 \pm 2.4	10.0 \pm 0.5
TCEP	60.5 \pm 5.3	49.4 \pm 4.6	116 \pm 14	52.1 \pm 2.9	105 \pm 5.4	38.8 \pm 2.4
TCPP	261 \pm 3.8	237 \pm 15	293 \pm 5.1	72.1 \pm 7.2	120 \pm 2.8	302 \pm 68
TDCPP	10.5 \pm 1.6	nd	7.6 \pm 3.5	nd	nd	nd
TPHP	nd	nd	nd	nd	nd	nd
TMPP	nd	nd	3.4 \pm 0.8	nd	nd	nd
EHDP	nd	nd	nd	nd	nd	nd

Table S8 Concentrations (mean ± standard deviation, copies/mL) of ARGs in RWTPs in Beijing, China.

Genes	RWTP1		RWTP2		RWTP3	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
<i>sul1</i>	(3.58±0.41)×10 ⁵	(7.63±0.61)×10 ⁵	(1.13±0.21)×10 ⁶	(4.64±0.56)×10 ⁴	(1.42±0.15)×10 ⁶	(3.92±0.65)×10 ⁵
<i>sul2</i>	(4.86±0.55)×10 ⁶	(2.00±0.18)×10 ⁷	(5.40±0.82)×10 ⁵	(7.66±0.65)×10 ⁶	(6.55±0.32)×10 ⁶	(5.81±0.66)×10 ⁶
<i>tetA</i>	(2.18±0.22)×10 ⁵	(2.67±0.17)×10 ⁵	(7.19±0.72)×10 ⁵	(1.42±0.21)×10 ⁵	(4.87±0.56)×10 ⁵	(4.09±0.74)×10 ⁵
<i>tetB</i>	(1.54±0.20)×10 ⁶	(1.28±0.16)×10 ⁶	(9.29±0.55)×10 ⁵	(1.57±0.61)×10 ⁶	(1.21±0.35)×10 ⁶	(1.20±0.23)×10 ⁶
<i>tetC</i>	(7.50±0.71)×10 ⁴	(1.12±0.65)×10 ⁵	(2.42±0.39)×10 ⁵	(1.56±0.25)×10 ⁴	(3.35±0.18)×10 ⁵	(1.51±0.26)×10 ⁵
<i>tetW</i>	(5.35±0.61)×10 ⁴	(6.41±0.72)×10 ⁴	(2.39±0.36)×10 ⁴	(1.55±0.26)×10 ⁴	(4.15±0.20)×10 ⁴	(3.36±0.18)×10 ⁴
<i>tetM</i>	(2.05±0.59)×10 ⁴	(2.50±0.25)×10 ⁴	(2.20±0.62)×10 ⁴	(1.79±0.25)×10 ⁴	(1.96±0.27)×10 ⁴	(2.96±0.58)×10 ⁴
<i>qnrS</i>	(2.78±0.33)×10 ⁵	(4.39±0.57)×10 ⁵	(6.30±0.75)×10 ⁴	(2.39±0.19)×10 ⁴	(1.46±0.23)×10 ⁶	(3.49±0.48)×10 ⁵
<i>ermB</i>	(2.68±0.35)×10 ⁶	(2.48±0.17)×10 ⁶	(2.06±0.18)×10 ⁶	(2.10±0.21)×10 ⁶	(2.10±0.55)×10 ⁶	(2.30±0.19)×10 ⁶
<i>int1</i>	(1.70±0.45)×10 ⁶	(1.68±0.26)×10 ⁶	(4.06±0.37)×10 ⁶	(8.44±0.54)×10 ⁵	(3.48±0.18)×10 ⁶	(1.94±0.32)×10 ⁶
16S	(5.78±0.65)×10 ⁸	(8.88±0.54)×10 ⁷	(2.04±0.31)×10 ⁸	(3.95±0.49)×10 ⁶	(1.94±0.12)×10 ⁸	(1.60±0.51)×10 ⁸

Table S9 Concentrations (mean ± standard deviation) of emerging contaminants in sludge of RWTPs in Beijing, China.

Process	Influent	A	A	O
PPCP (ng/g)				
DEET	129±2.5	6.0±0.3	14.2±0.2	5.5±0.3
CAF	22.2±0.3	4.8±0.1	5.2±0.7	4.4±0.2
OCT	203±5.0	29.0±12.6	49.4±4.1	29.2±4.4
TCC	89.2±27.2	48.6±11.4	11.2±1.6	11.7±1.0
CMZP	nd	nd	nd	nd
KTP	136±5.6	39.6±1.0	38.8±0.5	38.2±0.4
DF	11.1±2.0	nd	nd	nd
IND	101±8.4	30.1±0.5	30.2±0.1	30.2±0.2
MTP	1182±48	16.2±1.0	18.7±1.1	14.3±0.9
BF	51.9±1.8	7.8±0.6	6.3±2.1	4.7±1.0
GFL	nd	nd	nd	nd
SMX	nd	nd	nd	nd
SDZ	737±25	110±11	112±5.6	86.1±3.8
SMZ	nd	nd	nd	nd
OFL	5419±265	185±14	229±1.9	202±14
CIP	255±13	43.6±4.5	54.3±1.3	40.7±4.4
NOR	1299±37	216±15	252±6.8	220±11
TC	590±13	35.6±11	28.2±5.2	38.4±8.5
OTC	327±9.1	23.3±1.2	21.6±2.3	18.3±2.2
ERY	nd	nd	nd	nd
CP	45.8±2.9	4.0±1.2	1.9±0.2	2.5±0.2
PIN	5.5±0.3	2.9±1.6	3.1±1.6	1.4±1.0
ARGs (copies/g)				
<i>sul1</i>	--	(9.82±0.56)×10 ⁷	(6.67±0.12)×10 ⁷	(9.67±1.12)×10 ⁷
<i>sul2</i>	--	(2.43±0.23)×10 ⁸	(1.67±0.45)×10 ⁸	(3.71±0.47)×10 ⁸
<i>tetA</i>	--	(2.39±0.51)×10 ⁷	(1.08±0.21)×10 ⁷	(2.57±0.11)×10 ⁷
<i>tetB</i>	--	(1.79±0.05)×10 ⁷	(1.29±0.14)×10 ⁷	(1.46±0.13)×10 ⁷
<i>tetC</i>	--	(1.09±0.14)×10 ⁷	(4.11±0.87)×10 ⁶	(1.11±0.21)×10 ⁷

<i>tetW</i>	--	$(3.25 \pm 0.55) \times 10^6$	$(2.07 \pm 0.23) \times 10^6$	$(3.27 \pm 0.12) \times 10^6$
<i>tetM</i>	--	$(4.38 \pm 0.26) \times 10^6$	$(2.82 \pm 0.47) \times 10^6$	$(3.78 \pm 0.28) \times 10^6$
<i>qnrS</i>	--	$(3.91 \pm 0.15) \times 10^5$	$(3.51 \pm 0.39) \times 10^5$	$(9.26 \pm 0.89) \times 10^5$
<i>ermB</i>	--	$(5.33 \pm 0.58) \times 10^7$	$(2.97 \pm 0.32) \times 10^7$	$(5.16 \pm 0.47) \times 10^7$
<i>int1</i>	--	$(1.24 \pm 0.15) \times 10^8$	$(6.91 \pm 0.85) \times 10^7$	$(1.29 \pm 0.12) \times 10^8$
16S	--	$(2.15 \pm 0.26) \times 10^{10}$	$(8.53 \pm 0.54) \times 10^9$	$(2.00 \pm 0.22) \times 10^{10}$
OPFRs (ng/g)				
TMP	nd	nd	nd	nd
TEP	48.6±5.6	59.1±2.3	67.7±4.4	99.3±2.1
TNBP	3.6±0.5	nd	nd	nd
TBOEP	27.3±2.1	2.2±0.2	13.7±1.4	1.9±0.4
TEHP	51.3±4.6	16.7±2.3	17.3±1.2	11.6±1.0
TCEP	4.7±0.6	8.1±0.2	28.5±0.3	29.7±0.5
TCPP	84.3±4.1	33.0±0.7	90.9±3.3	44.5±2.5
TDCPP	nd	nd	nd	nd
EHDP	nd	nd	nd	nd
TPHP	nd	nd	nd	nd
TMPP	26.3±0.6	nd	nd	nd

nd: not detected

--: no data.

Table S10 Data of PPCPs for meta-analysis from literatures.

Reference	Secondary treatment		Reference	Tertiary treatment	
	Number ^a	Total number ^b		Number ^a	Total number ^b
Simonich et al., 2002	0	3	Adams et al., 2002	0	7
Yang and Metcalfe, 2006	0	2	Esplugas et al., 2007	33	62
Buttiglieri and Knepper, 2008	5	10	Rodríguez et al., 2008	48	77
Teske and Arnold, 2008	1	4	Gerrity et al., 2011	20	38
Liu et al., 2009	8	13	Cruz et al., 2012	62	118
Miege et al., 2009	8	48	Reungoat et al., 2012	4	21
Rosal et al., 2010	2	41	Nguyen et al., 2013	1	22
Melo-Guimarães et al., 2013	0	16	Prieto-Rodríguez et al., 2013	0	32
Luo et al., 2014	6	14	Tijani et al., 2013	9	15
Phan et al., 2014	6	26	Rivera-Utrilla et al., 2013	20	50
Yuan et al., 2015	1	23	Yuan et al., 2015	1	23
Afonso-Olivares et al., 2017	5	23	Afonso-Olivares., 2017	9	21
Ashfaq et al., 2017	2	36	Lee et al., 2012	9	15
Li et al., 2018	6	15	Li et al., 2018	8	15
Wang et al., 2018a	1	42	He et al., 2013	0	6

Kumar et al., 2019	6	15	Tarpani and Azapagic, 2018	2	14
This study	2	18	This study	6	18

Number ^a: Number of compounds with 99% removal efficiency.

Total number ^b: Total number of target compounds in study.

Table S11 Data of OPFR s for meta-analysis from literatures.

Reference	Secondary treatment		Reference	Tertiary treatment	
	Number ^a	Total number ^b		Number ^a	Total number ^b
Meyer and Bester, 2004	3	7	Krzeminski et al., 2017	3	4
Marklund et al., 2005	3	8	Marklund et al., 2005	2	7
Rodil et al., 2005	0	6	Rodil et al., 2005	2	6
Green et al., 2008	2	8	Wang et al., 2018b	2	5
Schreder and La Guardia, 2014	0	3	Cristale et al., 2016	3	6
Shi et al., 2016	2	11	Cristale et al., 2016	5	6
Liang and Liu, 2016	4	12	Liang and Liu, 2016	5	12
Kim et al., 2017	0	15	Kim et al., 2017	2	15
Wang et al., 2018c	1	3	Wang et al., 2018c	1	3
Xu et al., 2019	5	10	Xu et al., 2019	6	10
This study	2	6	This study	3	6

Number ^a: Number of compounds with 60% removal efficiency.

Total number ^b: Total number of target compounds in study.

Table S12 Data of ARGs for meta-analysis from literatures.

Reference	Secondary treatment		Reference	Tertiary treatment	
	Number ^a	Total number ^b		Number ^a	Total number ^b
Zhang et al., 2009	2	9	Laht et al., 2014	7	7
Marti et al., 2013	3	12	Bergeron et al., 2015	2	6
Biswal et al., 2014	2	11	Biswal et al., 2014	11	11
Alexander et al., 2015	1	4	Alexander et al., 2015	1	4
Amador et al., 2015	1	7	Bengtsson-Palme et al., 2016	12	15
Rodriguez-Mozaz et al., 2015	5	5	Li et al., 2019	4	4
Yang et al., 2014	72	78	Di Cesare et al., 2016	1	4
Neudorf et al., 2017	5	9	Neudorf et al., 2017	4	9
Xu et al., 2015	6	13	Xu et al., 2015	7	13
Zhang et al., 2018	0	8	Xu et al., 2016	4	8
This study	4	10	This study	6	10

Number ^a: The number of compounds whose concentration is reduced.

Total number ^b: Total number of target compounds in study.

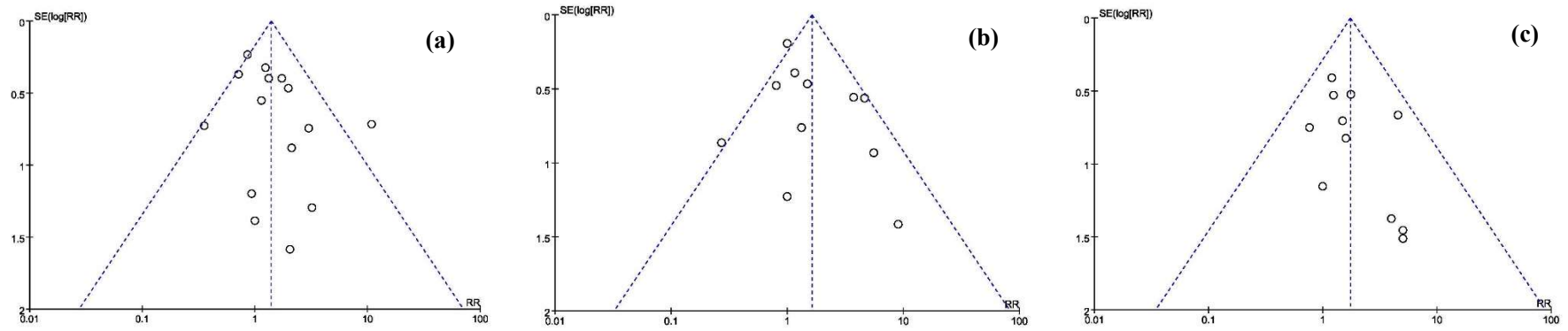


Figure S1 Bias testing for removal of emerging contaminants in meta-analysis. (a) PPCPs; (b) ARGs; (c) OPFRs.

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