
Supplementary information

Intra- and interpopulation transposition of mobile genetic elements driven by antibiotic selection

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Supplementary Information for

Intra- and inter-population transposition of mobile genetic elements driven by antibiotic selection

Yi Yao, Rohan Maddamsetti, Andrea Weiss, Yuanchi Ha, Teng Wang, Shangying Wang, Lingchong You*

* Corresponding author. E-mail: you@duke.edu

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Supplementary Tables

Supplementary Table 1. Parameters and initial values used for the single strain model.

All variables are dimensionless.

Parameters	Interpretation	Values in Fig. 1	Values in Extended Data Fig. 1	Values in Extended Data Fig. 2
$S_c(0)$	Initial density of S_c	0.00001	0.00001	0.00001
$S_p(0)$	Initial density of S_p	0	0	0
$\mu_c(0)$	Maximum growth rate of S_c (at $[A] = 0$)	0.7	0.7	0.7
$\mu_p(0)$	Maximum growth rate of S_p (at $[A] = 0$)	0.5	0.5, 0.4, 0.3	0.5
η_T	Transposition rate from S_c to S_p	10^{-5}	0.01, 10^{-4} , 10^{-6}	10^{-5}
A_c	Half-maximal antibiotic concentration against S_c	1.5	1.5	1.5
A_p	Half-maximal antibiotic concentration against S_p	10	20, 10, 5	10
n_c	Hill coefficient of antibiotic effect on S_c	2	2	1, 2, 3
n_p	Hill coefficient of antibiotic effect on S_p	2	2	1, 2, 3
$[A]$	Antibiotic concentration	0-5	0-5	0.1-100

Supplementary Table 2. Parameters and initial values used for the two-strain mixed culture model. All variables are dimensionless.

Parameters	Interpretation	Values
$D_c(0)$	Initial density of D_c	0.00001
$D_p(0)$	Initial density of D_p	0
$R(0)$	Initial density of R	0.00001
$R_p(0)$	Initial density of R_p	0
$R_{pt}(0)$	Initial density of R_{pt}	0
$\mu_{dc}(0)$	Maximum growth rate of D_c (at $[A] = 0$)	1.0
$\mu_{dp}(0)$	Maximum growth rate of D_p (at $[A] = 0$)	0.5
$\mu_r(0)$	Maximum growth rate of R (at $[A] = 0$)	2.8
$\mu_{rp}(0)$	Maximum growth rate of R_p (at $[A] = 0$)	1.6
$\mu_{rpt}(0)$	Maximum growth rate of R_{pt} (at $[A] = 0$)	0.8
η_T	Transposition rate from D_c to D_p	0.001
γ	Conjugation rate from Donor strains to Recipient strains	0.001
κ	Dilution rate	0.2
A_c	Half-maximal antibiotic concentration against D_c	1.5
A_p	Half-maximal antibiotic concentration against D_p and R_{pt}	10
A_r	Half-maximal antibiotic concentration against R and R_p	0.1
n	Hill coefficient	2
$[A]$	Antibiotic concentration	0, 0.5, 5

Supplementary Table 3. Strains used in this work

Strain No.	Strain Name	Derived from	First occurrence
S01	DH5 α		--
S02	S17-1	ATCC No. 47055	--
S03	DH5 α -attB-HK022::pB030+pA018	DH5 α	Fig. 2b
S04	DH5 α -attB-HK022::pB059+pA018	DH5 α	Fig. 2d
S05	DH5 α -attB-HK022::pB106+pB147	DH5 α	Fig. 2d
S06	DH5 α -attB-HK022::pB026+pA018	DH5 α	Fig. 3b
S07	DH5 α -attB-HK022::pB020+pA018	DH5 α	Fig. 3b
S08	DH5 α -attB-HK022::pB092+pA018	DH5 α	Fig. 3c
S09	DH5 α -attB-HK022::pB090+pA011	DH5 α	Fig. 3c
S10	DH5 α -attB-HK022::pB091+pA018	DH5 α	Fig. 3c
S11	DH5 α -attB-HK022::pB095+pA018	DH5 α	Fig. 3c
S12	DH5 α -attB-HK022::pB030+pA029	DH5 α	Fig. 3d
S13	DH5 α -attB-HK022::pB030+pA030	DH5 α	Fig. 3d
S14	DH5 α -attB-HK022::pB030+pA031	DH5 α	Fig. 3d
S15	DH5 α -attB-HK022::pB030+pD034	DH5 α	Fig. 3e
S16	DH5 α -attB-HK022::pB030+pD036	DH5 α	Fig. 3e
S17	DH5 α -attB-HK022::pB030+pD042	DH5 α	Fig. 3e
S18	DH5 α -attB-HK022::pB107+pA042	DH5 α	Fig. 4a
S19	DH5 α -attB-HK022::pB108+pA042	DH5 α	Fig. 4a
S20	DH5 α -attB-HK022::pB109+pA042	DH5 α	Fig. 4a
S21	DH5 α -attB-HK022::pB110+pA042	DH5 α	Fig. 4a
S22	DH5 α -attB-HK022::pB111+pA042	DH5 α	Fig. 4a
S23	DH5 α -attB-HK022::pB112+pA042	DH5 α	Fig. 4a
S24	DH5 α -attB-HK022::pB113+pA042	DH5 α	Fig. 4a
S25	DH5 α -attB-HK022::pB114+pA042	DH5 α	Fig. 4a
S26	DH5 α -attB-HK022::pB115+pA042	DH5 α	Fig. 4a
S27	DH5 α -attB-HK022::pB116+pA042	DH5 α	Fig. 4a
S28	DH5 α -attB-HK022::pB117+pA042	DH5 α	Fig. 4a
S29	DH5 α -attB-HK022::pB118+pA042	DH5 α	Fig. 4a
S30	DH5 α -attB-HK022::pB119+pA042	DH5 α	Fig. 4a
S31	DH5 α -attB-HK022::pB120+pA042	DH5 α	Fig. 4a
S32	DH5 α -attB-HK022::pB121+pA042	DH5 α	Fig. 4a
S33	DH5 α -attB-HK022::pB122+pA042	DH5 α	Fig. 4a
S34	DH5 α -attB-HK022::pB123+pA042	DH5 α	Fig. 4a
S35	DH5 α -attB-HK022::pB124+pA042	DH5 α	Fig. 4a
S36	DH5 α -attB-HK022::pB125+pA042	DH5 α	Fig. 4a
S37	DH5 α -attB-HK022::pB126+pA042	DH5 α	Fig. 4a
S38	DH5 α -attB-HK022::pB127+pA042	DH5 α	Fig. 4a
S39	DH5 α -attB-HK022::pB128+pA042	DH5 α	Fig. 4a

S40	DH5 α -attB-HK022::pB129+pA042	DH5 α	Fig. 4a
S41	DH5 α -attB-HK022::pB130+pA042	DH5 α	Fig. 4a
S42	DH5 α -attB-HK022::pB131+pA042	DH5 α	Fig. 4a
S43	DH5 α -attB-HK022::pB132+pA042	DH5 α	Fig. 4a
S44	DH5 α -attB-HK022::pB133+pA042	DH5 α	Fig. 4a
S45	DH5 α -attB-HK022::pB134+pA042	DH5 α	Fig. 4a
S46	DH5 α -attB-HK022::pB135+pA042	DH5 α	Fig. 4a
S47	DH5 α -attB-HK022::pB136+pA042	DH5 α	Fig. 4a
S48	DH5 α -attB-HK022::pB137+pA042	DH5 α	Fig. 4a
S49	DH5 α -attB-HK022::pB138+pA042	DH5 α	Fig. 4a
S50	DH5 α -attB-HK022::pB139+pA042	DH5 α	Fig. 4a
S51	DH5 α -attB-HK022::pB140+pA042	DH5 α	Fig. 4a
S52	DH5 α -attB-HK022::pB141+pA042	DH5 α	Fig. 4a
S53	DH5 α -attB-HK022::pB142+pA042	DH5 α	Fig. 4a
S54	DH5 α -attB-HK022::pB143+pA042	DH5 α	Fig. 4a
S55	DH5 α -attB-HK022::pB144+pA042	DH5 α	Fig. 4a
S56	DH5 α -attB-HK022::pB145+pA042	DH5 α	Fig. 4a
S57	DH5 α -attB-HK022::pB146+pA042	DH5 α	Fig. 4a
S58	S17-1-attB-HK022::pB030+pA030	S17-1	Fig. 5b
S59	DH5 α -attB-HK022::pA037	DH5 α	Fig. 5b
S60	S17-1-attB-HK022::pB030+pA025	S17-1	Fig. 6a
S61	JW5419+PA054	JW5419	Fig. 6a
S62	JW5776+PA055	JW5776	Fig. 6a
S63	JW0696+PA056	JW0696	Fig. 6a
S64	JW1282+PA057	JW1282	Fig. 6a
S65	JW2729+PA058	JW2729	Fig. 6a
S66	JW0026+PA059	JW0026	Fig. 6a
S67	JW1464+PA060	JW1464	Fig. 6a
S68	JW5198+PA061	JW5198	Fig. 6a
S69	JW5422+PA062	JW5422	Fig. 6a
S70	JW5439+PA063	JW5439	Fig. 6a
S71	JW5456+PA064	JW5456	Fig. 6a
S72	JW5503+PA065	JW5503	Fig. 6a
S73	JW5800+PA066	JW5800	Fig. 6a
S74	JW1455+PA067	JW1455	Fig. 6a
S75	JW1822+PA068	JW1822	Fig. 6a
S76	JW5424+PA069	JW5424	Fig. 6a
S77	JW5440+PA070	JW5440	Fig. 6a
S78	JW5457+PA071	JW5457	Fig. 6a
S79	JW5529+PA072	JW5529	Fig. 6a
S80	JW5441+PA073	JW5441	Fig. 6a
S81	JW3566+PA074	JW3566	Fig. 6a
S82	JW3451+PA075	JW3451	Fig. 6a

S83	JW2528+PA076	JW2528	Fig. 6a
S84	JW0746+PA077	JW0746	Fig. 6a
S85	JW2549+PA078	JW2549	Fig. 6a
S86	JW5426+PA079	JW5426	Fig. 6a
S87	JW5444+PA080	JW5444	Fig. 6a
S88	JW5458+PA081	JW5458	Fig. 6a
S89	JW5531+PA082	JW5531	Fig. 6a
S90	JW0055+PA083	JW0055	Fig. 6a
S91	JW3381+PA084	JW3381	Fig. 6a
S92	JW4056+PA085	JW4056	Fig. 6a
S93	JW4367+PA086	JW4367	Fig. 6a
S94	JW5427+PA087	JW5427	Fig. 6a
S95	JW5460+PA088	JW5460	Fig. 6a
S96	JW5803+PA089	JW5803	Fig. 6a
S97	JW0689+PA090	JW0689	Fig. 6a
S98	JW0323+PA091	JW0323	Fig. 6a
S99	JW0285+PA092	JW0285	Fig. 6a
S100	JW3386+PA093	JW3386	Fig. 6a
S101	JW3518+PA094	JW3518	Fig. 6a
S102	JW5064+PA095	JW5064	Fig. 6a
S103	JW5428+PA096	JW5428	Fig. 6a
S104	JW5577+PA097	JW5577	Fig. 6a
S105	JW5142+PA098	JW5142	Fig. 6a
S106	JW1730+PA099	JW1730	Fig. 6a
S107	JW0345+PA100	JW0345	Fig. 6a
S108	JW5076+PA101	JW5076	Fig. 6a
S109	JW5475+PA102	JW5475	Fig. 6a
S110	JW5432+PA103	JW5432	Fig. 6a
S111	JW0486+PA104	JW0486	Fig. 6a
S112	JW3384+PA105	JW3384	Fig. 6a
S113	JW1572+PA106	JW1572	Fig. 6a
S114	JW2799+PA107	JW2799	Fig. 6a
S115	JW5437+PA108	JW5437	Fig. 6a
S116	JW5454+PA109	JW5454	Fig. 6a
S117	JW5476+PA110	JW5476	Fig. 6a
S118	JW5707+PA111	JW5707	Fig. 6a
S119	JW5442+PA112	JW5442	Fig. 6a
S120	JW1451+PA113	JW1451	Fig. 6a
S121	JW0952+PA114	JW0952	Fig. 6a
S122	JW1948+PA115	JW1948	Fig. 6a
S123	JW3650+PA116	JW3650	Fig. 6a
S124	JW2505+PA117	JW2505	Fig. 6a
S125	JW5183+pA118	JW5183	Fig. 6a

S126	JW2862+pA119	JW2862	Fig. 6a
S127	MG1655-attB-HK022::pB030+pA018	MG1655	Extended Data Fig. 4a
S128	MG1655-attB-HK022::pB020+pA018	MG1655	Extended Data Fig. 6a
S129	MG1655-attB-HK022::pB026+pA018	MG1655	Extended Data Fig. 6b
S130	DH5 α -attB-HK022::pB059+pA029	DH5 α	Extended Data Fig. 7
S131	DH5 α -attB-HK022::pB106+pB148	DH5 α	Extended Data Fig. 7
S132	DH5 α -attB-HK022::pB059+pA030	DH5 α	Extended Data Fig. 7
S133	DH5 α -attB-HK022::pB106+pB149	DH5 α	Extended Data Fig. 7
S134	DH5 α -attB-HK022::pB059+pA031	DH5 α	Extended Data Fig. 7
S135	DH5 α -attB-HK022::pB106+pB150	DH5 α	Extended Data Fig. 7
S136	DH5 α +pD002+pA042	DH5 α	Extended Data Fig. 9b

Supplementary Table 4. Plasmids used in this work

Plasmid No.	Elements containing	Copy number	First occurrence
pA004	SC101 origin, HK022 integrase	5	
pA018	PUC origin, <i>kanR</i>	200	Fig. 2b
pB030	attP:HK022, R6ky origin, <i>cmR</i> , miniTn5 transposase, miniTn5-J23104-tetA	Suicide	Fig. 2b
pB059	attP:HK022, R6ky origin, <i>cmR</i> , miniTn5-J23104-tetA	Suicide	Fig. 2d
pB147	PUC origin, KmR, miniTn5-J23104-tetA	200	Fig. 2d
pB106	attP:HK022, R6ky origin, <i>cmR</i>	Suicide	Fig. 2d
pB026	attP:HK022, R6ky origin, <i>cmR</i> , miniTn5 transposase, miniTn5-J23110-tetA	Suicide	Fig. 3b
pB020	attP:HK022, R6ky origin, <i>cmR</i> , miniTn5 transposase, miniTn5-J23113-tetA	Suicide	Fig. 3b
pA011	PUC origin, <i>smR</i>	200	Fig. 3c
pB092	attP:HK022, R6ky origin, <i>cmR</i> , miniTn5 transposase, miniTn5-J23109-ampR	Suicide	Fig. 3c
pB090	attP:HK022, R6ky origin, <i>cmR</i> , miniTn5 transposase, miniTn5-J23109-kanR	Suicide	Fig. 3c
pB091	attP:HK022, R6ky origin, <i>cmR</i> , miniTn5 transposase, miniTn5-J23109-smR	Suicide	Fig. 3c
pB095	attP:HK022, R6ky origin, <i>smR</i> , miniTn5 transposase, miniTn5-J23109-cmR	Suicide	Fig. 3c
pA029	PBR322 origin, <i>kanR</i> , oriT-RP4	60	Fig. 3d
pA030	CloDF13 origin, <i>kanR</i> , oriT-RP4	100	Fig. 3d
pA031	P15A origin, <i>kanR</i> , oriT-RP4	20	Fig. 3d
pD034	Native plasmid (2545) from a pathogen (GN02545) collected by Duke hospital, IncFII, MOBF	3	Fig. 3e
pD036	Native plasmid (94-1) from a pathogen (ESBL94) collected by Duke, hospital IncFIB/IncFIA/IncFII, MOBF	2	Fig. 3e
pD042	Native plasmid (5505-1) from a pathogen (GN05505) collected by Duke hospital, IncFIC(FII), MOBF	2	Fig. 3e
pA042	PUC origin, <i>kanR</i> , landing pad sequence for native transposons	200	Fig. 4a
pB107	attP:HK022, R6ky origin, <i>cmR</i> , IS1-IS1A-J23110-tetA	Suicide	Fig. 4a
pB108	attP:HK022, R6ky origin, <i>cmR</i> , IS3-J23110-tetA	Suicide	Fig. 4a
pB109	attP:HK022, R6ky origin, <i>cmR</i> , IS4-J23110-tetA	Suicide	Fig. 4a

pB110	attP:HK022, R6ky origin, <i>cmR</i> , IS4-IS50R-J23110-tetA	Suicide	Fig. 4a
pB111	attP:HK022, R6ky origin, <i>cmR</i> , IS5-IS903-J23110-tetA	Suicide	Fig. 4a
pB112	attP:HK022, R6ky origin, <i>cmR</i> , IS6-IS26-J23110-tetA	Suicide	Fig. 4a
pB113	attP:HK022, R6ky origin, <i>cmR</i> , IS21-ISEc12-J23110-tetA	Suicide	Fig. 4a
pB114	attP:HK022, R6ky origin, <i>cmR</i> , IS30-J23110-tetA	Suicide	Fig. 4a
pB115	attP:HK022, R6ky origin, <i>cmR</i> , IS66-IS679-J23110-tetA	Suicide	Fig. 4a
pB116	attP:HK022, R6ky origin, <i>cmR</i> , IS91-ISEc37-J23110-tetA	Suicide	Fig. 4a
pB117	attP:HK022, R6ky origin, <i>cmR</i> , IS91-ISVsa3-J23110-tetA	Suicide	Fig. 4a
pB118	attP:HK022, R6ky origin, <i>cmR</i> , IS110-ISEc32-J23110-tetA	Suicide	Fig. 4a
pB119	attP:HK022, R6ky origin, <i>cmR</i> , IS110-ISEc45-J23110-tetA	Suicide	Fig. 4a
pB120	attP:HK022, R6ky origin, <i>cmR</i> , IS200IS605-IS200-J23110-tetA	Suicide	Fig. 4a
pB121	attP:HK022, R6ky origin, <i>cmR</i> , IS200IS605-IS605-IS609-J23110-tetA	Suicide	Fig. 4a
pB122	attP:HK022, R6ky origin, <i>cmR</i> , IS200IS605-IS1341-ISEc42-J23110-tetA	Suicide	Fig. 4a
pB123	attP:HK022, R6ky origin, <i>cmR</i> , IS256-ISEc58-J23110-tetA	Suicide	Fig. 4a
pB124	attP:HK022, R6ky origin, <i>cmR</i> , IS481-ISEc18-J23110-tetA	Suicide	Fig. 4a
pB125	attP:HK022, R6ky origin, <i>cmR</i> , IS607-IS1602-J23110-tetA	Suicide	Fig. 4a
pB126	attP:HK022, R6ky origin, <i>cmR</i> , IS607-ISLhe60-J23110-tetA	Suicide	Fig. 4a
pB127	attP:HK022, R6ky origin, <i>cmR</i> , IS630-ISEc40-J23110-tetA	Suicide	Fig. 4a
pB128	attP:HK022, R6ky origin, <i>cmR</i> , IS701-ISAb11-J23110-tetA	Suicide	Fig. 4a
pB129	attP:HK022, R6ky origin, <i>cmR</i> , IS1182-ISPPu16-J23110-tetA	Suicide	Fig. 4a
pB130	attP:HK022, R6ky origin, <i>cmR</i> , IS1380-ISEc69-J23110-tetA	Suicide	Fig. 4a
pB131	attP:HK022, R6ky origin, <i>cmR</i> , IS1595-IS1016-ISEc695-J23110-tetA	Suicide	Fig. 4a

pB132	attP:HK022, R6ky origin, <i>cmR</i> , IS1595-ISEc75-J23110-tetA	Suicide	Fig. 4a
pB133	attP:HK022, R6ky origin, <i>cmR</i> , IS1595-ISNha5-J23110-tetA	Suicide	Fig. 4a
pB134	attP:HK022, R6ky origin, <i>cmR</i> , IS1595-ISNwi1-J23110-tetA	Suicide	Fig. 4a
pB135	attP:HK022, R6ky origin, <i>cmR</i> , IS1595-ISPna2-ISAchd1-J23110-tetA	Suicide	Fig. 4a
pB136	attP:HK022, R6ky origin, <i>cmR</i> , IS1595-ISSod11-J23110-tetA	Suicide	Fig. 4a
pB137	attP:HK022, R6ky origin, <i>cmR</i> , IS1634-IS1549-J23110-tetA	Suicide	Fig. 4a
pB138	attP:HK022, R6ky origin, <i>cmR</i> , ISAs1-ISEc26-J23110-tetA	Suicide	Fig. 4a
pB139	attP:HK022, R6ky origin, <i>cmR</i> , ISAzo13-J23110-tetA	Suicide	Fig. 4a
pB140	attP:HK022, R6ky origin, <i>cmR</i> , ISH3-ISH3C-J23110-tetA	Suicide	Fig. 4a
pB141	attP:HK022, R6ky origin, <i>cmR</i> , ISH6-J23110-tetA	Suicide	Fig. 4a
pB142	attP:HK022, R6ky origin, <i>cmR</i> , ISKra4-ISKpn19-J23110-tetA	Suicide	Fig. 4a
pB143	attP:HK022, R6ky origin, <i>cmR</i> , ISL3-ISKox3-J23110-tetA	Suicide	Fig. 4a
pB144	attP:HK022, R6ky origin, <i>cmR</i> , ISLre2-J23110-tetA	Suicide	Fig. 4a
pB145	attP:HK022, R6ky origin, <i>cmR</i> , ISNCY-IS1202-ISKpn21-J23110-tetA	Suicide	Fig. 4a
pB146	attP:HK022, R6ky origin, <i>cmR</i> , Tn3-Tn2-J23110-tetA	Suicide	Fig. 4a
pA037	attP:HK022, R6ky origin, <i>ampR</i>	Suicide	Fig. 5b
pA53	P15A origin, <i>cmR</i> , mCherry	20	
pA54	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GACCTCTCCCACCGCACTCCTCAGGGTCACTA GGGTGGGCTATAGTGAGTAA	20	Fig. 6a
pA55	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTAAAATCTAGTATTCCACCTCAGGGTCACTAG GAATAGTGCTCAAACCTGA	20	Fig. 6a
pA56	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTCCCCCGGCTGCATGGCCTCAGGGTCACTA GGGACAAACCGGCTGTGTCC	20	Fig. 6a
pA57	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TGCCCAACTATTCATATACCTCAGGGTCACTAG GTAATATCCCCCACGTCC	20	Fig. 6a

pA58	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CCTATGGTGCATCGTTTTCTCAGGGTCACTAG GCACACTATCCCGGCTACA	20	Fig. 6a
pA59	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GTTATCATGTTTATGCTGCCTCAGGGTCACTAG GCGTAGGTCAATTACAAGG	20	Fig. 6a
pA60	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GTCAAGTCAATTAATATCCCTCAGGGTCACTAG GAAACTAGGCGGCACATGG	20	Fig. 6a
pA61	P15A origin, <i>cmR</i> , mCherry, barcode sequence: ATTCATTTTTGGGGTCGTCCTCAGGGTCACTAG GCACGCAAGACCTAAACCC	20	Fig. 6a
pA62	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CATCTCATATTACTACGACCTCAGGGTCACTAG GTTTTAGACCGGAGGAGC	20	Fig. 6a
pA63	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GCTGACTTTAACTTCATTCCTCAGGGTCACTAG GCTAAGATATTTAAACACT	20	Fig. 6a
pA64	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CTAGCAACAACAGCCTATCCTCAGGGTCACTA GGTTACTAAACAACCCGCAA	20	Fig. 6a
pA65	P15A origin, <i>cmR</i> , mCherry, barcode sequence: ATATGTGGCTTATATACTCCTCAGGGTCACTAG GCAGTCCAGATTAGAAAAC	20	Fig. 6a
pA66	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TATTCTGCTTTAACTCTACCTCAGGGTCACTAG GGACTGTCGTTGCGCAAGG	20	Fig. 6a
pA67	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GAAGTCAATGTTATAAGTCCTCAGGGTCACTAG GAGTGCTCTCTTAAACAG	20	Fig. 6a
pA68	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTTCTTAACGAAATCTTACCTCAGGGTCACTAG GAGAAAAGGGCCATAGCAC	20	Fig. 6a
pA69	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TCTTATGGTAGGCATGTTCTCAGGGTCACTAG GACCTCATCCCTTAGCGGC	20	Fig. 6a
pA70	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTCTCTCATAATACTCCCTCAGGGTCACTAG GGGGGGTCTAGGACCACAC	20	Fig. 6a
pA71	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GTCTAGTGACGGAACACCTCAGGGTCACTAG GTAGCCGACAAAGTCCTGG	20	Fig. 6a

pA72	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTTCCCTACAGTTATGACCCTCAGGGTCACTAG GAAAACCTGCTCATCACTGA	20	Fig. 6a
pA73	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TACAATCAGGAGACTTCTCCTCAGGGTCACTAG GCACCGAACGCAGCTATGA	20	Fig. 6a
pA74	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CTTGGGGGGGATGGTTGTCCTCAGGGTCACTA GGGTATCACATTATACTTCC	20	Fig. 6a
pA75	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TAAACTGGGCGGGAAAAGCCTCAGGGTCACTA GGCCACAATAACACCCAGAC	20	Fig. 6a
pA76	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TATCTGTGTTGGTAGCATCCTCAGGGTCACTAG GGATTCTAAGATAGGCGCT	20	Fig. 6a
pA77	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TGAGATTGCTTGGTCTCGCCTCAGGGTCACTA GGCAAATGCATGTACTTTTC	20	Fig. 6a
pA78	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GCAGTGCGTTTATTCGTGCCTCAGGGTCACTA GGGTAGCCAATTCCAAGCTT	20	Fig. 6a
pA79	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GCTGTATTTTGTTTCATCCCCTCAGGGTCACTAG GTCATAAAGCACCACTA	20	Fig. 6a
pA80	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTTTTAGTTTCTGCCAAGCCTCAGGGTCACTAG GAAAGTCGGAGAAAACGCT	20	Fig. 6a
pA81	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AACGTAACGTAGATTGGGCCTCAGGGTCACTA GGCGATGCAAAATTCCACCA	20	Fig. 6a
pA82	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GTCCAGTTTGTGTTTAGGACCTCAGGGTCACTAG GTAAACACCCTCAGCCATT	20	Fig. 6a
pA83	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TAGAGGGGTGCGCCTTGACCTCAGGGTCACTA GGTAAACAGCCACCATAAC	20	Fig. 6a
pA84	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTTCGTTCAAATTGGGGTCTCAGGGTCACTAG GCCACTAGCTCGAAGCAAT	20	Fig. 6a
pA85	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTCTGAGCTGATGATACACCTCAGGGTCACTAG GCCCTCACCGGGGCTCCTA	20	Fig. 6a

pA86	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTATTTTAAAATTTGCCACCTCAGGGTCACTAG GTCAGTCAATCTACCGATA	20	Fig. 6a
pA87	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TTTATTATTCTTCTTGAACCTCAGGGTCACTAG GTGGCACTTTAAATCCGAG	20	Fig. 6a
pA88	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AATCCCTTTTCTGAAAGTCCTCAGGGTCACTAG GCTCAAACTCCCAGTTGA	20	Fig. 6a
pA89	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TGATATGTCTATCGGGGGCCTCAGGGTCACTA GGCCATCTCCAACAAATTCC	20	Fig. 6a
pA90	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AACACCGTGAGTCTTTAACCTCAGGGTCACTAG GGCGTCCGGCAAAAGTCTA	20	Fig. 6a
pA91	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TGTAGATTAGATTTTTATCCTCAGGGTCACTAG GCACTCCCCGCACATACGA	20	Fig. 6a
pA92	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AATAATAGCGAATGGCATCCTCAGGGTCACTAG GAGCAGTTTTCTCGACTC	20	Fig. 6a
pA93	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GGATTCCAAATTAACGTCCTCAGGGTCACTAG GAGAAGCCACCTAGTATTG	20	Fig. 6a
pA94	P15A origin, <i>cmR</i> , mCherry, barcode sequence: ATTGTATATATTAGATTACCTCAGGGTCACTAG GAACTGACATACTCCTCAC	20	Fig. 6a
pA95	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GTTTCGCTTGTCTTAACCTCCTCAGGGTCACTAG GGTATCTGAGACGATGCAC	20	Fig. 6a
pA96	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CAAACTGAGCAATGCTGCCTCAGGGTCACTA GGGTTACTTCTCAACTAGCT	20	Fig. 6a
pA97	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TCTCTTACATTTTTATTCCCTCAGGGTCACTAG GGCGGCTTACCCCGAACAT	20	Fig. 6a
pA98	P15A origin, <i>cmR</i> , mCherry, barcode sequence: ACTCCATAATCCTAATCCCCTCAGGGTCACTAG GGCAAGCGGACTATTTAAA	20	Fig. 6a
pA99	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GGCACTCAAGGCCAGTCCTCAGGGTCACTA GGTGCCTGGCAATGACATTC	20	Fig. 6a

pA100	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GATTAGGTATTATCCAGTCCTCAGGGTCACTAG GTCGACTCTTCTACTGATA	20	Fig. 6a
pA101	P15A origin, <i>cmR</i> , mCherry, barcode sequence: ATTTATTGGCTCGATCCGCCTCAGGGTCACTAG GAAACATGCACCTGGTCTGA	20	Fig. 6a
pA102	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AATATACGACCTGTACAACCTCAGGGTCACTAG GGTAGAACACTGGCTTACC	20	Fig. 6a
pA103	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CCCGATGCATAATCCTTTCTCAGGGTCACTAG GATACACTCCCCGGCACAT	20	Fig. 6a
pA104	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TCCTTTTTTAATGAGCTACCTCAGGGTCACTAG GAATAGCCAAAGCACGTTG	20	Fig. 6a
pA105	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CCTCTATTCTCGAGCATACTCAGGGTCACTAG GCACACCGTGACACAAACA	20	Fig. 6a
pA106	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CCCGTATTTACAGCGCACCTCAGGGTCACTA GGGCAGACTATATTTGCTCT	20	Fig. 6a
pA107	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GGTTGCGCTTTATTACGCCCTCAGGGTCACTA GGTGTTTTGAGCCCCTATAT	20	Fig. 6a
pA108	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CACGCTTTCTGTTTCATGCCCTCAGGGTCACTAG GTACTCCTCGCAACTAGAA	20	Fig. 6a
pA109	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TATGTCGAACTGGAAGCCCCTCAGGGTCACTA GGGAAATCAATTATTAGTCA	20	Fig. 6a
pA110	P15A origin, <i>cmR</i> , mCherry, barcode sequence: GCAAAGGCAATGATGGATCCTCAGGGTCACTA GGTTTTGTGGAACCGACCCG	20	Fig. 6a
pA111	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TATGAGTTTTATTAGCCTCCTCAGGGTCACTAG GCCATGGCATTGTAATCC	20	Fig. 6a
pA112	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TCCCGATTAGCTAGCGGGCCTCAGGGTCACTA GGTACGCTCTAATCAAAGCA	20	Fig. 6a
pA113	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AGAGTCTCAAATTTCCGTCCTCAGGGTCACTAG GCAAACCCGCCCCCGGCTA	20	Fig. 6a

pA114	P15A origin, <i>cmR</i> , mCherry, barcode sequence: CCAGGGCCGTTGAGCGGGCCTCAGGGTCACT AGGTTGCCCCACAACCTTCAAG	20	Fig. 6a
pA115	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AGCCTATGTATCTTCGCCCCTCAGGGTCACTAG GGTTCATCCTCCGGCGAAC	20	Fig. 6a
pA116	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TGAGATCGACATGTGGGGCCTCAGGGTCACTA GGTCGTAGGAATGATTATTA	20	Fig. 6a
pA117	P15A origin, <i>cmR</i> , mCherry, barcode sequence: TAACGAGATAAGTACGCTCCTCAGGGTCACTA GGCCTAATTATGGTTTTTCGG	20	Fig. 6a
pA118	P15A origin, <i>cmR</i> , mCherry, barcode sequence: AGCTCAGGTTTGGACTTTCCTCAGGGTCACTAG GTTAAGCATCTCCCCTCCT	20	Fig. 6a
pA119	P15A origin, <i>cmR</i> , mCherry, barcode sequence: ATCCCTTTGAGTGTTGATCCTCAGGGTCACTAG GGATCATACCAACGAGAAG	20	Fig. 6a
pA025	pUC origin, <i>ampR</i> , oriT-RP4	200	Fig. 6a
pB148	PBR322 origin, <i>kanR</i> , miniTn5-J23104-tetA	60	Extended Data Fig. 7
pB149	CloDF13 origin, <i>kanR</i> , miniTn5-J23104-tetA	100	Extended Data Fig. 7
pB150	P15A origin, <i>kanR</i> , miniTn5-J23104-tetA	20	Extended Data Fig. 7
pD002	native F plasmid	1	Extended Data Fig. 9b

Supplementary Table 5 Primers used in this work

Name	Sequence
qPCR-tetA-f	GCCACTATCGACTACGCGATCA
qPCR-tetA-r	TGCGTCCGGCGTAGAGAAT
qPCR- <i>cmR</i> -f	CCGCTGGCGATTTCAGGTT
qPCR- <i>cmR</i> -r	AAGCATTCTGCCGACATGGA
qPCR- <i>kanR</i> -f	TGATGCGCTGGCAGTGTTT
qPCR- <i>kanR</i> -r	GCGATCGCTGTATAAAAGGACAA
qPCR- <i>smR</i> -f	TCCGTGGCGTTATCCAGCTA
qPCR- <i>smR</i> -r	GTCATTGCGCTGCCATTCTC
qPCR- <i>ampR</i> -f	GCTATGTGGCGCGGTATTATCC
qPCR- <i>ampR</i> -r	TGCGGCGACCGAGTTG
P1	ggccgctaattaattaatcTGCCACCTGACGTCCAGTG
P2	gtactatcgggcccctgaggcTGCGCGGAACCCCTATTTG
P3	CCGACCACCGAGATCTACACXXXXXXXXXXXXXXXXXXXXAACACTCTT TCCCTACACGACG
P4	CAAGCAGAAGACGGCATAACGAGATXXXXXXXXGTGACTGGAGTTCA GACGTGTGC
P5	AATGATACGGCGACCACCGAGATCTAC
P6	CAAGCAGAAGACGGCATAACGAG

Supplementary Table 6. qPCR probes used in this work

Name	Sequence	Fluorescence
tetA-probe-MGB-NED	ACCACACCCGTCCTGT	NED
cmR-probe-MGB-FAM	CCATCACAAACGGCATGA	FAM
kanR-probe-QSY-VIC	CGCCGGTTGCATTCGATTCCTGT	VIC
smR-probe-MGB-NED	CGCGAACTGCAATTT	NED
ampR-probe-MGB-NED	ATTGACGCCGGGCAA	NED