Appendix

Olesen SW, Barnett ML, MacFadden DR, *et al.* Trends in outpatient antibiotic prescribing practice among US older adults, 2011-2015: an observational study.

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Appendix Table 1. Dosage form codes for oral and injected drugs. Part D Events were filtered for oral and injected drugs using the values in this table.

Dosage code	Dosage form
CA	CAPSULE
CE	CAPSULE,DELAYED RELEASE (ENTERIC COATED)
CJ	CAPSULE,EXTENDED RELEASE MULTIPHASE 24HR
HH	AMPUL (ML)
HK	IV SOLUTION, PIGGYBACK PREMIX FROZEN(ML)
HM	INTRAVENOUS SOLUTION
HP	INTRAVENOUS SOLUTION, PIGGYBACK (ML)
HQ	DISPOSABLE SYRINGE (ML)
HQ	SYRINGE (ML)
HS	VIAL (SDV,MDV OR ADDITIVE) (EA)
HS	VIAL (EA)
HV	VIAL (SDV,MDV OR ADDITIVE) (ML)
HV	VIAL (ML)
IF	VIAL WITH THREADED PORT (EA)
IG	VIAL WITH THREADED PORT (ML)
IM	CAPSULE,IMMEDIATE, DELAY RELEASE,BIPHASE
PD	SUSPENSION, RECONSTITUTED, ORAL (ML)
PI	SOLUTION, RECONSTITUTED, ORAL
PP	PACKET (EA)
QI	SUSPENSION, EXTENDED RELEASE, RECONST.
RG	SUSPENSION, MICROCAPSULE RECONSTITUTED
RH	DROPS, VISCOUS (ML)
SC	SUSPENSION, ORAL (FINAL DOSE FORM)
SJ	SOLUTION, ORAL
ST	SYRUP
TA	TABLET
TC	TABLET, CHEWABLE
TE	TABLET, DELAYED RELEASE (ENTERIC COATED)
TM	TABLET, EXTENDED RELEASE 12 HR
TS	TABLET, EXTENDED RELEASE
UP	TABLET,EXTENDED RELEASE MULTIPHASE 24 HR
ZD	COMBINATION PACKAGE (EA)

Appendix Table 2. Antibiotic generic names. Part D Events were filtered for antibiotics using the generic names in this table.

Generic name	Antibiotic
AMIKACIN SULFATE	amikacin
AMOXICILLIN	amoxicillin
AMOXICILLIN/POTASSIUM CLAV	amoxicillin/clavulanate
AMPICILLIN SODIUM	ampicillin
AMPICILLIN SODIUM/SULBACTAM NA	ampicillin
AMPICILLIN TRIHYDRATE	ampicillin
AZITHROMYCIN	azithromycin
AZTREONAM	aztreonam
AZTREONAM LYSINE	aztreonam
AZTREONAM/DEXTROSE-WATER	aztreonam
BACITRACIN	bacitracin
BACITRACIN/POLYMYXIN B SULFATE	bacitracin
BEDAQUILINE FUMARATE	bedaquiline
BESIFLOXACIN HCL	besifloxacin
BESIFLOXACIN HYDROCHLORIDE	besifloxacin
BISMUTH SAL/METRONID/TETRACYC	metronidazole/tetracycline
BISMUTH/METRONID/TETRACYCLINE	metronidazole/tetracycline
CAPREOMYCIN SULFATE	capreomycin
CEFACLOR	cefaclor
CEFADROXIL	cefadroxil
CEFADROXIL HYDRATE	cefadroxil
CEFAZOLIN SODIUM	cefazolin
CEFAZOLIN SODIUM/DEXTROSE,ISO	cefazolin
CEFDINIR	cefdinir
CEFDITOREN PIVOXIL	cefditoren
CEFEPIME HCL	cefepime
CEFIXIME	cefixime
CEFOTAXIME SODIUM	cefotaxime
CEFOTETAN DISODIUM	cefotetan
CEFOXITIN SODIUM	cefoxitin
CEFOXITIN SODIUM/DEXTROSE,ISO	cefoxitin
CEFPODOXIME PROXETIL	cefpodoxime
CEFPROZIL	cefprozil
CEFTAROLINE FOSAMIL ACETATE	ceftaroline
CEFTAZIDIME	ceftazidime
CEFTAZIDIME IN DEXTROSE5%WATER	ceftazidime
CEFTAZIDIME NA/DEXTROSE,ISO	ceftazidime
CEFTAZIDIME PENTAHYDRATE	ceftazidime
CEFTAZIDIME PENTAHYDRATE/D5W	ceftazidime
CEFTIBUTEN DIHYDRATE	ceftibuten
CEFTRIAXONE SODIUM	ceftriaxone
CEFUROXIME AXETIL	cefuroxime

CEFUROXIME SODIUM	cefuroxime
CEFUROXIME SODIUM/DEXTROSE,ISO	cefuroxime
CEFUROXIME SODIUM/WATER	cefuroxime
CEPHALEXIN	cephalexin
CHLORAMPHENICOL NA SUCC	chloramphenicol
CHLORAMPHENICOL SOD SUCC	chloramphenicol
CHLORHEXIDINE GLUCONATE	chlorhexidine
CIPROFLOXACIN	ciprofloxacin
CIPROFLOXACIN HCL	ciprofloxacin
CIPROFLOXACIN HCL/DEXAMETH	ciprofloxacin
CIPROFLOXACIN LACTATE	ciprofloxacin
CIPROFLOXACIN LACTATE/D5W	ciprofloxacin
CIPROFLOXACIN/CIPROFLOXA HCL	ciprofloxacin
CIPROFLOXACIN/HYDROCORTISONE	ciprofloxacin
CLARITHROMYCIN	clarithromycin
CLINDAMYCIN HCL	clindamycin
CLINDAMYCIN PALMITATE HCL	clindamycin
CLINDAMYCIN PHOS/BENZOYL PEROX	clindamycin
CLINDAMYCIN PHOS/SKIN CLNSR 19	clindamycin
CLINDAMYCIN PHOSPHATE	clindamycin
CLINDAMYCIN PHOSPHATE/D5W	clindamycin
CLINDAMYCIN/BENZ PER/HYALUR NA	clindamycin
CLINDAMYCIN/TRETINOIN	clindamycin
COLISTIN (COLISTIMETHATE NA)	colistin
CYCLOSERINE	cycloserine
DAPTOMYCIN	daptomycin
DEMECLOCYCLINE HCL	demeclocycline
DICLOXACILLIN SODIUM	dicloxacillin
DORIPENEM	doripenem
DOXYCYCLINE CALCIUM	doxycycline
DOXYCYCLINE HYCLATE	doxycycline
DOXYCYCLINE MONOHYDRATE	doxycycline
ERTAPENEM SODIUM	ertapenem
ERY E-SUCC/SULFISOXAZOLE	erythromycin/sulfisoxazole
ERYTHROMYCIN BASE	erythromycin
ERYTHROMYCIN BASE/ETHANOL	erythromycin
ERYTHROMYCIN ETHYLSUCCINATE	erythromycin
ERYTHROMYCIN LACTOBIONATE	erythromycin
ERYTHROMYCIN STEARATE	erythromycin
ERYTHROMYCIN/BENZOYL PEROXIDE	erythromycin
ETHAMBUTOL HCL	ethambutol
ETHIONAMIDE	ethionamide
FIDAXOMICIN	fidaxomicin
FOSFOMYCIN TROMETHAMINE	fosfomycin
GATIFLOXACIN	gatifloxacin

GEMIFLOXACIN MESYLATE	gemifloxacin
GENTAMICIN IN NACL, ISO-OSM	gentamicin
GENTAMICIN SULFATE	gentamicin
GENTAMICIN SULFATE/PF	gentamicin
GENTAMICIN/PREDNISOL AC	gentamicin
IMIPENEM/CILASTATIN SODIUM	imipenem
ISONIAZID	isoniazid
KANAMYCIN SULFATE	kanamycin
LANSOPRAZOLE/AMOXICILN/CLARITH	clarithromycin/amoxicillin
LEVOFLOXACIN	levofloxacin
LEVOFLOXACIN/D5W	levofloxacin
LEVOFLOXACIN/DEXTROSE 5%-WATER	levofloxacin
LINCOMYCIN HCL	lincomycin
LINEZOLID	linezolid
MEROPENEM	meropenem
METRONIDAZOLE	metronidazole
METRONIDAZOLE/SODIUM CHLORIDE	metronidazole
MINOCYCLINE HCL	minocycline
MINOCYCLINE HCL/SKIN CL NO.4	minocycline
MOXIFLOXACIN HCL	moxifloxacin
MOXIFLOXACIN IN NACL (ISO-OSM)	moxifloxacin
NAFCILLIN IN DEXTROSE,ISO-OSM	nafcillin
NAFCILLIN SODIUM	nafcillin
NAFCILLIN SODIUM/D2.4W	nafcillin
NEO/POLYMYX B SULF/DEXAMETH	neomycin/polymyxin B
NEOMY SULF/BACITRA/POLYMYXIN B	neomycin/bacitracin/polymyxin B
NEOMY SULF/BACITRAC ZN/POLY/HC	neomycin/bacitracin/polymyxin B
NEOMY SULF/COLIST SUL/HC/THONZ	neomycin/colistin
NEOMY SULF/POLYMYX B SULF/PRED	neomycin/polymyxin B
NEOMY SULF/POLYMYXIN B SULFATE	neomycin/polymyxin B
NEOMYCIN SULFATE	neomycin
NEOMYCIN SULFATE/FLUOCINOLONE	neomycin
NEOMYCIN/BACITRA/POLYMYXIN/HC	neomycin/bacitracin/polymyxin B
NEOMYCIN/POLYMYXIN B SULF/HC	neomycin/polymyxin B
NEOMYCIN/POLYMYXN B/GRAMICIDIN	neomycin/polymyxin B
NITROFURANTOIN	nitrofurantoin
NITROFURANTOIN MACROCRYSTAL	nitrofurantoin
NITROFURANTOIN MONOHYD/M-CRYST	nitrofurantoin
NORFLOXACIN	norfloxacin
OFLOXACIN	ofloxacin
OMEPRAZOLE/CLARITH/AMOXICILLIN	clarithromycin/amoxicillin
OXACILLIN SODIUM	oxacillin
OXACILLIN SODIUM/DEXTROSE,ISO	oxacillin
PAROMOMYCIN SULFATE	paromomycin
PEN G BENZ/PEN G PROCAINE	penicillin G

PEN G POT/DEXTROSE-WATER	penicillin G
PENICILLIN G BENZATHINE	penicillin G
PENICILLIN G POTASSIUM	penicillin G
PENICILLIN G PROCAINE	penicillin G
PENICILLIN G SODIUM	penicillin G
PENICILLIN V POTASSIUM	penicillin V
PIPERACILLIN SODIUM	piperacillin
PIPERACILLIN SODIUM/TAZOBACTAM	piperacillin/tazobactam
PIPERACILLIN-TAZO-DEXTROSE,ISO	piperacillin/tazobactam
POLYMYXIN B SULF/TRIMETHOPRIM	polymyxin B/trimethoprim
POLYMYXIN B SULFATE	polymyxin B
POLYMYXIN B SULFATE/TMP	polymyxin B/trimethoprim
PYRAZINAMIDE	pyrazinamide
QUINUPRISTIN/DALFOPRISTIN	quinupristin/dalfopristin
RETAPAMULIN	retapamulin
RIFABUTIN	rifabutin
RIFAMP/ISONIAZID/PYRAZINAMIDE	rifampin/isoniazid/pyrazinamide
RIFAMPIN	rifampin
RIFAMPIN/ISONIAZID	rifampin/isoniazid
RIFAMPIN/ISONIAZID/PYRAZINAMID	rifampin/isoniazid/pyrazinamide
RIFAPENTINE	rifapentine
RIFAXIMIN	rifaximin
STREPTOMYCIN SULFATE	streptomycin
SULFACETAMIDE SODIUM	sulfacetamide
SULFACETAMIDE/PREDNISOLONE SP	sulfacetamide
SULFACETM NA/PREDNISOL AC	sulfacetamide
SULFADIAZINE	sulfadiazine
SULFAMETHOXAZOLE/TRIMETHOPRIM	trimethoprim/sulfamethoxazole
TEDIZOLID PHOSPHATE	tedizolid
TELAVANCIN HCL	telavancin
TELITHROMYCIN	telithromycin
TETRACYCLINE HCL	tetracycline
TICARCILLIN/K CLAVULANATE	ticarcillin/clavulanate
TIGECYCLINE	tigecycline
TINIDAZOLE	tinidazole
TOBRAMYCIN	tobramycin
TOBRAMYCIN IN 0.225% NACL	tobramycin
TOBRAMYCIN SULF/DEXAMETHASONE	tobramycin
TOBRAMYCIN SULFATE	tobramycin
TOBRAMYCIN/DEXAMETHASONE	tobramycin
TOBRAMYCIN/LOTEPRED ETAB	tobramycin
TOBRAMYCIN/SODIUM CHLORIDE	tobramycin
TRIMETHOPRIM	trimethoprim
VANCOMYCIN HCL	vancomycin

Appendix Table 3. Number of beneficiaries meeting each inclusion criterion. Increase in size of the study population (bottom row) is due to an increase in the size of the overall Medicare population (top row), increasing age of the Medicare population, and increasing number of beneficiaries of full-year coverage for Parts A, B, and D.

	No. eligible beneficiaries (% retained from previous step)				
Criterion	**2011**	**2012**	**2013**	**2014**	**2015**
20% sample[a]	10,341,350 (ref)	10,707,986 (ref)	11,053,790 (ref)	11,550,386 (ref)	12,365,119 (ref)
Age ≥65	7,998,700 (77.3)	8,251,542 (77.1)	8,577,277 (77.6)	9,030,236 (78.2)	9,777,278 (79.1)
Parts A, B, D[b]	2,435,965 (30.5)	2,581,773 (31.3)	2,997,160 (34.9)	3,144,145 (34.8)	3,431,090 (35.1)
Demographic data[c]	2,429,554 (99.7)	2,575,367 (99.8)	2,990,851 (99.8)	3,136,990 (99.8)	3,425,194 (99.8)

a: Beneficiaries in the 20% sample provided by Medicare

b: 12 months of eligibility for all three Parts

c: Sex is coded as male or female, and state of residence code matches one of the 50 states or District of Columbia

Appendix Table 4. Trends in study population characteristics.

Population characteristic	**Relative trend*, % (95% CI)**
Age (%)	
65-74	5.01 (4.85 to 5.17)
75-84	–5.14 (–5.33 to –4.94)
85-94	–4.04 (–4.37 to –3.71)
≥95	0.81 (–0.33 to 1.97)
Mean no. chronic conditions	–0.038 (–0.127 to 0.050)
% female	–1.10 (–1.21 to –0.98)
% white	2.68 (2.61 to 2.75)
% dual eligible for Medicaid	–34.5 (–34.6 to –34.3)
Region	
% South	–1.94 (–2.12 to –1.75)
% Midwest	–2.98 (–3.23 to –2.72)
% West	–0.35 (–0.66 to –0.03)
% Northeast	8.19 (7.87 to 8.52)

*: 2011-2015 change from Poisson regression (for first 3 characteristics) or log-binomial regression (for proportions) on population characteristic.

Appendix Table 5. Patterns and trends in overall antibiotic use by demography and geography.

	Claims per 1,000 beneficiaries per year		
	2011	**2015**	**Relative change*, % (95% CI)**
Overall	1365	1364	–0.20 (–0.30 to –0.09)
Age			
65-74	1296	1277	–1.05 (–1.23 to –0.86)
75-84	1386	1410	1.05 (0.83 to 1.26)
85-94	1498	1519	–0.02 (–0.33 to –0.28)
≥95	1622	1608	–3.3 (–4.2 to –2.5)
Sex			
female	1469	1475	0.78 (0.62 to 0.93)
male	1187	1179	–2.4 (–2.6 to –2.2)
Race			
white	1407	1416	0.42 (0.28 to 0.56)
Hispanic	1275	1224	–2.8 (–3.3 to –2.2)
other	1230	1106	–5.5 (–6.1 to –4.9)
black	1074	1023	–3.6 (–4.1 to –3.0)
Region			
South	1487	1519	0.80 (0.60 to 0.99)
Midwest	1351	1335	–1.5 (–1.8 to –1.3)
West	1266	1203	–4.4 (–4.7 to –4.1)
Northeast	1218	1246	2.9 (2.6 to 3.2)

*: Adjusted value for 2011-2015 change from Poisson regression on claims per beneficiary per year adjusted for dual eligibility, number of chronic conditions, and (depending on subpopulation) age, sex, race, and US Census region.

Appendix Table 6. Trends in use of azithromycin, levofloxacin, and amoxicillin/clavulanate for respiratory conditions, linking each claim with only one diagnosis.

		Claims per 1,000 beneficiaries per year[a]								
		Azithromycin			**Levofloxacin**			**Amoxicillin/clavulanate**		
Diagnosis	**Antibiotics appropriate?[b]**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**
Pneumonia[d]	Yes	5.9	4.7	–17.1 ± 1.9	7.8	10.0	30.9 ± 2.2	2.2	2.1	–0.4 ± 3.5
Sinusitis	Potentially	21.9	17.7	–22.7 ± 0.9	4.1	7.7	69.1 ± 3.5	11.3	15.6	35.9 ± 2.0
VURI[e]	No	39.6	34.0	–14.2 ± 0.8	9.2	13.9	52.8 ± 2.3	6.2	8.0	32.0 ± 2.6
Acute bronchitis[f]	No	38.2	29.3	–23.0 ± 0.7	8.2	12.6	49.1 ± 2.3	5.2	5.8	13.3 ± 2.5
Other respiratory[g]	No	29.2	23.6	–16.5 ± 0.9	20.6	25.7	30.1 ± 1.4	9.9	10.3	9.4 ± 1.8
Asthma & allergy[h]	No	11.0	9.4	–15.1 ± 1.4	3.2	4.7	44.0 ± 3.6	2.9	3.6	28.0 ± 3.7

a: Includes claims for each antibiotic linked to the given diagnosis. In this analysis, if a single claim was eligible to be linked to multiple diagnoses, it was linked with only one diagnosis selected at random.
b: Appropriateness of antibiotics for that diagnosis as determined by the CDC working group (see Methods)
c: Adjusted value for 2011-2014 change from Poisson regression on claims per beneficiary per year adjusted for age, sex, race, census region, dual eligibility, and number of chronic conditions. Plus-minus contains 95% confidence interval.
d: Includes *Streptococcus pneumoniae* pneumonia, other bacterial pneumonia, pneumonia due to other specified organism, pneumonia in infectious diseases classified elsewhere, bronchopneumonia with organism unspecified, pneumonia with organism unspecified
e: Includes acute nasopharyngitis, acute laryngitis and tracheitis, acute upper respiratory infections of multiple or unspecified sites, and cough
f: Includes bronchitis not specified as acute or chronic, acute bronchitis and bronchiolitis
g: Includes chronic bronchitis, dyspnea, stridor, hemoptysis, and abnormal sputum
h: Includes allergic rhinitis and unspecified allergy

Appendix Table 7. Trends in use of ciprofloxacin, metronidazole, and levofloxacin for gastrointestinal conditions.

		Claims per 1,000 beneficiaries per year[a]								
		Ciprofloxacin			Metronidazole			Levofloxacin		
Diagnosis	**Antibiotics appropriate?[b]**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**
Infection[d]	Potentially	36.4	32.9	–6.5 ± 0.9	29.7	27.6	–4.9 ± 0.9	16.8	19.5	20.3 ± 1.5
Other conditions[e]	No	42.9	39.9	–4.0 ± 0.8	29.3	28.6	–0.8 ± 1.0	23.6	29.0	27.1 ± 1.3

a: Includes claims for each antibiotic linked to the given diagnosis. A single claim may be linked to multiple diagnoses, so the sum of the "2011" and "2014" columns exceeds the number of claims associated with any listed diagnosis (see main text Methods).
b: Appropriateness of antibiotics for that diagnosis as determined by the CDC working group (see main text Methods)
c: Adjusted value for 2011-2014 change from Poisson regression on claims per beneficiary per year adjusted for age, sex, race, census region, dual eligibility, and number of chronic conditions. Plus-minus contains 95% confidence interval.
d: Includes intestinal infectious diseases, symptoms involving the abdomen or digestive system
e: Includes other conditions of the digestive system

Appendix Table 8. Trends in use of ciprofloxacin, trimethoprim/sulfamethoxazole, and nitrofurantoin for genitourinary conditions.

		Claims per 1,000 beneficiaries per year[a]								
		Ciprofloxacin			TMP/SMX			Nitrofurantoin		
Diagnosis	**Antibiotics appropriate?[b]**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**
Infection[d]	Yes	92.9	83.2	–6.4 ± 0.6	40.6	37.2	–2.4 ± 0.8	44.8	38.3	–7.0 ± 0.8
Other conditions[e]	No	76.9	73.8	–3.0 ± 0.6	30.1	30.6	4.8 ± 1.0	24.1	22.0	–2.3 ± 1.1

a: Includes claims for each antibiotic linked to the given diagnosis. A single claim may be linked to multiple diagnoses, so the sum of the "2011" and "2014" columns exceeds the number of claims associated with any listed diagnosis (see main text Methods).
b: Appropriateness of antibiotics for that diagnosis as determined by the CDC working group (see main text Methods)
c: Adjusted value for 2011-2014 change from Poisson regression on claims per beneficiary per year adjusted for age, sex, race, census region, dual eligibility, and number of chronic conditions. Plus-minus contains 95% confidence interval.
d: Includes acute pyelonephritis, renal abscess, other pyelonephritis/pyelonephrosis, unspecified kidney infection, acute cystitis, unspecified cystitis, and unspecified UTI
e: Includes other symptoms involving urinary system, including dysuria

Appendix Table 9. Trends in use of cephalexin, trimethoprim/sulfamethoxazole, and ciprofloxacin for skin, cutaneous and mucosal conditions.

		Claims per 1,000 beneficiaries per year[a]								
		Cephalexin			TMP/SMX			Ciprofloxacin		
Diagnosis	**Antibiotics appropriate?[b]**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**	**2011**	**2014**	**Relative change[c] (%)**
Infection[d]	Potentially	31.7	31.9	3.5 ± 1.0	22.5	22.1	2.1 ± 1.1	12.5	10.2	–15.0 ± 1.3
Other conditions[e]	No	44.2	46.6	7.4 ± 0.9	27.5	27.8	6.3 ± 1.1	34.5	31.9	–3.9 ± 0.9

a: Includes claims for each antibiotic linked to the given diagnosis. A single claim may be linked to multiple diagnoses, so the sum of the "2011" and "2014" columns exceeds the number of claims associated with any listed diagnosis (see main text Methods).
b: Appropriateness of antibiotics for that diagnosis as determined by the CDC working group (see main text Methods)
c: Adjusted value for 2011-2014 change from Poisson regression on claims per beneficiary per year adjusted for age, sex, race, census region, dual eligibility, and number of chronic conditions. Plus-minus contains 95% confidence interval.
d Includes cellulitis, carbuncle/furuncle, impetigo, lymphadenitis, erysipelas, dermatophytosis, folliculitis, myositis, mastitis, necrotizing fasciitis, and infective otitis externa
e: Includes inflammatory and other skin conditions, open wounds, superficial injuries, burns, diseases of the eye/adnexa, ear diseases other than otitis media and mastoiditis, symptoms of skin/integumentary tissues excluding acne, gangrene, and enlargement of lymph node