

Index

A

- AAC(6′)-Ib-cr, 185
- ACHN-975
 - clinical studies, 163–164
 - medicinal chemistry, 166
 - structure, 162
- AcrAB-TolC, 180
- AcrD, 236
- AdeRS, 257
- AFN-1252
 - mechanism of action, 148, 153
 - resistance, 153
 - structure, 149
- AIM-1, 74
- Amicoumacin A, 222
- Amikacin
 - indications, 240
 - structure, 230
 - synthesis, 4
- Aminoglycosides. *See also specific drugs*
 - historical perspective, 229–230
 - indications, 239–241
 - mechanism of action, 232
 - novel drugs, 237
 - pharmacodynamics, 238–239
 - pharmacokinetics, 238–239
 - resistance mechanisms
 - aminoglycoside-modifying enzymes
 - acetyltransferases, 233–235
 - nucleotidyltransferases, 235
 - phosphotransferases, 235
 - efflux-mediated resistance, 236
 - molecular epidemiology, 236–237
 - overview, 17, 233
 - ribosomal RNA modifications, 235–236
 - spectrum of activity, 230–232
 - structures, 230
 - targets, 17
- Amoxicillin, structure, 27
- AmpC, 74
- Ampicillin, structure, 26
- Antibiotic resistance dating
 - challenges, 9
 - experimental evidence for old resistance, 11–12
 - phylogenetics, 11
 - sequencing techniques, 9–10
 - technology impact, 10–11
- Antibiotic restriction, guidelines, 5

- Antifolates. *See also specific drugs*
 - novel compounds, 378–379
 - overview, 373–374
 - resistance mechanisms
 - sulfamethoxazole, 378
 - trimethoprim, 374–378
- Apramycin, structure, 230
- Arbekacin, 237–238
- Avibactam, structure, 38
- Azithromycin
 - resistance, 291, 295
 - structure, 272
- Aztreonam, structure, 36

B

- BaeSR, 257
- BAL30072, 36
- BB-78495, 162
- BC-3205, 341, 344
- BC-7013, 341, 344
- β -Lactamase. *See also specific enzymes*
 - classification
 - class A, 67–71
 - class B, 69–74
 - class C, 69, 74
 - class D, 70, 74–77
 - evolution of antibiotic resistance, 4
 - historical perspective, 67
 - inhibitors
 - overview, 37–39
 - structures, 38
 - nomenclature, 67
- β -Lactams. *See also specific classes and antibiotics*
 - Enterococcus faecium*—resistance mechanisms, 52–54
 - mechanism of action, 24–25, 45–46, 65–66
 - monocyclic β -lactams, 36–37
 - Mycobacterium tuberculosis*—resistance mechanisms, 56–57
 - penicillin-binding proteins
 - Enterococcus faecium*, 52–53
 - Mycobacterium tuberculosis*, 56
 - peptidoglycan assembly enzymology, 46–48
 - Staphylococcus aureus*, 54–55
 - Staphylococcus pneumoniae*
 - overview, 48–49
 - resistance proteins, 49–52
 - targets, 45–46, 65–66

Index

- β -Lactams. *See also specific classes and antibiotics (Continued)*
popularity, 23–24
Staphylococcus aureus–resistance
mechanisms, 54–56
Staphylococcus pneumoniae–resistance
mechanisms, 48
targets and resistance mechanisms, 17, 66–67
- Biapenem, 35
Blasticidin S, 225
Brachy bacterium, phylogenetic analysis of resistance, 12
- ### C
- Capreomycin, 223
Carbapenems. *See also specific drugs*
historical perspective, 34–36
types and structures, 35
Carbenicillin, 27
Cathelicidin microbial peptide (CRAMP), 130
Cefaclor, 29
Cefazolin, 30
Cefdinir, 30
Cefepime, 31
Cefixime, 29
Cefoperazone, 30
Cefotaxime, 30
Cefoxitin, 32
Cefpoxime, 29
Ceftaroline, 31
Ceftazidime, 31
Ceftibutin, 29
Ceftobiprole, 31
Ceftolozane
structure, 31
uses, 33
Ceftriaxone, 30
Cefuroxime, 30
Cephalexin, 29
Cephalosporin, 357
Cephalosporins. *See also specific drugs*
historical perspective, 28, 33
types and structures, 29–32
uses, 28, 33
CF. *See* Cystic fibrosis
Cfr, 347
cfr, 327–329
CG400462
mechanism of action, 148
structure, 149
CG400549
mechanism of action, 148, 153
structure, 149
CHIR-090
bacterial defense effects of inhibition, 169
medicinal chemistry, 165–166
resistance, 164–165
structural basis of species specificity and kinetics, 166–167
structure, 162
Chloramphenicol, 17, 311–312, 316–317, 321–322, 326
5-Chloro-2-phenoxyphenol
mechanism of action, 148
structure, 149
Chlortetracycline, structure, 248
Ciprofloxacin. *See* Fluoroquinolones
Clarithromycin
resistance, 295
structure, 272
Clavulanic acid, 38
Clindamycin, 311, 316
Clomocycline, 248
Clostridium difficile
clinical features of infection, 383–384
fidaxomicin therapy. *See* Fidaxomicin
LFF571 therapy. *See* LFF571
rifaximin therapy, 209
Cloxacillin, 26
CmlB1, 326
Cmr, 323
CRAMP. *See* Cathelicidin microbial peptide
CTX, 70
Cycloheximide, 344
Cystic fibrosis (CF), tobramycin therapy, 240
- ### D
- Dalbavancin
historical perspective, 83
resistance mechanisms, 90–91
structure, 82
Dalfopristin, 310–311, 316
Daptomycin
historical perspective, 109–110
mechanism of action, 112–114
resistance
Enterococcus faecalis, 118–120
Enterococcus faecium, 118–120
overview of mechanisms, 17, 114
Staphylococcus aureus, 114–118
structure, 110–111
synthesis, 110–112
targets, 17
Demethylchlorotetracycline, 248
DHFR. *See* Dihydrofolate reductase
DHPS. *See* Dihydropteroate synthase
Dihydrofolate reductase (DHFR), 373–375, 377
Dihydropteroate synthase (DHPS), 373–374, 378–379
DIM-1, 74
Dityromycin, 222
Doripenem, 35
Doxycycline, 248

E

- eat*(A), 325
- Edeine, 218
- Elongation factors
 - fusidic acid targeting of Ef-G, 18, 225, 355, 360–363
 - LFF571 targeting of Ef-Tu, 389–392
 - translation, 219–225
- EmrR, 181
- Enoyl-acyl carrier protein reductase (FabI) inhibitors.
 - See also specific inhibitors*
 - bisubstrate inhibitors, 148–152
 - mechanism of action, 18
 - NAD(P)–FabI-binding inhibitors
 - product complex binders, 152–153
 - substrate complex binders, 153–154
 - prospects for study, 154–155
 - types and structures, 146–147
- Enterococcus faecalis*, daptomycin resistance, 118–120
- Enterococcus faecium*
 - β -lactam-resistance mechanisms, 52–54
 - daptomycin resistance, 118–120
- Eravacycline
 - clinical studies, 262
 - development, 249
 - structure, 248
- Ere(A), 287–288
- Ere(B), 287–288
- Erm, 272, 274, 281–283
- Ertapenem, 35
- Erythromycin
 - resistance, 295
 - structure, 272
- 5-Ethyl-2-phenoxyphenol
 - mechanism of action, 148
 - structure, 149
- EttA, 347
- ExPortal, 131

F

- FabI inhibitors. *See* Enoyl-acyl carrier protein reductase inhibitors
- FDX. *See* Fidaxomicin
- FepA, 180
- FepR, 180
- Fidaxomicin (FDX)
 - efficacy against *Clostridium difficile*, 386
 - historical perspective, 384–385
 - mechanism of action, 385–386
 - prospects for study, 392–393
 - resistance
 - frequencies, 387
 - mechanisms, 18, 387–389
 - resistant *Clostridium difficile* features, 389
 - structure, 386
 - target, 18, 385

- FIM-1, 74
- Florfenicol, 311–312, 315, 317, 326
- Fluoroquinolones
 - historical perspective, 173–174
 - mechanism of action, 174–177
 - resistance
 - mechanisms
 - permeation alterations, 178–182
 - plasmid-mediated resistance, 182–186
 - PMQR determinants, 186
 - target enzyme mutational alteration, 177–178
 - overview, 4, 17
 - targets, 17
- Folate pathway inhibitors. *See* Antifolates
- FomA, 104
- FomB, 104
- FosA3, 103, 105
- FosB, 103
- Fosfomycin
 - historical perspective, 97–98
 - mechanism of action, 98–100
 - resistance
 - clinical considerations
 - combination therapy, 104–105
 - overview, 104
 - modifying enzymes, 102–104
 - mutational resistance, 100–101
 - overview of mechanisms, 18
 - spectrum of activity, 98
 - target, 18
 - uptake, 100
- FosX, 104
- fus* genes, 364–366
- Fusidic acid
 - mechanism of action, 18, 225, 355, 360–363
 - pH effects and intracellular activity, 360–361
 - prospects for study, 369
 - resistance
 - cross-resistance with other antibiotics, 366
 - development, 363–364
 - dosing optimization for prevention, 366–368
 - mechanisms, 18, 363–366
 - prevalence, 358–359
 - spectrum of activity, 356–360
 - structure, 356

G

- GE2270A, 220
- GE2832, 223
- GE81112, 218
- Gene transfer
 - bacteria, 4–5
 - horizontal gene transfer, 18

Index

- Genomics, antibacterial drug target identification, 16–17
- Gentamycin, 222
- Gentamycin C1a, 230
- GES β -lactamases, 71
- GIM-1, 74
- Glycopeptide antibiotics. *See also specific antibiotics*
- antibacterial spectrum, 84
 - historical perspective, 83
 - mechanisms of action, 84–87
 - overview, 81, 83
 - resistance mechanisms, 87–91
 - structures, 82
- GSK2251052, 19
- GyrA, 177
- GyrB, 177
- H**
- HE. *See* Hepatic encephalopathy
- Helvoic acid, 357
- Hepatic encephalopathy (HE), rifaximin therapy, 206–207
- I**
- IBS. *See* Irritable bowel syndrome
- Iclaprim, 375, 378
- Imipenem, 35
- IMP, 72–73
- InhA, 150
- Initiation factors, translation, 216–219
- Irritable bowel syndrome (IBS), rifaximin therapy, 205–206
- Isoniazid
- mechanism of action, 148, 150
 - resistance mechanisms, 150–152
 - structure, 149
- J**
- Josamycin, 273
- K**
- Kanamycin, 222
- Kasugamycin, 218
- KatG, 150
- Kirromycin, 220
- Kitasamycin, 273
- KPC, 70–73
- L**
- Lefamulin, 341–342, 344–346
- Levofloxacin. *See* Fluoroquinolones
- LFF571
- historical perspective, 385
 - mechanism of action, 389–391
 - prospects for study, 392–393
 - resistance
 - frequencies, 391–392
 - mechanisms, 391–392
 - structure, 386
- Limecycline, 248
- Lincomycins, 17, 310–311
- Lincosamides. *See also specific drugs*
- indications, 310
 - mechanism of action, 313–315
 - prospects for study, 328, 330
 - resistance
 - efflux genes
 - multidrug transporters, 323
 - specific exporters, 323–325
 - enzymatic inactivation, 319, 321
 - mechanisms, 315, 317
 - prevalence, 315–317
 - ribosomal mutations, 317–319
 - target site modifications and resistance, 327
 - structures, 311
- Linezolid, 327
- Lipopolysaccharide (LPS)
- LpxC inhibitors. *See* LpxC inhibitors
 - modifications in polymyxin resistance, 132–137
- lmr* genes, 324
- Lon protease, tetracycline resistance, 258
- LPS. *See* Lipopolysaccharide
- LpxC inhibitors. *See also specific inhibitors*
- adaptation to alteration of lipopolysaccharide synthesis, 167–168
 - bacterial defense effects of inhibition, 168–169
 - clinical studies, 162–163
 - historical perspective, 160–162
 - lipid A biosynthesis, 159–160
 - medicinal chemistry, 165–166
 - overview, 18
 - Pseudomonas aeruginosa* studies, 162
 - resistance, 164–165
 - structural basis of species specificity and kinetics, 166–167
 - structures, 162
- lsa* genes, 324–325
- M**
- Macrolides. *See also specific drugs*
- indications, 271
 - mechanism of action, 272–273, 275–276
 - resistance mechanisms
 - characterization of molecular mechanisms, 290–295

- Macrolides (*Continued*)
 efflux
 Mef, 284–286
 Msr, 286–287
 overview, 273, 275
 inactivation of drug
 esterases, 287–288
 phosphotransferases, 288–290
 overview, 17, 272–275
 prospects for study, 295
 ribosomal modification
 cis-acting peptides, 283–284
 erm gene mutations, 281–283
 ribosomal protein mutations, 280–281
 ribosomal RNA, 276–280
 Rlm methyltransferases, 284
 structures, 271–273
 surveillance of resistance, 291–294
 targets, 17
MarA, 254, 256
MdeA, 179
MdfA, 182, 323
Mecillinam
 applications, 28
 structure, 27
Mef, 284–286
MepA, 180
MepR, 180
Methacycline, structure, 248
Methicillin, structure, 26
Methicillin-resistant *Staphylococcus aureus* (MRSA)
 cephalosporin therapy, 33–34
 FabI inhibitor therapy and resistance, 152–153
 genomics studies of resistance, 16
 lefamulin activity, 345
 macrolide resistance, 291
 penicillin-binding proteins, 55
Metronidazole, targets and resistance mechanisms, 17
Metropenem, 35
MexAB, 181
MgrA, 179
Midecamycin, 273
Milkamycin, 310, 312
Minocycline
 clinical studies, 259, 261
 structure, 248
Moxalactam, 32
Mph phosphotransferases, 289–290
MRSA. *See* Methicillin-resistant *Staphylococcus aureus*
Msr, 286–287
msr genes, 325
MUT0563999
 mechanism of action, 148
 structure, 149
Mycobacterium tuberculosis
 β -lactam-resistance mechanisms, 56–57
 fosfomycin resistance, 99
 isoniazid-resistance mechanisms, 150–152
 resistance overview, 3
 rifamycin management
 rifabutin, 200
 rifampicin
 latent tuberculosis prophylaxis, 201
 overview, 199–200
 rifapentine, 200
Mycoplasma pneumoniae, macrolide resistance, 295
- N**
Nafcillin, structure, 27
Nalidixic acid. *See* Fluoroquinolones
NDM-1, 72–73
Negamycin, 222
Neomycin, 222–223
Neomycin B, 230
Nmc-A, 71
NorB, 179
NorC, 179
- O**
Oleandomycin, 272
Omadacycline
 clinical studies, 261–262
 development, 248–249
 structure, 248
OmpC, 249, 255
OmpF, 180, 249, 255
OprE, 180–181
OprJ, 181
OprM, 180
optrA, 327
OqxAB, 185
Oritavancin
 historical perspective, 83
 mechanisms of action, 86
 resistance mechanisms, 90–91
 structure, 82
OXA β -lactamases, 75–77
Oxacillin, structure, 26
Oxazolidinones
 resistance mechanisms
 exporters, 326–327
 overview, 17
 target site modifications, 327–328
 targets, 17
Oxytetracycline, 248
- P**
Pactamycin, 218
Paromomycin, indications, 241
PatAB, 180

Index

- Penicillin-binding proteins. *See* β -Lactams
- Penicillins. *See also specific drugs*
- historical perspective, 3, 25–28
 - types and structures, 26–28
- PF-5081090
- clinical studies, 163–164
 - resistance, 165
- Phenolics. *See also specific drugs*
- indications, 312
 - mechanism of action, 313–315
 - prospects for study, 328, 330
 - resistance
 - efflux genes
 - multidrug transporters, 323
 - specific exporters, 326–327
 - enzymatic inactivation, 321–323
 - mechanisms, 315, 317
 - prevalence, 315–317
 - ribosomal mutations, 317–319
 - target site modifications and resistance, 327–328
 - structures, 311
- PhoBR, 257
- Piperacillin, structure, 27
- Pirlimycin, 310–311, 316
- PJI. *See* Prosthetic joint infection
- Plague, historical perspective, 2
- Plazomycin, 237–238, 240
- Pleuromutilins. *See also specific drugs*
- indications, 313
 - mechanism of action, 17, 313–315, 341–342
 - overview, 339–340
 - prospects for study, 328, 330
 - resistance
 - efflux genes
 - multidrug transporters, 323
 - specific exporters, 324–325
 - enzymatic inactivation, 323
 - mechanisms, 17, 315, 317, 345–348
 - prevalence, 315–317, 348
 - ribosomal mutations, 317–319
 - target site modifications and resistance, 327–328
 - spectrum of activity, 343–345, 348
 - structures, 311, 340–341
- Polymyxin
- historical perspective, 3, 126
 - indications, 127
 - mechanism of action
 - bacterial respiration, 129–130
 - cell division, 130–131
 - ExPortal, 131
 - overview, 126–127
 - reactive oxygen species, 131
 - ribosome binding, 129
 - targets, 17, 128–129
 - resistance
 - lipopolysaccharide modifications, 132–137
 - overview of mechanisms, 17, 131–132
 - plasmid-mediated resistance, 138
 - polymyxin efflux, 138
 - prospects for study, 138–139
 - stress responses, 137–138
 - structure, 126
 - synthesis, 126–127
- Pregnane receptor, rifaximin as effector, 204
- Pristinamycin, 310, 312
- Prontosil, 374
- Propargyl-linked antifolates, 375, 379
- Prosthetic joint infection (PJI), rifampicin therapy, 202–204
- Protein synthesis. *See* Ribosome
- Pseudomonas aeruginosa*
- fosfomycin resistance, 101–102
 - LpxC inhibitor studies, 162
- Puromycin, 344
- ## Q
- QepA, 185
- Qnr
- origins, 183–184
 - quinolone resistance plasmids, 185–186
 - structure and function, 182–183
- Quinupristin, 310–311, 316
- ## R
- RamA, 254, 256–257
- RarA, 254
- Release factors, translation, 224–225
- Relebactam, 38
- Resistome
- environment and gene mobilization, 8–9
 - overview, 4, 7–8
- Retapamulin, 311, 313, 341, 344
- RG6080, 38
- Ribosome
- elongation of translation, 219–221
 - fusidic acid interactions, 18, 225, 355, 360–363
 - initiation of translation, 216–219
 - LFF571 interactions, 390–391
 - lincosamide–streptogramin–phenicol–pleuromutilin interactions
 - mutations in resistance, 317–319
 - overview, 313–315, 341–342
 - macrolide resistance and modifications
 - cis*-acting peptides, 283–284
 - erm* gene mutations, 281–283
 - ribosomal protein mutations, 280–281
 - ribosomal RNA, 276–280
 - Rlm methyltransferases, 284
 - peptide bond formation, 221–222
 - sites, 215–216
 - structure, 215, 223

- Ribosome (*Continued*)
 termination and recycling, 224–225
 tetracycline interactions
 binding site mutations and resistance, 250–251
 overview, 249–250
 tetracycline ribosomal protection proteins, 251–252
 translocation and EF-G, 222–223
- Rifabutin. *See also* Rifamycins
 minimum inhibitory concentrations, 197
 pharmacology, 198
 structure, 196
 tuberculosis management, 200
- Rifampicin. *See also* Rifamycins
 Gram-positive bacteria infection management, 202
 minimum inhibitory concentrations, 197
 pharmacology, 198
 prosthetic joint infection treatment, 202–204
 structure, 196
 target and resistance mechanisms, 18
 tuberculosis management
 latent tuberculosis prophylaxis, 201
 overview, 199–200
- Rifamycins. *See also specific drugs*
 mechanism of action, 195–196
 minimum inhibitory concentrations, 197
 peptic ulcer disease treatment, 201
 pharmacology, 198
 prospects for study, 209–210
 resistance potential, 196, 199
 structures, 196
 tuberculosis management
 rifabutin, 200
 rifampicin
 latent tuberculosis prophylaxis, 201
 overview, 199–200
 rifapentine, 200
- Rifapentine. *See also* Rifamycins
 minimum inhibitory concentrations, 197
 pharmacology, 198
 structure, 196
 tuberculosis management, 200
- Rifaximin. *See also* Rifamycins
 Clostridium difficile management, 209
 gastrointestinal infection management, 204
 hepatic encephalopathy management, 206–207
 inflammatory bowel disease management, 204–205
 irritable bowel syndrome management, 205–206
 minimum inhibitory concentrations, 197
 pharmacology, 198
 pregnane receptor effector, 204
 resistance development, 207–209
 structure, 196
 traveler's diarrhea management, 207
- RNA polymerase, fidaxomicin interactions, 385, 388–389
- RobA, 254
- Rolitetracycline, 248
- Rosamicin, 273
- Roxithromycin, 272
- rpl* genes, 319–321, 345–348
- RpoE, 137
- RpoS, 137
- RprXY, 257
- RPX7009, 38
- S**
- S-649266, 32
- sal*(A), 325
- SatAB, 180
- SdrM, 179
- SD sequence. *See* Shine–Dalgarno sequence
- Shine–Dalgarno (SD) sequence, 217
- SHV, 70
- SigI, 151
- SIM-1, 74
- SMB-1, 74
- SME-1, 71
- Solithromycin, 272
- SoxS, 254
- Spectinomycin, 222
- Spiramycin, 273
- SPM-1, 74
- Staphylococcus aureus*. *See also* Methicillin-resistant *Staphylococcus aureus*
 β -lactam-resistance mechanisms, 54–56
 daptomycin resistance, 114–118
- Staphylococcus epidermidis*, triclosan resistance, 153
- Staphylococcus pneumoniae*
 β -lactam-resistance mechanisms, 48
 penicillin-binding proteins
 overview, 48–49
 resistance proteins, 49–52
- Streptogramins. *See also specific drugs*
 indications, 310, 312
 mechanism of action, 17, 313–315
 prospects for study, 328, 330
 resistance
 efflux genes
 multidrug transporters, 323
 specific exporters, 325
 enzymatic inactivation, 321
 mechanisms, 17, 315, 317
 prevalence, 315–317
 ribosomal mutations, 317–319
 target site modifications and resistance, 327–328
 structures, 311
- Streptomycin, 230
- Sulbactam, 38

Index

- Sulfamethoxazole
 - development, 374
 - resistance mechanisms, 378
 - structure, 375
- Sulfonamides
 - historical perspective, 3
 - target and resistance mechanisms, 18
- T**
- Tazobactam, 38
- TD. *See* Traveler's diarrhea
- Tebipenem, 35
- Tedizolid, 327
- Teicoplanin
 - historical perspective, 83
 - mechanisms of action, 85–86
 - resistance mechanisms, 90–91
 - structure, 82
- Telavancin
 - historical perspective, 83
 - mechanisms of action, 86–87
 - resistance mechanisms, 90–91
 - structure, 82
- Telithromycin, 272
- TEM, 70
- Temocillin
 - applications, 28
 - structure, 27
- Tet proteins, 364–365
- Tetracyclines. *See also* specific drugs, 248
 - clinical studies
 - eravacycline, 262
 - minocycline, 259, 261
 - omadacycline, 261–262
 - historical perspective, 247–248
 - mechanism of action, 249
 - resistance mechanisms
 - efflux, 252–253
 - enzymatic inactivation, 253–254
 - multidrug-resistance mechanisms
 - AraC transcriptional activators, 254–257
 - intrinsic efflux, 258–260
 - Lon protease, 258
 - two-component systems, 257–258
 - overview, 17
 - ribosome interactions
 - binding site mutations and resistance, 250–251
 - overview, 249–250
 - tetracycline ribosomal protection proteins, 251–252
 - structures, 248
 - targets, 17
 - uptake, 249
- Thiamphenicol, 311–312, 321
- Tiamulin, 311, 313, 316, 339, 341, 344
- Ticarcillin, 27
- Tigecycline
 - clinical studies, 248, 261
 - resistance, 257
 - structure, 248
- Timicosin, 273
- TMB-1, 74
- TMP. *See* Trimethoprim
- Tobramycin, 230
- TolC, 323, 344
- Topoisomerase IV inhibitors. *See* Fluoroquinolones
- Translation. *See* Ribosome
- Traveler's diarrhea (TD), rifaximin therapy, 207
- Triclosan
 - mechanism of action, 148
 - Staphylococcus epidermidis* resistance, 153
 - structure, 149
- Trimethoprim (TMP)
 - development, 374
 - historical perspective, 3
 - resistance mechanisms, 18, 374–378
 - structure, 375
 - targets, 18
- Troleandomycin, 272
- Tuberculosis. *See* *Mycobacterium tuberculosis*
- Tulathromycin, 272
- Tylosin, 273
- U**
- Ureaplasma urealyticum*, macrolide resistance, 295
- V**
- Valnemulin, 311, 313, 339, 341, 344
- Vancomycin
 - historical perspective, 83
 - mechanisms of action, 85
 - resistance mechanisms, 87–91
 - structure, 82
- Vancomycin-resistant *Enterococcus* (VRE), 87
- Vancomycin-resistant *Staphylococcus aureus* (VRSA), 87
- vat* genes, 321
- Veterinary antibiotics, limiting of usage, 5
- vga* genes, 324, 345, 347
- vgb* genes, 321
- Vibrio cholera*, phylogenetic analysis of resistance, 12
- VIM, 72–74
- Viomycin, 223
- Virginiamycin, 310, 312
- Viridin, 357
- VRE. *See* Vancomycin-resistant *Enterococcus*
- VRSA. *See* Vancomycin-resistant *Staphylococcus aureus*