Table 1. rRNA Methylase Genes Modified **Feb. 15, 2024**

Most genes, except noted, confer resistance to macrolides, lincosamides and streptogramin B

Originally modified from AAC 1999 43:2823-30 with permission from ASM Journals

| Class | Protein name | Gene name | Gene(s) included | % homology DNA | % homology aa | Plasmid Transposon | GenBank number * |
|---|---|---|---|---|---|---|---|
| **rRNA METHYLASES** | | | | | | | |
| A | Erm(A) | *erm*(A) | *erm*(A) | 83% | 81% | Tn*554* | X03216 |
| | | | *erm*(TR) | | | | AF002716 |
| B | Erm(B) | *erm*(B) | *erm*(AM) | 98%-100% | 98%-100% | Tn*1545* | X52632 |
| | | | *erm*(AM) | | | pAMβ-1 | Y00116 |
| | | | *erm*(AM) | | | pAM77 | K00551 |
| | | | *erm*(B) | | | Tn*917* | M36722 |
| | | | *erm*(B) | | | pAD2 | M11180 |
| | | | *erm*(B) | | | pTE44 | NC_003528 |
| | | | *erm*(B) | | | | AJ294530 |
| | | | | | | | AF242872, AF368302 |
| | | | | | | | AF406971, AF299292 |
| | | | *erm*(B) | | | pSE20 | U35228 |
| | | | *erm*(AMR) | | | | U86375 |
| | | | *erm*(BC) | | | pIP1527 | M19270 |
| | | | *erm*(P), *erm*(BP) | | | pIP402 | U18931 |
| | | | *erm*(IP) | | | pIP501 | X72021 |

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|---|---|---|---|---|---|---|---|
| | | | *erm*(Z), *erm*(BZ1), *erm*(BZ2) | | | Tn*5398* | AF109075 |
| | | | *erm* | | | pLEM3 | U48430, X82819 |
| | | | *erm*(2) | | | pBT233, pMD101 | X64695, X66468 |
| | | | *erm*(80) | | | pTE80 | AF080450 |
| C | Erm(C) | *erm*(C) | *erm*(C) | 99%-100% | 98%-100% | pE194 | V01278 |
| | | | *erm*(C) | | | pT48 | M19652 |
| | | | *erm*(C) | | | pE5 | M17990 |
| | | | *erm*(C) | | | pJR5 | L04687 |
| | | | *erm*(C) | | | pA22 | X54338 |
| | | | *erm*(C) | | | pSES6 | X82668 |
| | | | | | | | X82665, X82667 |
| | | | *erm*(C) | | | pSES5 | Y09001 |
| | | | *erm*(C) | | | pSES4a | Y09002 |
| | | | *erm*(C) | | | pSES21 | Y09003 |
| | | | *erm*(C) | | | J3356::pOX7 | U36911 |
| | | | *erm*(IM) | | | pIM13 | M13761 |
| | | | *erm*(M) | | | pNE131 | M12730 |
| | | | *erm*(M) | | | pPV141 | U82607 |
| | | | *erm*(M) | | | pPV42 | AF019140 |
| D | Erm(D) | *erm*(D) | *erm*(D) | 97%-99 | 97%-99% | pBD90 | M29832 |
| | | | *erm*(J) | | | pBA423 | L08389 |
| | | | *erm*(K) | | | | M77505 |
| E | Erm(E) | *erm*(E) | *erm*(E) | 99% | 96% | pUC31, pIJ43 | X51891 |
| | | | *erm*(E2) | | | | M11200 |
| F | Erm(F) | *erm*(F) | *erm*(F) | 98%-100% | 97%-100% | pBF4 | M14730 |

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|---|---|---|---|---|---|---|---|
| | | | *erm*(F) | | | Tn*4351* | M17124 |
| | | | *erm*(FS) | | | pBI106, Tn*4551* | M17808 |
| | | | *erm*(FU) | | | Chromosome | M62487 |
| G | Erm(G) | *erm*(G) | *erm*(G) | 99% | 99% | pBD370 | M15332 |
| | | | *erm*(G) | | | Tn*7853* | L42817 |
| H | Erm(H) | *erm*(H) | *car*(B) | | | pOJ159 | M16503 |
| I | Erm(I) | *erm*(I) | *mdm*(A) | | | | Hara & Hutchinson [h] |
| N | Erm(N) | *erm*(N) | *tlr*(D) | | | | X97721 |
| O | Erm(O) | *erm*(O) | *lrm* | 84% | 84% | pLST391 | M74717 |
| | | | *srm*(A) | | | | AJ223970 |
| Q | Erm(Q) | *erm*(Q) | *erm*(Q) | | | Chromosome | L22689 |
| R | Erm(R) | *erm*(R) | *erm*(A) | | | | M11276 |
| | | | *erm*(R | | | | AY623658 |
| S | Erm(S) | *erm*(S) | *erm*(SF*)* | 100% | 100% | pET23 | M19269 |
| | | | *tlr*(A) | | | | P45439 |
| T | Erm(T) | *erm*(T) | *erm*(GT) | 85%-99% | 85%-100% | pGT633 | M64090 |
| | | | | | | Chromosome | AY894138 |
| | | | | | | p121BS | AF310974 |
| | | | *erm*(LF) | | | pLME3000 | AJ488494 |
| U | Erm(U) | *erm*(U) | *lmr*(B) | | | Chromosome | NG_047843 |
| V | Erm(V) | *erm*(V) | *erm*(SV*)* | | | | U59450 |
| W | Erm(W) | *erm*(W) | *myr*(B) | | | | D14532 |

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|---|---|---|---|---|---|---|---|
| X | Erm(X) | *erm*(X) | *erm*(CD), *erm*(A) | 99%-100% | 99%-100% | pNG2 | M36726, X51472 |
| | | | *erm*(Y) | | | Tn*5432* | U21300 |
| | | | | | | pAP2 | NC_005206 |
| Y | Erm(Y) | *erm*(Y) | *erm*(GM) | | | pMS97 | AB014481 |
| Z | Erm(Z) | *erm*(Z) | *srm*(D) | | | | AM709783 |
| 30 | Erm(30) | *erm*(30) | *pikR1* | | | Chromosome | AF079138 |
| 31 | Erm(31) | *erm*(31) | *pikR2* | | | Chromosome | AF079138 |
| 32 | Erm(32) | *erm*(32) | *tlr*(B) | | | Chromosome | AJ009971 |
| 33 | Erm(33) | *erm*(33)[a] | | | | | AJ313523 |
| | | | | | | pSCFS1 | AJ579365 |
| 34 | Erm(34) | *erm*(34) | | | | | AY234334 |
| 35 | Erm(35) | *erm*(35) | | | | | AF319779 |
| 36 | Erm(36) | *erm*(36) | *erm*(MT) | | | | AF462611 |
| 37 | Erm(37) | *erm*(37) | | | | Chromosome[b] | Z74025 |
| 38 | Erm(38) | *erm*(38) | | | | Chromosome[c] | AY154657 |
| 39 | Erm(39) | *erm*(39) | | | | Chromosome[c] | AY487229 |
| 40 | Erm(40) | *erm*(40) | | | | Chromosome[c] | AY570506 |
| 41 | Erm(41) | *erm*(41) | | | | Chromosome[c] | EU177504 |
| 42 | Erm(42) | *erm*(42) | *erm*(MI) | | 99% | Chromosome | FR734406 |
| | | | | | | pPDP9106b | AB601890 |
| 43 | Erm(43) | *erm*(43) | | | | Chromosome | HE650138 |
| 44 | Erm(44) | *erm*(44) | | | 81% | Chromosome, prophage | HG796218, LN623525 KJ728534, LK392593.1, KJ72853 |
| 44 | Erm(44)$_v$ | *erm*(44)$_v$[e] | | | | | KACC16562 |
| 45 | Erm(45) | *erm*(45) | | | | Chromosome, genomic island | CEJ95855 |
| 46 | Erm(46) | *erm*(46) | | | | pREm46 | KM679362 |

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|---|---|---|---|---|---|---|
| 47 | Erm(47) | *erm*(47) | | | Chromosome | KU612222 |
| 48 | Erm(48) | *erm*(48)[f] | | | Plasmid | LT223129 |
| 49 | Erm(49) | *erm*(49)[j] | | | Chromosome | MWVR01000009.1 [34385-35299] |
| 50 | Erm(50) | *erm*(50) | | | pTZC1 | LC473083 |
| 51 | Erm(51) | *erm*(51) | | | pRErm51 | MN928789 |
| 52 | Erm(52) | *erm*(52)[l] | | | Chromosome | MW269959.1 |
| 53 | Erm(53) | *erm*(53)[m] | | | Chromosome | **TNO85784.1**[*] |
| 54 | Erm(54) | *erm*(54)[o] | | | Plasmid | ULG10102 |
| 55 | Erm(55) | *erm*(55)[p] | | | **Plasmid. Chromosome** | **OQ656455, OQ656457** |
| | | | | | **Transposon** | **OQ656456** |
| **56** | **Erm(56)** | ***erm*(56)[q]** | | | **Chromosome** | **OQ326498** |
| **57** | **Erm(57)** | ***erm*(57)[r]** | | | **Chromosome** | |
| **S-adenyosylmethionine rRNA methyltransferase [n]** | | | | | | |
| Phenicols, lincosamides, oxazolidinones, pleuromutlins, streptogramin A | | | | | | |
| *cfr*[d] | | *cfr* | | | pSCFS3, pSWCF36<br>Chromosome, Tn*649* | AJ879565, AM408573 |
| *cfr*(B)[d] | | *cfr*(B) | 99%-100% | 99%-100% | Chromosome<br>Plasmid | KM359438, KM359439<br>KR610408 |
| *cfr*(C)[g] | | *cfr*(C) | | | Chromosome,<br>Plasmid | CCL89685, ENZ41453<br>KX686749 |
| *cfr*(D)[i] | | *cfr*(D) | | | Plasmid | CP044327 |
| *cfr*(E) | | *cfr*(E)[k] | | | Chromosome | WP_10511968658, AJ879565 |

**Blue changes since last update** ND= not done;

**Genera that may carry MLS genes found by WGS and unknown if the genes are expressed are not listed in the current table:** [*] **protein sequence**

[a] Hybrid between *erm*(A) and *erm*( C) < 80% aa identity with either gene; [b] Innate methylase from the chromosome of *Mycobacterium tuberculosis* named Rv1988 in *M. tuberculosis* H37Rv and MT2042 in *M. tuberculosis* CDC155; [c] Innate methylase from the chromosome of other *Mycobacterium* sp.; [d] Confers resistance to lincosamides, oxazolidinones, streptogramin A, phenicols & pleuromutilins [$PhLOPS_A$] but not macrolides; [e] Confers resistance to macrolides, lincosamides but not streptogramins Strauss, Hu, Coates, Perreten AAC 61:e01655-16, 2017; [f] Wipf et al., AAC e00066-17, 2017; [g] Tang et al. manuscript in preparation; [h] Hara, Hutchisnon, J Antibiotics 977, 1990 https://www.jstage.jst.go.jp/article/antibiotics1968/43/8/43_8_977/_pdf ; [i] Guerin et al., JAC 2020 doi:10.1093/jac/dkaa125; [j] Martinez et al., AEM 2018 e02888-17; [k] Stojkovic et al., 2019. AAC2019 doi 10.1128/AAC.01074-19; [l] Imwattana et al. bioRxiv doi: https://doi.org/10.1101/2020.11.12.379040; [m]Greninger, Addetia, Starr et al., CID 2020: 71 DOI: 10:1093/cid/ciz1060 **protein sequence**;

[n] Schwarz et al., 2021 CMR doi: 10.1128/CMR.00188-20 review on mobile oxazolidinone genes**;**

**[o] Kruger, Ji, Hanke et al. JAC 2022 doi:10.1093/jac/dkac149;**

**[p] Alexander, Brown-Elliott, Wallace Jr. J Clin Micro 2023 DOI: 10.1128/jcm.00428-23**

**[q] Marchionatti, Perreten 10.1128/msphere.00239-23**

**[r] Dr. Koizumi Japan**

**Not all GenBank# are provided just some represented ones**