3004508: Cytomegalovirus Drug Resistance by Next Generation Sequencing, Ganciclovir, Foscarnet, Cidofovir and Maribavir

EVALUATED MUTATIONS

Gene	Variant	Cidofovir	Foscarnet	Ganciclovir	Maribavir	Letermovir	Confirmed by Phenotyping	References
UL27	A269T	-	-	-	P	-	Y	85
UL27	A406V	-	-	-	P	-	Y	85
UL27	C415*	-	-	-	P	-	Y	85
UL27	D534Y	-	-	-	P	-	Y	97
UL27	E22*	-	-	-	P	-	Y	85
UL27	L193F	-	-	-	P	-	Y	85
UL27	L335P	-	-	-	P	-	N	85
UL27	L426F	-	-	-	P	-	Y	85
UL27	R233S	-	-	-	P	-	Y	97
UL27	R448P	-	-	-	P	-	Y	97
UL27	V353E	-	-	-	P	-	Y	85
UL27	W153R	-	-	-	P	-	Y	85
UL27	W362*	-	-	-	P	-	Y	85
UL27	W362R	-	-	-	P	-	Y	59
UL54	883-884ins	-	-	-	-	-	N	107
UL54	981-982del	R	R	R	-	-	Y	28, 44, 49, 56, 64, 88, 131, 132
UL54	A505V	P	-	P	-	-	Y	105, 132
UL54	A543P	R	-	R	-	-	Y	131, 138
UL54	A809V	-	R	R	-	-	Y	15, 44, 47, 49, 56, 74, 77, 127, 132
UL54	A834P	R	R	R	-	-	Y	80, 88, 132
UL54	A987G	R	-	R	-	-	Y	2, 17, 24, 38, 44, 47, 53, 132
UL54	A987V	-	R	-	-	-	Y	139
UL54	C524del	R	-	R	-	-	Y	101, 132
UL54	C539G	R	-	R	-	-	Y	106, 132
UL54	C539R	R	-	R	-	-	Y	93, 95
UL54	D301N	R	-	R	-	-	Y	35, 49, 56, 132
UL54	D413A	R	-	R	-	-	Y	78, 88, 132
UL54	D413E	R	-	R	-	-	Y	10, 35, 38, 39, 44, 49, 56, 88, 132
UL54	D413N	R	-	R	-	-	Y	106, 132
UL54	D413Y	R	-	R	-	-	Y	93, 132
UL54	D515E	R	R	R	-	-	Y	113, 116
UL54	D515Y	P	P	R	-	-	Y	116, 130, 131, 132

Gene	Variant	Cidofovir	Foscarnet	Ganciclovir	Maribavir	Letermovir	Confirmed by Phenotyping	References
UL54	D542E	R	-	-	-	-	Y	102, 132
UL54	D588E	-	R	-	-	-	Y	11, 17, 38, 44, 66
UL54	D588N	-	R	R	-	-	Y	38, 56, 66, 69, 92, 132
UL54	D594N	S	S	S	-	-	Y	139
UL54	E303D	R	-	R	-	-	Y	118, 132
UL54	E303G	R	-	R	-	-	Y	118, 132
UL54	E756D	-	R	-	-	-	Y	10, 49, 56, 66, 132
UL54	E756K	-	R	R	-	-	Y	38, 49, 56, 65, 66, 92, 108, 129, 132, 136
UL54	E756Q	-	R	-	-	-	Y	55, 56, 66, 74, 132
UL54	E951D	-	R	R	-	-	Y	127, 132
UL54	E989D	P	R	R	-	-	Y	139
UL54	F412C	R	-	R	-	-	Y	1, 9, 11, 14, 17, 38, 44, 56, 132
UL54	F412L	R	-	R	-	-	Y	92, 132
UL54	F412S	R	-	R	-	-	Y	47, 92, 95, 132
UL54	F412V	R	-	R	-	-	Y	17, 38, 44, 132
UL54	F595I	-	R	-	-	-	Y	93, 95, 132
UL54	G841A	R	R	R	-	-	Y	44, 77, 88, 132
UL54	G841S	-	P	P	-	-	Y	107, 132
UL54	I521T	R	-	R	-	-	Y	30, 44, 82, 132
UL54	I726T	P	-	P	-	-	Y	107, 132
UL54	I726V	R	-	R	-	-	Y	107, 132
UL54	K493N	R	R	R	-	-	Y	139
UL54	K500N	R	-	R	-	-	Y	93, 95, 132
UL54	K513E	R	-	R	-	-	Y	11, 17, 22, 38, 44, 56, 132
UL54	K513N	R	-	R	-	-	Y	11, 35, 38, 44, 56, 132
UL54	K513R	R	-	R	-	-	Y	11, 44, 106, 132
UL54	K513T	R	-	R	-	-	Y	139
UL54	K805Q	R	-	-	-	-	Y	11, 17, 44, 74, 77, 132
UL54	L501F	P	-	R	-	-	N	10, 35, 38, 44, 47
UL54	L501I	R	-	R	-	-	Y	1, 17, 38, 44, 56, 60, 66, 132
UL54	L516M	S	S	S	-	-	Y	100

Gene	Variant	Cidofovir	Foscarnet	Ganciclovir	Maribavir	Letermovir	Confirmed by Phenotyping	References
UL54	L516P	R	-	R	-	-	Y	130
UL54	L516R	R	-	R	-	-	Y	49, 56, 132
UL54	L516W	R	-	R	-	-	Y	119, 132
UL54	L545S	R	-	R	-	-	Y	17, 44, 56, 66, 132
UL54	L545W	R	-	R	-	-	Y	92, 95, 132
UL54	L565V	P	R	P	-	-	Y	139
UL54	L773V	R	R	R	-	-	Y	54, 106, 132
UL54	L776M	-	R	R	-	-	Y	83, 88, 132
UL54	L802M	-	R	P	-	-	Y	3, 9, 11, 14, 17, 38, 56, 66, 69, 74, 88, 132
UL54	L897P	P	P	-	-	-	Y	65, 95
UL54	L957F	-	-	R	-	-	Y	93, 95, 132
UL54	M393K	R	R	R	-	-	N	14, 44
UL54	M393R	R	R	R	-	-	N	14, 44
UL54	M844T	-	R	-	-	-	Y	96, 132
UL54	M844V	-	R	R	-	-	Y	96, 132
UL54	N408D	R	-	R	-	-	Y	10, 11, 17, 35, 38, 44, 56, 66, 132
UL54	N408K	R	-	R	-	-	Y	80, 92, 132
UL54	N408S	R	-	R	-	-	Y	101, 114, 132
UL54	N410K	R	-	R	-	-	Y	38, 49, 132
UL54	N495K	-	R	-	-	-	Y	71, 88, 127, 132
UL54	P488R	R	-	R	-	-	Y	93, 95, 132
UL54	P497S	R	-	P	-	-	Y	139
UL54	P522A	R	-	R	-	-	Y	17, 44, 47, 49, 55, 56, 82, 132
UL54	P522S	R	-	R	-	-	Y	44, 82, 132
UL54	P829S	-	-	R	-	-	Y	93, 95, 132
UL54	Q578H	R	R	R	-	-	Y	54, 92, 95, 132
UL54	Q578L	-	P	P	-	-	Y	107, 132
UL54	Q783R	-	R	R	-	-	Y	127
UL54	R1052C	S	S	S	-	-	Y	11, 44, 121
UL54	S290R	-	R	-	-	-	Y	127, 132
UL54	S585A	-	R	-	-	-	Y	93, 95, 132
UL54	T419M	-	R	-	-	-	N	54

Gene	Variant	Cidofovir	Foscarnet	Ganciclovir	Maribavir	Letermovir	Confirmed by Phenotyping	References
UL54	T503I	R	-	R	-	-	Y	11, 44, 49, 56, 66, 88, 132
UL54	T552N	-	R	-	-	-	Y	93, 95, 127, 132
UL54	T700A	-	R	-	-	-	Y	6, 15, 17, 44, 56, 74, 132
UL54	T813S	R	R	R	-	-	Y	77, 88, 132
UL54	T821I	-	R	R	-	-	Y	11, 17, 44, 56, 74, 77, 88, 132
UL54	T838A	-	R	-	-	-	Y	69, 77, 88, 132
UL54	V526L	R	-	R	-	-	Y	108, 132
UL54	V715A	-	R	-	-	-	Y	119, 132
UL54	V715M	-	R	-	-	-	Y	6, 15, 17, 44, 47, 55, 56, 74, 132
UL54	V781I	-	R	R	-	-	Y	3, 17, 38, 92, 132
UL54	V787A	-	R	R	-	-	Y	116, 132
UL54	V787E	R	R	R	-	-	Y	136, 138
UL54	V787I	-	R	-	-	-	N	56
UL54	V787L	-	R	R	-	-	Y	36, 55, 74, 88, 132
UL54	V812L	R	R	R	-	-	Y	14, 16, 44, 56, 66, 69, 74, 77, 88, 118, 132
UL54	V823A	R	-	R	-	-	Y	139
UL54	V946L	-	R	-	-	-	Y	93, 95, 132
UL54	Y722V	R	-	R	-	-	N	11, 44
UL54	Y751H	R	-	R	-	-	N	11, 44
UL97	590-593del	-	-	R	-	-	Y	44, 66
UL97	590-600del	-	-	R	-	-	N	40, 44
UL97	590-603del	-	-	R	-	-	N	35, 44
UL97	590-607del	-	-	R	-	-	Y	103
UL97	591-594del	-	-	R	-	-	Y	11, 22, 25, 44, 56, 75, 126
UL97	591-607del	-	-	R	-	-	Y	43, 44
UL97	595-603del	-	-	R	-	-	Y	29, 36, 44, 56, 126
UL97	597-598del	-	-	R	-	-	Y	126, 132
UL97	597-599del	-	-	R	-	-	Y	119, 126
UL97	597-603del	-	-	R	-	-	N	47
UL97	600-601del	-	-	R	-	-	Y	36, 44, 126, 132
UL97	601-602del	-	-	R	-	-	Y	47, 126, 132

Gene	Variant	Cidofovir	Foscarnet	Ganciclovir	Maribavir	Letermovir	Confirmed by Phenotyping	References
UL97	601-603del	-	-	R	-	-	Y	78, 126
UL97	A590T	-	-	R	-	-	Y	23, 25, 44
UL97	A591D	-	-	R	-	-	N	23, 25, 44
UL97	A591V	-	-	R	-	-	Y	126, 131, 132
UL97	A594E	-	-	R	-	-	Y	87, 88, 132
UL97	A594G	-	-	R	-	-	Y	8, 114, 132
UL97	A594P	-	-	R	-	-	Y	37, 44, 46, 47
UL97	A594S	-	-	R	-	-	Y	137, 138
UL97	A594T	-	-	R	-	-	Y	25, 34, 41, 43, 47, 56, 65, 132
UL97	A594V	-	-	R	-	-	Y	6, 25, 34, 37, 40, 47, 56, 64, 69, 75, 91, 126, 132
UL97	A606D	-	-	P	-	-	N	23, 25, 44
UL97	A613V	-	-	R	-	-	Y	100, 114, 132
UL97	A619V	-	-	S	-	-	Y	132
UL97	A674T	-	-	S	-	-	Y	132
UL97	C480F	-	-	R	R	-	Y	138, 139
UL97	C480R	-	-	R	R	-	Y	105, 132
UL97	C518Y	-	-	R	-	-	Y	104, 114, 132
UL97	C592F	-	-	R	-	-	N	44
UL97	C592G	-	-	R	-	-	Y	14, 25, 37, 38, 43, 56, 64, 69, 75, 91, 126, 127, 132
UL97	C603R	-	-	R	-	-	Y	88, 89, 91, 132
UL97	C603S	-	-	R	-	-	Y	88, 103, 132
UL97	C603W	-	-	R	-	-	Y	11, 14, 25, 37, 38, 44, 47, 56, 75, 91, 132
UL97	C603Y	-	-	R	-	-	N	23, 25, 37, 44
UL97	C607F	-	-	R	-	-	Y	34, 43, 44, 75, 132
UL97	C607Y	-	-	R	-	-	Y	11, 13, 22, 25, 43, 44, 47, 56, 132
UL97	D456N	-	-	R	R	-	Y	138
UL97	D605E	-	-	S	-	-	Y	132, 138
UL97	E362D	-	-	R	S	-	Y	140
UL97	E596D	-	-	S	-	-	Y	113, 132

Gene	Variant	Cidofovir	Foscarnet	Ganciclovir	Maribavir	Letermovir	Confirmed by Phenotyping	References
UL97	E596G	-	-	R	-	-	Y	11, 14, 25, 43, 44, 56, 65, 132
UL97	E596Y	-	-	R	-	-	Y	113, 132
UL97	E596del	-	-	R	-	-	Y	126, 132
UL97	E655K	-	-	S	-	-	Y	132
UL97	F342S	-	-	R	R	-	Y	99, 111, 117, 132
UL97	F342Y	-	-	R	R	-	Y	133, 138
UL97	G598S	-	-	R	-	-	Y	23, 25, 33, 44, 56
UL97	G598V	-	-	R	-	-	Y	23, 25, 33, 44, 56
UL97	H411L	-	-	-	R	-	Y	97, 138
UL97	H411N	-	-	-	R	-	Y	97, 138
UL97	H411Y	-	-	-	R	-	Y	97, 138, 139
UL97	H520Q	-	-	R	-	-	Y	25, 37, 47, 53, 56, 72, 91, 132
UL97	I610T	-	-	R	-	-	Y	113, 132
UL97	K355M	-	-	R	R	-	Y	99, 132
UL97	K355del	-	-	R	R	-	Y	99
UL97	K359E	-	-	R	-	-	Y	133, 138
UL97	K359N	-	-	R	-	-	Y	140
UL97	K359Q	-	-	R	-	-	Y	133, 138
UL97	K599E	-	-	S	-	-	Y	132
UL97	K599M	-	-	R	-	-	N	23, 25, 44
UL97	K599R	-	-	S	-	-	Y	132
UL97	K599T	-	-	R	-	-	Y	19, 44, 132
UL97	K599del	-	-	R	-	-	Y	126, 132
UL97	L337M	-	-	-	R	-	Y	97, 138
UL97	L348V	-	-	-	R	-	Y	140
UL97	L397R	-	-	-	R	-	Y	97, 138
UL97	L405P	-	-	R	-	-	Y	87, 132
UL97	L595F	-	-	R	-	-	Y	5, 25, 44, 56, 132
UL97	L595S	-	-	R	-	-	Y	6, 25, 37, 38, 40, 47, 56, 64, 66, 75, 91, 132
UL97	L595T	-	-	R	-	-	N	11, 25, 44
UL97	L595W	-	-	R	-	-	Y	25, 37, 43, 44, 47, 56, 75, 132
UL97	L595del	-	-	R	-	-	Y	4, 25, 40, 44, 126, 132

Gene	Variant	Cidofovir	Foscarnet	Ganciclovir	Maribavir	Letermovir	Confirmed by Phenotyping	References
UL97	L600I	-	-	S	-	-	Y	132
UL97	L600del	-	-	R	-	-	Y	25, 43, 44, 56, 65, 126, 132
UL97	L634Q	-	-	S	-	-	Y	132
UL97	M460I	-	-	R	-	-	Y	3, 6, 25, 37, 38, 47, 56, 66, 72, 75, 91, 132
UL97	M460L	-	-	R	-	-	N	23, 44
UL97	M460T	-	-	R	-	-	Y	87, 132
UL97	M460V	-	-	R	-	-	Y	25, 34, 37, 40, 53, 54, 56, 64, 72, 75, 91, 132
UL97	M615V	-	-	S	-	-	Y	132
UL97	N597D	-	-	S	-	-	Y	132
UL97	N597I	-	-	R	-	-	N	23, 25, 44
UL97	P521L	-	-	R	R	-	Y	99, 132
UL97	T409M	-	-	-	R	-	Y	97, 138, 139
UL97	T601M	-	-	S	-	-	Y	132
UL97	T601del	-	-	R	-	-	Y	67, 126, 132
UL97	V345I	-	-	-	S	-	Y	140
UL97	V353A	-	-	-	R	-	Y	97, 138
UL97	V356G	-	-	R	R	-	Y	99, 111, 132
UL97	V466G	-	-	R	R	-	Y	88, 89, 132
UL97	Y617H	-	-	S	-	-	Y	132
UL97	Y617del	-	-	R	R	-	Y	138

* = stop codon
del = deletion
R = "Resistant". Resistant indicates evidence of drug resistance compared with a wild-type virus.
P = "Possible Resistance". Possible resistance indicates mutations were detected with borderline-level drug resistance or conflicting resistance status reported in the literature.
S = "Sensitive". Ignored by the plugin and reported as additional variant.
'-' = No known resistance-association or phenotypically confirmed sensitivity to specified drug. Ignored by the plugin.
Y = "Yes". Mutation's resistance profile was confirmed by marker transfer/phenotyping experiments.
N = "No". Mutation's resistance profile has not been confirmed by marker transfer/phenotyping experiments.

REFERENCES

1. Lurain NS et al. 1992. J Virol. PMID:1331515
2. Sullivan V et al. 1993. Antimicrob Agents Chemother. PMID:8381637
3. Lurain NS et al. 1994. J Virol. PMID:8207815
4. Baldanti F et al. 1995. J Virol. PMID:7815545
5. Wolf DG et al. 1995. J Clin Invest. PMID:7814623
6. Baldanti F et al. 1996. J Virol. PMID:8627655
7. Kimberlin DW et al. 1996. J Antimicrob Chemother. PMID:9182098
8. Bourgeois C et al. 1997. J Virol Methods. PMID:9300382
9. Chou S et al. 1997. J Infect Dis. PMID:9291334
10. Erice A et al. 1997. J Infect Dis. PMID:9129070
11. Smith IL et al. 1998. Arch Ophthalmol. PMID:9488269
12. Baldanti F et al. 1998. J Infect Dis. PMID:9498475
13. Baldanti F et al. 1998. Antimicrob Agents Chemother. PMID:9527804
14. Cherrington JM et al. 1998. J Infect Dis. PMID:9815243
15. Chou S et al. 1998. J Infect Dis. PMID:9697736
16. Cihlar T et al. 1998. Virology. PMID:9721246
17. Cihlar T et al. 1998. J Virol. PMID:9621055
18. Erice A et al. 1998. J Infect Dis. PMID:9697737
19. Harada K et al. 1997. Arch Virol. PMID:9125039
20. Gilbert C et al. 1998. AIDS. PMID:9468360
21. Jabs DA et al. 1998. Antimicrob Agents Chemother. PMID:9736542
22. Smith IL et al. 1998. Arch Ophthalmol. PMID:9488269
23. Wolf DG et al. 1998. J Infect Dis. PMID:9697738
24. Chou S et al. 1999. Antimicrob Agents Chemother. PMID:10348781
25. Erice A. 1999. Clin Microbiol Rev. PMID:10194460
26. Michel D et al. 1999. J Virol. PMID:10482650
27. Prix L et al. 1999. J Infect Dis. PMID:10395867
28. Chou S et al. 2000. J Infect Dis. PMID:11069251
29. Chou S et al. 2000. Antimicrob Agents Chemother. PMID:10602745
30. Eckle T et al. 2000. Blood. PMID:11050017
31. Emery VC et al. 2000. Proc Natl Acad Sci U S A. PMID:10859361
32. Arens M. 2001. J Clin Virol. PMID:11418349
33. Baldanti F et al. 2001. Antiviral Res. PMID:11397507
34. Boivin G et al. 2001. J Infect Dis. PMID:11740736

35. Emery VC. 2001. J Clin Virol. PMID:11397658
36. Jabs DA et al. 2001. J Infect Dis. PMID:11120934
37. Lurain NS et al. 2001. Antimicrob Agents Chemother. PMID:11557468
38. Mousavi-Jazi M et al. 2001. J Clin Virol. PMID:11595579
39. Seo SK et al. 2001. Clin Infect Dis. PMID:11577375
40. Wolf DG et al. 2001. Antimicrob Agents Chemother. PMID:11158760
41. Baldanti F et al. 2002. Clin Infect Dis. PMID:11915006
42. Biron KK et al. 2002. Antimicrob Agents Chemother. PMID:12121906
43. Chou S et al. 2002. J Infect Dis. PMID:11807689
44. Gilbert C et al. 2002. Drug Resist Updat. PMID:12135584
45. Hu H et al. 2002. J Infect Dis. PMID:11920309
46. Ijichi O et al. 2002. Antiviral Res. PMID:11750939
47. Lurain NS et al. 2002. J Infect Dis. PMID:12198609
48. Marschall M et al. 2002. J Gen Virol. PMID:11961255
49. Chou S et al. 2003. J Infect Dis. PMID:12825168
50. Hamprecht K et al. 2003. J Infect Dis. PMID:12508158
51. Komazin G et al. 2003. Nucleosides Nucleotides Nucleic Acids. PMID:14565505
52. Komazin G et al. 2003. J Virol. PMID:14557635
53. Kuo IC et al. 2003. Am J Ophthalmol. PMID:12504692
54. Mousavi-Jazi M et al. 2003. J Clin Virol. PMID:12637079
55. Weinberg A et al. 2003. J Infect Dis. PMID:12599051
56. Baldanti F et al. 2004. Hum Immunol. PMID:15172438
58. Boivin G et al. 2004. J Infect Dis. PMID:15116297
59. Chou S et al. 2004. J Virol. PMID:15194788
60. Ducancelle A et al. 2004. J Clin Virol. PMID:15018851
61. Evers DL et al. 2004. Antimicrob Agents Chemother. PMID:15388453
62. Fillet AM et al. 2004. Antimicrob Agents Chemother. PMID:15105145
63. Loregian A et al. 2004. J Virol. PMID:14671097
64. Chou S et al. 2005. Antimicrob Agents Chemother. PMID:15980340
65. Gilbert C et al. 2005. Antimicrob Agents Chemother. PMID:15728878
66. Gilbert C et al. 2005. Antimicrob Agents Chemother. PMID:16304146
67. Hantz S et al. 2005. Antimicrob Agents Chemother. PMID:15793144
68. Prichard MN et al. 2005. J Virol. PMID:16306620
69. Springer KL et al. 2005. J Clin Microbiol. PMID:15634973
70. Drew WL et al. 2006. J Clin Virol. PMID:16962820
71. Ducancelle A et al. 2006. Antivir Ther. PMID:16856628

72. Gv∂hring K et al. 2006. J Clin Microbiol. PMID:17035493
73. Jabs DA et al. 2006. J Infect Dis. PMID:16703517
74. Tchesnokov EP et al. 2006. J Virol. PMID:16415021
75. Castor J et al. 2007. J Clin Microbiol. PMID:17537934
76. Chou S et al. 2007. J Infect Dis. PMID:17538888
77. Chou S et al. 2007. Antimicrob Agents Chemother. PMID:17709468
78. Marfori JE et al. 2007. J Clin Virol. PMID:17157554
79. Picard-Jean F et al. 2007. Biochem J. PMID:17672827
80. Scott GM et al. 2007. Antimicrob Agents Chemother. PMID:17043128
81. Chou S et al. 2008. J Virol. PMID:17942550
82. Chou S et al. 2008. J Clin Virol. PMID:18502683
83. Shapira MY et al. 2008. Clin Infect Dis. PMID:18419454
84. Torres-Madriz G et al. 2008. Clin Infect Dis. PMID:18652557
85. Chou S. 2009. Antimicrob Agents Chemother. PMID:18981262
86. Chevillotte M et al. 2010. Antiviral Res. PMID:19853628
87. Chou S. 2010. Antimicrob Agents Chemother. PMID:20385869
88. Lurain NS et al. 2010. Clin Microbiol Rev. PMID:20930070
89. Martin M et al. 2010. J Clin Virol. PMID:20138805
90. Strasfeld L et al. 2010. J Infect Dis. PMID:20504236
91. Chou S et al. 2011. Antimicrob Agents Chemother. PMID:21041510
92. Chou S. 2011. J Clin Virol. PMID:21295516
93. Gilbert C et al. 2011. Antimicrob Agents Chemother. PMID:21709106
94. Goldner T et al. 2011. J Virol. PMID:21752907
95. Hakki M et al. 2011. Curr Opin Infect Dis. PMID:22001948
96. Chou S et al. 2012. Antimicrob Agents Chemother. PMID:21968367
97. Chou S et al. 2012. Antiviral Res. PMID:22664236
98. Marschall M et al. 2012. Antimicrob Agents Chemother. PMID:22106211
99. Chou S et al. 2013. Antimicrob Agents Chemother. PMID:23650173
100. Fischer L et al. 2013. Antiviral Res. PMID:24120366
101. Hantz S et al. 2013. Antiviral Res. PMID:23415883
102. James SH et al. 2013. Antimicrob Agents Chemother. PMID:23650158
103. Kotton CN et al. 2018. Transplantation. PMID:29596116
104. Zhang Y et al. 2013. Arch Virol. PMID:23011309
105. Chou S et al. 2014. Antimicrob Agents Chemother. PMID:24379208
106. Chou S et al. 2014. Antimicrob Agents Chemother. PMID:24890586
107. Chou S et al. 2014. J Infect Dis. PMID:24273181

108. Drouot E et al. 2014. J Clin Microbiol. PMID:25143583
109. Goldner T et al. 2014. Antimicrob Agents Chemother. PMID:24189264
110. Komazin-Meredith G et al. 2014. Antimicrob Agents Chemother. PMID:24145545
111. Chou S. 2015. Curr Opin Infect Dis. PMID:26098499
112. Chou S. 2015. Antimicrob Agents Chemother. PMID:26259791
113. Fischer L et al. 2015. J Clin Virol. PMID:26209398
114. G√∂hring K et al. 2015. Comput Struct Biotechnol J. PMID:25750703
115. Goldner T et al. 2015. Antiviral Res. PMID:25637709
116. Andouard D et al. 2016. Antiviral Res. PMID:26872863
117. Campos AB et al. 2016. Rev Med Virol. PMID:26990717
118. Chou S et al. 2016. Antimicrob Agents Chemother. PMID:27044553
119. Fischer L et al. 2016. Antiviral Res. PMID:27058773
121. Lanier ER et al. 2016. J Infect Dis. PMID:26941282
122. Lischka P et al. 2016. J Infect Dis. PMID:26113373
123. Lischka P et al. 2016. Antiviral Res. PMID:27345658
124. Chou S. 2017. Antiviral Res. PMID:29107686
125. Chou S. 2017. Antimicrob Agents Chemother. PMID:28827420
126. Muller F et al. 1993. Prenat Diagn. PMID:8446569
127. Chou S. 2017. Antiviral Res. PMID:27940027
128. Merck. 2017.
https://www.accessdata.fda.gov/drugsatfda_docs/label/2017/209939Orig1s000,209940Orig1s000lbl.pdf
129. Piret J et al. 2017. Antimicrob Agents Chemother. PMID:28807919
130. Cherrier L et al. 2018. Am J Transplant. PMID:30286286
131. Chou S et al. 2018. Antimicrob Agents Chemother. PMID:29914965
132. Kotton CN et al. 2018. Transplantation. PMID:29596116
133. Chou S et al. 2019. Antiviral Res. PMID:31568799
134. Douglas MW et al. 2019. J Infect Dis. PMID:30958539
135. Papanicolaou GA et al. 2019. Clin Infect Dis. PMID:30329038
136. Piret J et al. 2019. J Infect Dis. PMID:31199457
137. Wong DD et al. 2019. Antimicrob Agents Chemother. PMID:31262766
138. Chou S. 2020. Antiviral Res. PMID:31940472
139. Chou S et al. 2020. J Infect Dis. PMID:32726419
140. Chou S et al. 2021. Antiviral Res. PMID:34273445