

Alignment AA

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0.1 Dependencies

```
library(msa)
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.1.2
```

```
#plot alignment with ggmsa
library(ggmsa)
library(Biostrings)
```

1 Load files

```
#AA load file fasta with sequences NO ALIGNMENT
myseq <- "/data/TransportersAA.fasta"
sequences <- readAAStringSet(myseq)
```

How many sequences do we have?

```
length(sequences)
```

```
## [1] 22
```

2 Align

```
#uses default settings with the ClustalW algorithm  
myAln <- msa(sequences)
```

```
## use default substitution matrix
```

```
#show alignment  
print(myAln, show = "complete")
```

```
##  
## MsaAMultipleAlignment with 22 rows and 768 columns  
##      aln (1..53)                                     names  
## [1] ----- SLC22A17  
## [2] ----- SLC22A31  
## [3] MAIDRRREAAGGGPGRQPAPAEENGSLPPGDAAASAPLGGRAGPGGGAEIQPL SLC22A23  
## [4] ----- SLC22A1  
## [5] ----- SLC22A2  
## [6] ----- SLC22A3  
## [7] ----- SLC22A6  
## [8] ----- SLC22A8  
## [9] ----- SLC22A9  
## ... ..  
## [15] ----- SLC22A7  
## [16] ----- SLC22A13  
## [17] -----MAGEENFKEELRSQDASRNLNQH SLC22A14  
## [18] ----- SLC22A4  
## [19] ----- SLC22A5  
## [20] ----- SLC22A16  
## [21] ----- SLC22A15  
## [22] ----- SLC22A18  
## Con ----- Consensus  
##  
##      aln (54..106)                                    names  
## [1] ----- SLC22A17  
## [2] ----- SLC22A31  
## [3] PPLHPGGGPHPPSCCSAAAAPSLLLLDYDGSVLPFLGGLGGGYQKTLVLLTWIP SLC22A23  
## [4] -----MP-TVDDILEQVGESGWFFQKQAFILCLL SLC22A1  
## [5] -----MPTTVDDVLEHGGEFHFQKQMFFLLALL SLC22A2  
## [6] -----MP-SFDEALQRVGEFGRFQRRVFLLLCLT SLC22A3  
## [7] -----MAFNDLLQVGGVGRFQQIQVTLVVLPL SLC22A6  
## [8] -----MTFSEILDRVGSMDHGFQFLHVAILGLP SLC22A8  
## [9] -----MAFQDLLGHAGDLWRFQILQTVFLSIF SLC22A9  
## ... ..
```

```

## [15] -----MGFEELLEQVGGFGPFQLRNVALLALP SLC22A7
## [16] -----MAQFVQVLAIEIGDFGRFQIQLLILLCVL SLC22A13
## [17] EVAGHPHSWSLEMLLRRLRAVHTKQDDKFANLLDAVGEFGTFQQLVALTFIP SLC22A14
## [18] -----MRDYDEVIAFLGEWGPFQRLIFFLLSAS SLC22A4
## [19] -----MRDYDEVTAFLGEWGPFQRLIFFLLSAS SLC22A5
## [20] -----MGSRHFEGYDHYVGHFGRFQRLVLYFICAFQ SLC22A16
## [21] -----MEVEEAFQAVGEMGIYQMYLCFLLAVL SLC22A15
## [22] -----MCSQLLMWQNLGKSSAAAKSSSHQL SLC22A18
## Con -----??F???L??VG??G?FQ?????L??? Consensus
##
##      aln (107..159)                                names
## [1] -----MASDPIFTLAPPLH-CHYGAFPPNASGWEQPPNASGVS----- SLC22A17
## [2] ----- SLC22A31
## [3] ALFIGFSQFSDSFLLDQPNFW-CRGAGKGTELAGVTTTGRGDMGNWTSLPTT SLC22A23
## [4] SAAFAPICVGIVFLGFTPDHH-CQSPGVAELSRCGWSPAELNNTVPGL-GP SLC22A1
## [5] SATFAPIYVGIVFLGFTPDHR-CRSPGVAELSLRCGWSPAELNNTVPGP-GP SLC22A2
## [6] GVTFAFLFVGVFLGTQPDHYWCRGPSAAALAERCGWSPEEWNRTAPASRG SLC22A3
## [7] LLLMASHNTLQNFTAAPTHH-CRPPAD-----ANLSKNGGLEVLPR SLC22A6
## [8] ILNMANHNLLQIFTAATPVHH-CRPPHN-----ASTG-----PWVLP SLC22A8
## [9] AVATYLFHMLENFTAFIPGHR-CWVHILDNDTVSDNDTGALSQDALLRISIP SLC22A9
## ... ..
## [15] RVLLPLHFLLPIFLAAPPAHR-CALPGAPAN-----FSHQDVWLEAHLPR SLC22A7
## [16] NFLSPFYFFAHVFMVLDEPHH-CAVAWVKNHT-----FNLAAEQVLVSVPL SLC22A13
## [17] SIMSAFFMFADHFVFTAQKPY-CNTSWILAVG-----PHLSKAEQLNLTIPQ SLC22A14
## [18] IIPNGFNGMSVFLAGTPEHR-CRVPDAAN-----LSSAWRNNSVPLRLRDGR SLC22A4
## [19] IIPNGFTGLSSVFLIATPEHR-CRVPDAAN-----LSSAWRNHTVPLRLRDGR SLC22A5
## [20] NISCGIHYLASVFMGVTPHHV-CRPPGNVSQVVFHNHNSWSLEDTGALLSSGQ SLC22A16
## [21] LQLYVATEAILIALVGATPSY-----HWDLAELLPNQSH SLC22A15
## [22] EAGRGRVGTSTPLWEARPGGCCLGPSDSAPLPG---STGLLPAPPASCLDL SLC22A18
## Con ??????????F????P?H?-C??P?????????????????L????P? Consensus
##
##      aln (160..212)                                names
## [1] -----VASAALAASAAS-----RVATSTDPSCSGFAPPDFNHCLKD SLC22A17
## [2] ----- SLC22A31
## [3] PFATAPWEAAGNRSNSSGAD-----GGDTPPLPSPDPKGDNASNCDRA SLC22A23
## [4] AGEA--FLGQCRRYEVDWN-----QSALSCVDPLASLATNRSRLPLGPCQDG SLC22A1
## [5] AGEA--SPRQCRRYEVDWN-----QSTFDCVDPLASLDTNRSRLPLGPCRDG SLC22A2
## [6] EPPE--RRGRCQRYLLEAANDSASATSALSCADPLAAFP-NRS-APLVPCRGG SLC22A3
## [7] DRQG--QPESCLRFTSPQWG-----LPFLNGTEANG-----T-GATEPCTDG SLC22A6
## [8] GPNG--KPERCLRFVHPPN-----ASLPNDTQR-----AMEPCLDG SLC22A8
## [9] DSNM--RPEKCRRFVHPQWQ-----LLHLNGTFPNT-----SDADMEPCVDG SLC22A9
## ... ..
## [15] EPDG--TLSSCLRFAYPQAL-----PNTTLGEERQSRGELEDEPATVPCSQG SLC22A7
## [16] DTAG--HPEPCLMFRPPAN-----ASLQDILSHRFN-----ETQPCDMG SLC22A13
## [17] APNG--SFLTCFMYLPVPWN-----LDSIIQFGLN-----DTDTCQDG SLC22A14
## [18] E-----VPHSCSRYRLATIA-----NFSALGLEPGRDVLGQLEQESCLDG SLC22A4
## [19] E-----VPHSCSRYRLATIA-----NFSALGLEPGRDVLGQLEQESCLDG SLC22A5
## [20] KDYVTVQLQNGEIWELSRCS-----RNKRENTSSLGYEYTGSKKEFCVDG SLC22A16
## [21] GNQSAGEDQAFGDWLLTANG-----SEIHK SLC22A15
## [22] SWVSLRLSRMQGARAPRDQ-----GRSPGRMSALGRSSVILLTYVLAATE SLC22A18
## Con ???-P??C?R??P???-?????????-?????PC?DG Consensus
##
##      aln (213..265)                                names
## [1] WDYNGLPVLTNAIG-----QWDLVCDLGWQVILE SLC22A17

```

```

## [2] -----MPHQLSQ-----NWNLVCGDGWKVPLE SLC22A31
## [3] WDYGIRAGLVQNVVS-----KWDLVCDNAWKVHIA SLC22A23
## [4] WVYDTPGSSIVTEFN-----LVCADSWKLDLF SLC22A1
## [5] WVYETPGSSIVTEFN-----LVCANSWMLDLF SLC22A2
## [6] WRYAQAHSTIVSEFD-----LVCVNAWMLDLT SLC22A3
## [7] WIYDNSTFPSTIVTE-----WDLVCSHRALRQLA SLC22A6
## [8] WVYN--STKDSIVTE-----WDLVCNSNKLKEMA SLC22A8
## [9] WVYDRISFSSTIVTE-----WDLVCDSQLTSVA SLC22A9
## ... ..
## [15] WEYDHSEFSSTIATES-----QWDLVCEQKGLNRAA SLC22A7
## [16] WEYPENRPLSLKNEF-----NLVCDRKHLKDTT SLC22A13
## [17] WIYDPAKKRSLINEF-----DLVCGMETKKDTA SLC22A14
## [18] WEFSQDVYLVSTVVT-----EWNLVCEDNWKVPLT SLC22A4
## [19] WEFSQDVYLVSTIVTEQDSGAYNAMKNRMGKKPALCLPAQWNLVCEDDWKAPLT SLC22A5
## [20] YIIDQNTWKSTAVT-----QWNLVCDRKWLAMLI SLC22A16
## [21] HVHFSSSFTSIAS-----EWFLIANRSYKVSAA SLC22A15
## [22] LTCLFMQFSIVPYLS-----RKLGLDSIAFGYL SLC22A18
## Con W?Y?????STIV??-----WDLVC????L???? Consensus
##
##      aln (266..318)                                names
## [1] QILFILGFASGYLFLGYPADRFGRRGIVLLTLGLVGPCGVGGAAAGSSTGVMA SLC22A17
## [2] QVSHLLGWLLGCVILGAGCDRFGRRAVFVASLVLTTLGLGASEALAASFPTLLV SLC22A31
## [3] KFSLLVGLIFGYLITGCIADWVGRRPVLLFSIIFILIFGLTVALSVNVTMFST SLC22A23
## [4] QSCLNAGFLFGSLGVGYFADRFGRKLCLLGTVLVNAVSGVLMAFSPNYMSMLL SLC22A1
## [5] QSSVNVGFFIGSMSIGYIADRFGRKLCLLTTVLINAAAGVLMASPTYTWMLI SLC22A2
## [6] QAILNLGFLTGAFTLGYAADRYGRIVIIYLLSCLGVGVTGVVAFAPNFPVFI SLC22A3
## [7] QSLYVMGVLLGAMVFGYLADRLGRRKVLILNYLQTAVSGTCAAFAPNFIYCA SLC22A6
## [8] QSIFMAGILIGGLVLGDLSDRFGRRPILTCSYLLLAASGSGAASFPTFIYMV SLC22A8
## [9] KVFVMAGMMVGILGGHLSDRFGRRFVLRWCYLQVAIVGTCAALAPTFLIYCS SLC22A9
## ... ..
## [15] STFFFAGVLVGAVAFGYLSDRFGRRRLLLVAYVSTLVLGLASAAASVSVMFAI SLC22A7
## [16] QSVFMAGLLVGTLMFGPLCDRIGRKATILAQLLLFTLIGLATAFVPSFELYMA SLC22A13
## [17] QIMFMAGLPIGSLIFRLITDKMGYPAILLSLLGLIIFGFGTAFMNSFHLYLF SLC22A14
## [18] TSLFFVGVLGSGFVSGQLSDRFGRKNVLFATMAVQTGFSLQIFSISWEMFTV SLC22A4
## [19] ISLFFVGVLGSGFISGQLSDRFGRKNVLFVTMGMQTGFSLQIFSKNFEMFVV SLC22A5
## [20] QPLFMFGVLLGSVTFGYFSDRLGRRVVLWATSSSMFLGIAAFAVDYYTFMA SLC22A16
## [21] SSFFFGSVFVGVISFGQLSDRFGRKKVYLTGFALDILFAIANGFSPSYEFFAV SLC22A15
## [22] QTTFGVLLQLLGGPVFGRFADQRGARAALTSFLAALALYLLAAASSPALPGV SLC22A18
## Con QS?F??G?L?G????G?LSDRFGRR??L????L?????G???AFAP?F????? Consensus
##
##      aln (319..371)                                names
## [1] LRFLLG---FLLAGVDLGVYLMRLELCDPTQR-LRVALAGELVGVGGHFLFLG SLC22A17
## [2] LRL LHG---GTLAGALLALYLARLELCDPPHR-LAFSMGAGLFSVVGTL LLPG SLC22A31
## [3] LRFFEG---FCLAGIILTLYALRIELCPPGKR-FMITMVASFVAMAGQFLMPG SLC22A23
## [4] FRLLQG---LVSKGNWMAGYTLITEFVGSGSR-RTVAIMYQMAFTVGLVALTG SLC22A1
## [5] FRLIQG---LVSKAGWLIGYILITEFVGRRYR-RTVGIFYQVAYTVGLLVL AG SLC22A2
## [6] FRFLQG---VFGKGTWMTCYVIVTEIVGSKQR-RIVGIVIQMFFTLGIIILPG SLC22A3
## [7] FRLLSG---MALAGISLNCMTLNVEWMPHTR-ACVGTLIGYVYSLGQFLLAG SLC22A6
## [8] FRFLCG---FGISGITLSTVILNVEWVPTMR- AIMSTALGYCYTFGQFILPG SLC22A8
## [9] LRFLSG---IAAMSLITNTIMLIAEWATHRFQ-AMGITLGMCPSGIAFMTLAG SLC22A9
## ... ..
## [15] TRTLTG---SALAGFTIIIVMPLELEWLDVEHR-TVAGVLSSTFWTGGVMLLAL SLC22A7
## [16] LRFAVA---TAVAGLSFSNVTLTTEWVGPSWR-TQAVVLAQCNFSLGQMVL AG SLC22A13
## [17] FRFGIS---QSVVGYAIISSISLATEWLVEHR-AHAII LGHCFFAVGAVLLTG SLC22A14

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```

## [18] LFVIVG---MGQISNYVAFILGTEILGKSVRIIFSTLGVCTFFAVGYMLLPL SLC22A4
## [19] LFVLVG---MGQISNYVAAFVLGTEILGKSVRIIFSTLGVCFYAFGYMVLPL SLC22A5
## [20] ARFFLA---MVASGYLVGVFVYVMEFIGMKSR-TWASVHLHSFFAVGTLLVAL SLC22A16
## [21] TRFLVG---MMNGGMSLVAFVLLNECVGTAYW-ALAGSIGGLFFAVGIAQYAL SLC22A15
## [22] YLLFASRLPGALMHTLPAAQMVITDLSAFEER-PAALGRLGLCFGVGVILGSL SLC22A18
## Con LRFL?G---????G???????L??EW?????R-?????????????G??LL?G Consensus
##
##      aln (372..424)                                names
## [1] LALVSKDWRFLQRM-ITAPCILFLFYGWPGFLFLESARWLIVKRQIEEAQSVLR SLC22A17
## [2] LAALVQDWRLQLGLGALMSGLLLLFWGFPAFPESPCWLLATGQVARARKILW SLC22A31
## [3] LAALCRDWQVLQALIICPFLMLLYW---SIFPESLRWLMATQQFESAKRLIL SLC22A23
## [4] LAYALPHWRWLQLAVSLPTFLFLLY---WCVPEsprwllsQKRNTeAIKIMD SLC22A1
## [5] VAYALPHWRWLQFTVSLPNFFFLLY---WCIPESPRWLISQNKNAEAMRIIK SLC22A2
## [6] IAYFIPNWQGIQLAITLPSFLFLLY---WVVPESPRWLITRKKGDKALQILR SLC22A3
## [7] VAYAVPHWRHLQLLVSAFFFAFFIYS---WFFIESARWHSSSGRLDLTLRALQ SLC22A6
## [8] LAYAIPQWRWLQLTVSIPFFVFFLSS---WWTPEsirwlvsgksskalkilr SLC22A8
## [9] LAFAIRDWHILQLVVSVPYFVIFLTS---SWLLESARWLIINNKEEGLKELR SLC22A9
## ... ..
## [15] VGYLIRDWRWLLLAVTLPcAPGILSL---WWVPESARWLLTQGHVKEAHRYLL SLC22A7
## [16] LAYGFRNWRLQLITGTAPGLLLFFYF---WALPESARWLLTRGRMDEAIQLIQ SLC22A13
## [17] IAYSLPHWQLFLVGGILVIPFISYI---WILPESPRWLMMKGKVKEAKQVLC SLC22A14
## [18] FAYFIRDWRMLLLALTVPGLCVPLW---WFIPESPRWLISQRRFREAEDIIQ SLC22A4
## [19] FAYFIRDWRMLLVALTMPGVLcVALW---WFIPESPRWLISQGRFEEAEVIIR SLC22A5
## [20] TGYLVRTWwLYQMILSTVTPFILCC---WVLPETPFWLLSEGRYEEAQKIVD SLC22A16
## [21] LGYFIRSWRTLAILVNLTQGTVVFLS---LFIPESPRWLYSQGRlSEAEeALY SLC22A15
## [22] LGGTLVSAYGIQCPAILAALATLLGA---VLSFTCIPASTKGAKTDAQAPLP SLC22A18
## Con LAY??RDWR?LQL??S?P?????L?---W??PES?RWL???G???EA???L? Consensus
##
##      aln (425..477)                                names
## [1] ILAERNRP-HGQMLGEEAQEALQDLENTCPLPATSSFSFASLLNYRNIWKNLL SLC22A17
## [2] RFAEASGVGPGDSSLEENSLATELTMLSARSPQPRYHSPLGLLRTRVTRWNGL SLC22A31
## [3] HFTQKNRMNPEGDIKGVIPLEKELSR-----RPKKVCIVKVVGTRNLWKNIV SLC22A23
## [4] HIAQKNGK-----LPPADLKMLSLEEDVTEKLSPSFADLFRTPRLRKRTF SLC22A1
## [5] HIAKNGK-----SLPASLQRLLEEETGKKLNPSFDLVRTPQIRKHTM SLC22A2
## [6] RIAKNGK-----YLSSNYSEITVTDEEVS--NPSFDLVRTPQMRKCTL SLC22A3
## [7] RVARINGKREEGAKL-SMEVLRASLQKELTMGKGQA-SAMELLRCPTLRHLFL SLC22A6
## [8] RVAVFNGKKEEGERL-SLEELKLNlQKEISLAKAKY-TASDLFRIPMLRRMTF SLC22A8
## [9] KAAHRSGMKNARDTL-TLEILKSTMKKELEAAQKKKPSLCEMLHMPNICKRIS SLC22A9
## ... ..
## [15] HCARLNGRPVCEDSF-SQEAVSKVAAGERVVRPSY---LDLFRTPRLRHISL SLC22A7
## [16] KAASVNRRLKSPELM-NQLVP-----EKTGPSGNALDLFRHPQLRKVTL SLC22A13
## [17] YAASVNKKTIPSNLL-DELQLP-----RKKVTRASVLDFCKNRQLCKVTL SLC22A14
## [18] KAAKMN-----NIAV-PAVIFDS--VEELNPLKQKAFILDlFRTRNIAIMTI SLC22A4
## [19] KAAKAN-----GIVV-PSTIFDPSELQDLSSKKQqSHNILDLLRTWNIRMVTI SLC22A5
## [20] IMAKWNRAS-SCKLS-ELSLDLQGPVNSPTEVQKHNLsYLFYNWSITKRTL SLC22A16
## [21] LIAKRNrk-----LKCTFSLTHPANRSCRETGSFDLDFRYRVLLGHlTL SLC22A15
## [22] GGPRAS-----VFDLKAIASLLRLPDVPRIFLVKV SLC22A18
## Con ??A??NG????????-???????????E?????????S?LDL?R?P?LRK?T? Consensus
##
##      aln (478..530)                                names
## [1] ILGFTNFIAHAIRHCYQPVGGGGSPSD-----FYLCsLLASGTAAALAC--VFL SLC22A17
## [2] ILGFSSLVGGGIRASFRSLAPQVPT-----FYLPYFLEAGLEAAAL--VFL SLC22A31
## [3] VLCVNSLTGYGIHHCFARSMMGHEVKVPllENFYADYYTTASIALVSC--LAM SLC22A23
## [4] ILMYLWFTDSVLYQGLILHMGATSGNL-----YLDFLYSALVEIPGA--FIA SLC22A1

```

```

## [5] ILMYNWFTSSVLYQGLIMHMLAGDNI-----YLDFFYSALVEFPAA--FMI SLC22A2
## [6] ILMFAWFTSAVVYQGLVMRLGIIGNL-----YIDFFISGVVELPGA--LLI SLC22A3
## [7] CLSMLWFATSFAYYGLVMDLQGFVSI-----YLIQVIFGAVDLPK--LVG SLC22A6
## [8] CLSLAWFATGFAYYSLAMGVEEFGVNL-----YILQIIFGGVDVPAK--FIT SLC22A8
## [9] LLSFTRFANFMAYFGLNLHVQHLGNNV-----FLLQTLFGAVILLAN--CVA SLC22A9
## ... ..
## [15] CCVVWFVGFVNFSYYGLSLDVSGGLNV-----YQTQLLFGAVELPSK--LLV SLC22A7
## [16] IIFCVWFVDSLGGYGLSLQVGFGLDV-----YLTQLIFGAVEVPAK--CSS SLC22A13
## [17] VMSCVWFTVSYTYFTLSLRMRELGVSV-----HFRHVVPSSIMEVPAK--LCC SLC22A14
## [18] MSLLLWMLTSVGFYFALSDDLPHGDA-----YLNCFLSALIEIPAY--ITA SLC22A4
## [19] MSIMLWMTISVGFYGLSLDTPNLHGDI-----FVNCFLSAMVEVPAY--VLA SLC22A5
## [20] TVWLIWFTGSLGFYSFSLNSVNLGGNE-----YLNLFLLGVVEIPAY--TFV SLC22A16
## [21] ILMFIWFVCSLVYGLTSLAGDLGSI-----YANLALSGLIEIPSYPLCIY SLC22A15
## [22] ASNCPTGLFMVMSIISMDFQLEAAQAG----YLMSSFFGLLQMVMTQG--LVI SLC22A18
## Con ?L???WF????Y?GL?L???LG?N?-----YL???L?G?VE?PA?--??? Consensus
##
##      aln (531..583)                                names
## [1] GVTVDVFRGRRGILLSSMTLTGIASLVLLGLWDCEHPFPTVWAQQGNPNRDLN SLC22A17
## [2] LLTADCCGRPVLLLGTMVTGLASLLL-----AG--AQYLP SLC22A31
## [3] CVVVRFLGRRGGLLLFMILTALASLLQLGLLN---LIGKYSQHPDSGMSDSVK SLC22A23
## [4] LITIDRVGRIYPMAMSNLLAGAACLVMIFFIS-----PDL SLC22A1
## [5] ILTIDRIGRRYPWAASNMVAGAACLASVFIP-----GDL SLC22A2
## [6] LLTIERLGRRLPFAASNIVAGVACLVTAFIP-----EGI SLC22A3
## [7] FLVINSLGRRPAQMAALLAGICILLNGVIP-----QDQ SLC22A6
## [8] ILSLSYLGRHTTQAAALLAGGAILALTFVP-----LDL SLC22A8
## [9] PWALKYMNRRASQMLLMFLLAICLLAIFVP-----QEM SLC22A9
## ... ..
## [15] YLSVRYAGRRLTQAGTLLGTALAFGRLLVS-----SDM SLC22A7
## [16] IFMMQRFRGRKWSQLGTLVLGGLMCIIIFIP-----ADL SLC22A13
## [17] IFLLQQIGRKWSLAVTLLQAIWCLLLLFLPEGE----DGLRLKWPRCPATEL SLC22A14
## [18] WLLLRRTLPRRYIIAAVLFWGGGVLLFIQLVP-----VDY SLC22A4
## [19] WLLLQYLPRRYSMATALFLGGSVLLFMQLVP-----PDL SLC22A5
## [20] CIAMDKVGRRTVLAYSFLCSALACGVVMVIP-----QKH SLC22A16
## [21] LINQKWFRGRKRTLSAFLCLGGLACLIVMFLPEKKDTG-----VFA SLC22A15
## [22] GQLSSHFSSEVLLRASVLVFIIVGLAMAWMS-----SLC22A18
## Con ?L????GRR???A???L?G?A?L???F?P-----??? Consensus
##
##      aln (584..636)                                names
## [1] EAAITTFSVLGLFSSQAAAILSTLLAAEVIPTTVRGRGLGLIMALGALGGLSG SLC22A17
## [2] GWTVLFLSVLGLLASRAVSALSSLFAAEVFPTVIRGAGLGLVLGAGFLGQAAG SLC22A31
## [3] DKFSIAFSIVGMFASHAVGSLSVFFCAEITPTVIRCGGLGLVLASAGFGMLTA SLC22A23
## [4] HWLNIIIMCVGRMGITIAIQMICLVNAELYPTFVRNLGVMVCSSLCDIGGIIT SLC22A1
## [5] QWLKIIISCLGRMGITMAYEIVCLVNAELYPTFIRNLGVHICSSMCDIGGIIT SLC22A2
## [6] AWLRTTVATLGRLGITMAFEIVYLVNSELYPTTLRNFGVSLCSGLCDFGGIIA SLC22A3
## [7] SIVRTSLAVLKGKCLAASFNCIFLYTGELYPTMIRQTGMGMGSTMARVGSIVS SLC22A6
## [8] QTVRTVLAVFGKGCLSSSFSCFLYTSSELYPTVIRQTGMGVSNLWTRVGSIVS SLC22A8
## [9] QTLREVLATLGLGASALANTLAFAGHNEVIPTIIRARAMGINATFANIAGALA SLC22A9
## ... ..
## [15] KSWSTVLAVMGKAFSEAAFTTAYLFTSELYPTVLRQTGMGLTALVGRLLGSLA SLC22A7
## [16] PVVVTMLAVVGKMATAAFTISYVYSAELFPTILRQTGMGLVGIFSRIGGILT SLC22A13
## [17] KSMTILVLMLREFSLAATVTVFFLYTAELLPTVLRATGLGLVSLASVAGAILS SLC22A14
## [18] YFLSIGLVMLKFGITSAFMSLYVFTAELYPTLVNRMAVGVTSTASRVGSIIA SLC22A4
## [19] YYLATVLVMVGKFGVTAAFSMVYVYTAELYPTVVRNMGVGSSTASRLGSILS SLC22A5
## [20] YILGVVTAMVGKFAIGAAGFLIYLYTAELYPTIVRSLAVGSGSMVCRLASILA SLC22A16

```

```

## [21] VVNSHLSLLGKLTISA AFNIVYIYTSELYPTVIRNVGLGTCSMFSRVGGIIA SLC22A15
## [22] --SVFHFCLLVPLVFSCLTNVVTDSMLIKAVSTSDTGTMGLCASVQPLLR SLC22A18
## Con ??L???LA?LG?????AAF???????AEL?PT??R??G?G?????R?G?IL? Consensus
##
##      aln (637..689)                                names
## [1] PAQRLHM-GHGAFLQHVVLAACALLCILSIML-LPETKRKLLP----- SLC22A17
## [2] PLDTLHG-RQGFFLQQVVFASLAVLALLCVLL-LPESRSRGLP----- SLC22A31
## [3] PIIELHN-QKGYFLHHIIFACCTLICIIICILL-LPESRDQNLPL----- SLC22A23
## [4] PFIVFRLREVWQALPLILFEKQSPKKTRFTLR-SKPQNPRAPERDVLRRCRVG SLC22A1
## [5] PFLVYRLTNIWLELPLMVFGVLGLVAGGLVLL-LPETKGKALP----- SLC22A2
## [6] PFLFLRLAAVWLELPLIIFGILASICGGLVML-LPETKGIALP----- SLC22A3
## [7] PLVSMTA-ELYPSMPLFIYGAVPVAASAVTVL-LPETLGQPLP----- SLC22A6
## [8] PLVKITG-EVQPFIPNIIYGITALLGGSAAFL-LPETLNQPLP----- SLC22A8
## [9] PLMMILS-VYSPPLPWIIYGVPFISGFALL-LPETRNKPLF----- SLC22A9
## ... ..
## [15] PLAALLD-GVWLSLPKLTYYGGIALLAAGTALL-LPETRQAQLP----- SLC22A7
## [16] PLVILLG-EYHAALPMLIYGSPLIVAGLLCTL-LPETHGQGLK----- SLC22A13
## [17] --LTIIS-QTPSLLPIFLCCVLAIAVAFSLSSL-LPETRDQPLS----- SLC22A14
## [18] PYFVYLG-AYNRMLPYIVMGSLTVLIGILTLF-FPESLGMTLP----- SLC22A4
## [19] PYFVYLG-AYDRFLPYILMGSLTILTAILTLF-LPESFGTPLP----- SLC22A5
## [20] PFSVDLS-SIWIFIPQLFVGTMALLSGVLTLL-LPETLGKRLA----- SLC22A16
## [21] PFIPSLK-YVQWSLPFIVFGATGLTSGLLSLL-LPETLNSPLL----- SLC22A15
## [22] TLGPTVGGLLYRSFGVPVFGHVQVAINTLVLL---VLWRKPMP----- SLC22A18
## Con PL???L?-?????LP?I??G??????G???LL-LPET???PLP----- Consensus
##
##      aln (690..742)                                names
## [1] EVLRDGE LCRRLRQPPPTRCDHVP LLATPN-----PAL----- SLC22A17
## [2] QSLQDADRLRRSP LLRGRP--RQDHLPLLPSSNSY WAGHTPEQH----- SLC22A31
## [3] ENISNGEHYTRQPLLP HKKGEP LLLTNAELKDYSGLHDA AAGDTLPEGATA SLC22A23
## [4] GMKMELSSAEIPRLHF-SVFFLILAYPQINISPKEWFVWALS YFVFFLLSSP SLC22A1
## [5] ETIEEAENMRPRKNKE-KMIYLVQVKLDIPLN----- SLC22A2
## [6] ETVDDVEKLGSPHSCCKGRNKKTPVSRSHL----- SLC22A3
## [7] DTVQDLESRWAPTQKEAGIYPRKGKQTRQQEHQKYMVPLQAS AQEKNGL--- SLC22A6
## [8] ETIEDLEN-WSLRAKKPKQEPEVEKASQR-----IPLQPHGPGLGSS--- SLC22A8
## [9] DTIQDEKNER-KDPREPQKEDPRVEVTQF----- SLC22A9
## ... ..
## [15] ETIQDVERKSAPTS LQEEEMP MKQVQN----- SLC22A7
## [16] DTLQDLELGP HPRSPKSV PSEKETEAKGRTSSPGVAFVSSTYF----- SLC22A13
## [17] ESLN-----HSSQIRNKVKDMKTKETSSDDV----- SLC22A14
## [18] ETLEQM QKV KWF RSGKK---TRDSMETEENPKVLI-TAF----- SLC22A4
## [19] DTIDQMLRVKGMKHKRKT PSHTRMLKDGQERPTILKSTAF----- SLC22A5
## [20] TTWEAAKLESENE SKSSK LLLTTNNSGLEKTEAITPRDSGLGE----- SLC22A16
## [21] ETFSDLQVYSYRRLGEEALSLQALDPQQCVDKESSLGSESEEEEEFYDADEET SLC22A15
## [22] QRKDKVR----- SLC22A18
## Con ?TI?D?E?????????????????????????????????----- Consensus
##
##      aln (743..768)                                names
## [1] ----- SLC22A17
## [2] ----- SLC22A31
## [3] NGMKAM----- SLC22A23
## [4] KPWLSSTCAFDLGKAVGAIGIGYLII SLC22A1
## [5] ----- SLC22A2
## [6] ----- SLC22A3
## [7] ----- SLC22A6

```

```
## [8] ----- SLC22A8
## [9] ----- SLC22A9
## ... ...
## [15] ----- SLC22A7
## [16] ----- SLC22A13
## [17] ----- SLC22A14
## [18] ----- SLC22A4
## [19] ----- SLC22A5
## [20] ----- SLC22A16
## [21] QMIK----- SLC22A15
## [22] ----- SLC22A18
## Con ----- Consensus
```

3 Save alignment

```
## save alignment as fasta file
msaPrettyPrint(myAln, alFile="./data/SLC22AAalignmentR.fasta", output="asis", showNames="none", showLog=FALSE)

## \begin{texshade}{./data/SLC22AAalignmentR.fasta}
## \seqtype{P}
## \shadingmode{identical}
## \threshold{50}
## \showconsensus[ColdHot]{bottom}
## \shadingcolors{blues}
## \hidelogoscale
## \hidenames
## \shownumbering{right}
## \showlegend
## \end{texshade}
```

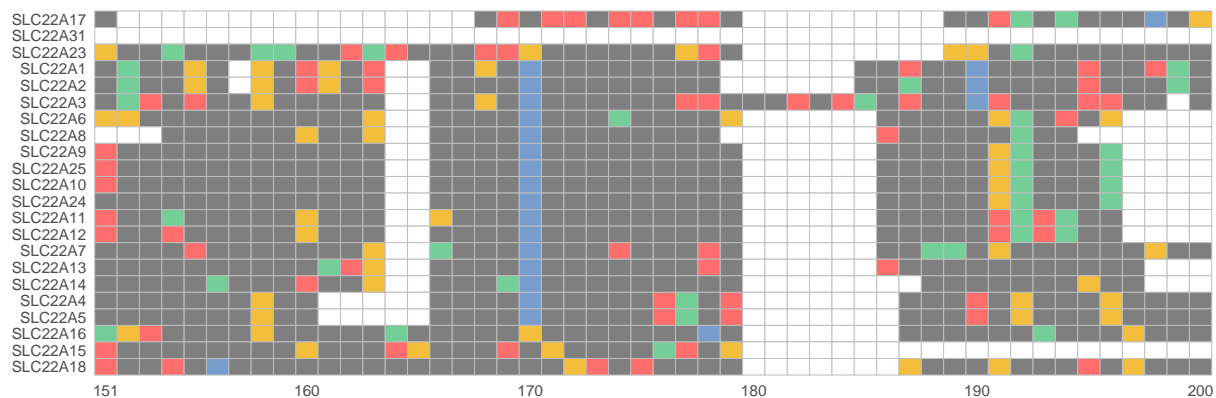
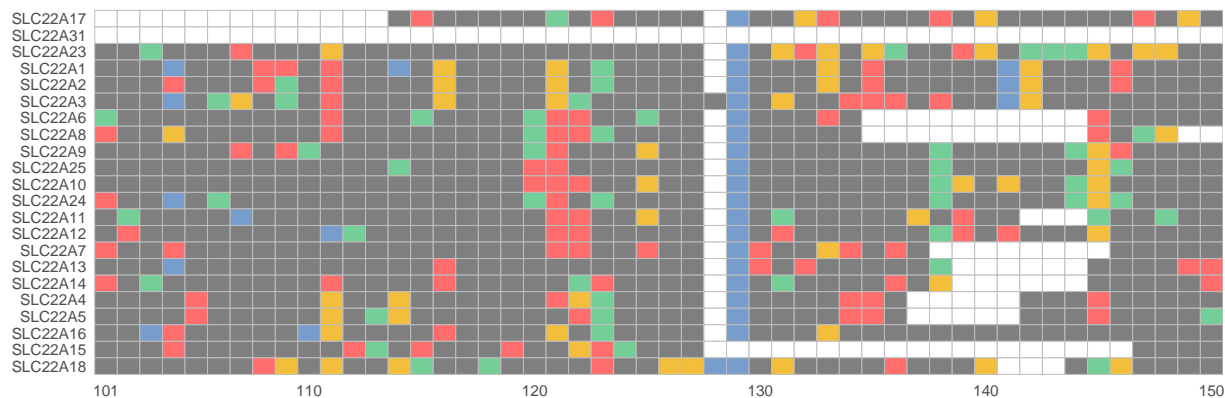
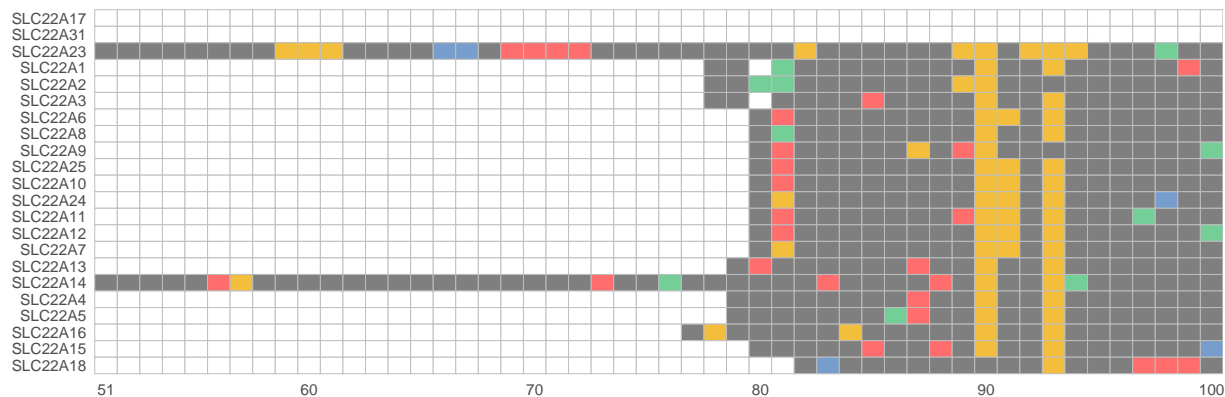
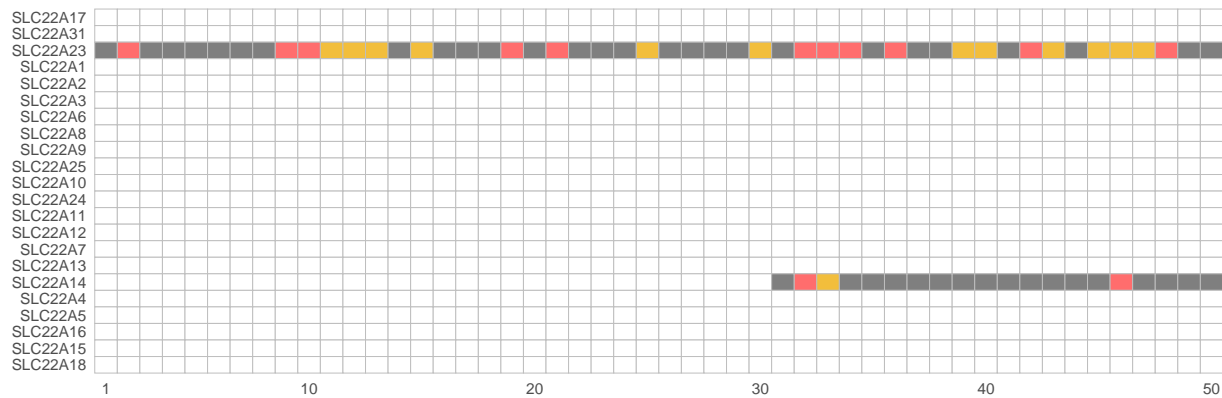
4 Load alignment

```
#load alignment file
aa_sequence <- "./data/SLC22AAalignmentR.fasta"

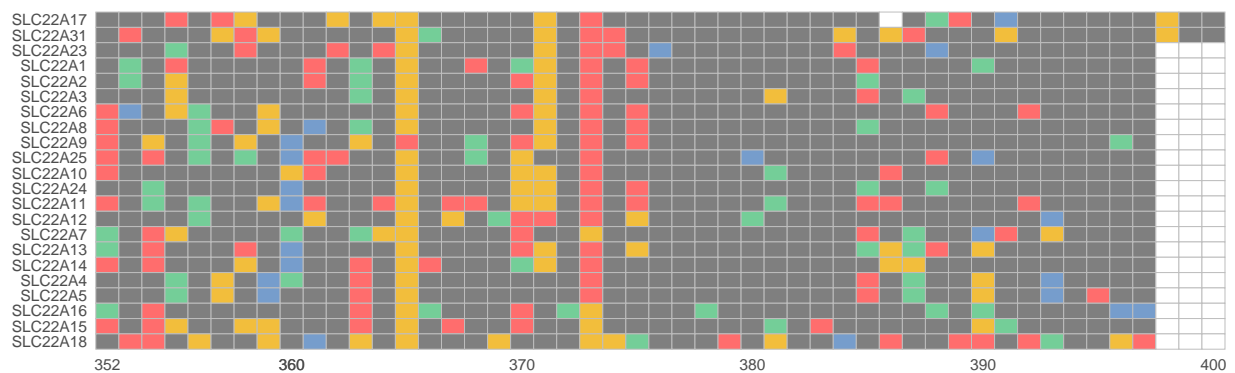
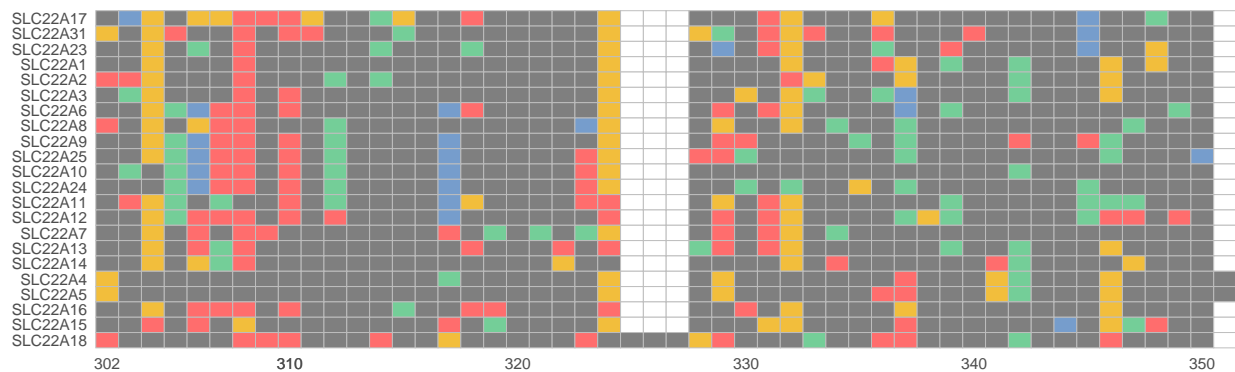
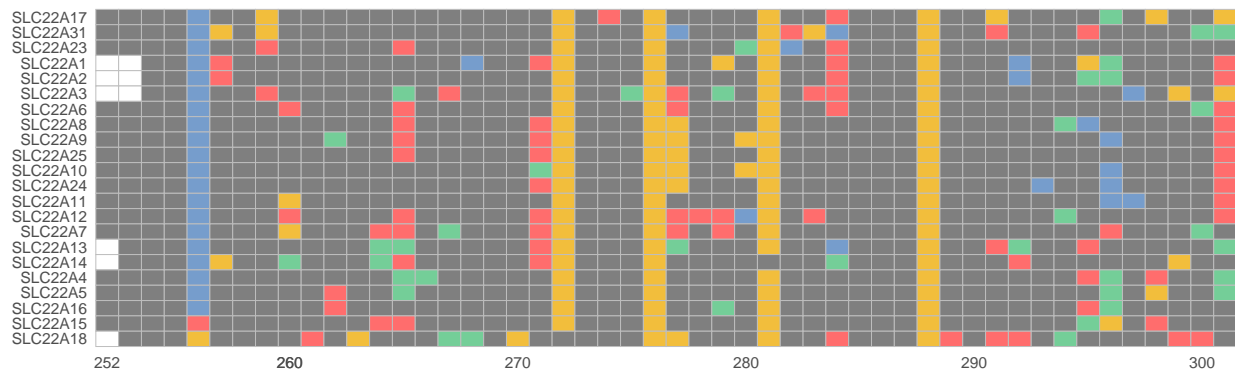
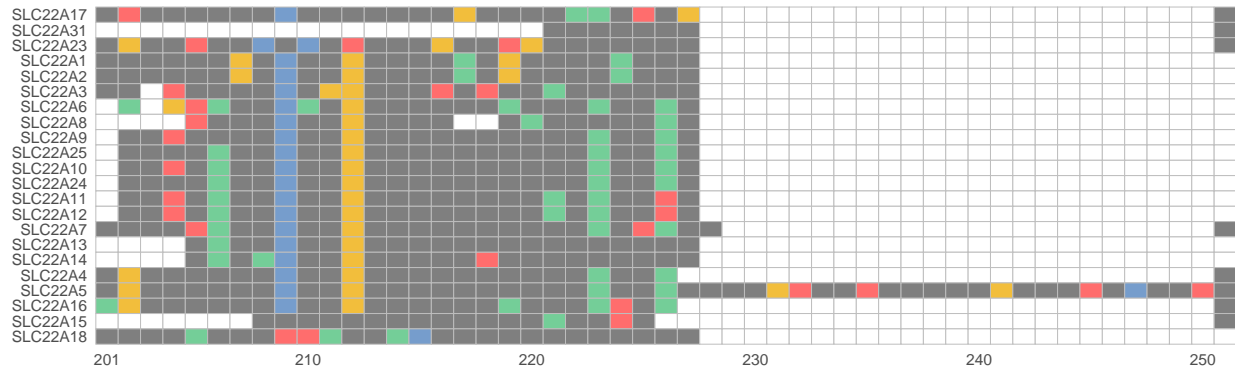
#read file
ma<- Biostrings::readAAMultipleAlignment(aa_sequence)
```

5 Plot as gmsa

```
#change start and end for desired part of the sequence
#changing field will change the length for each chunk
ggmsa(ma, start = 1, end = 200, char_width = 0.7, font = NULL, color="Chemistry_NT", seq_name = TRUE) +
```

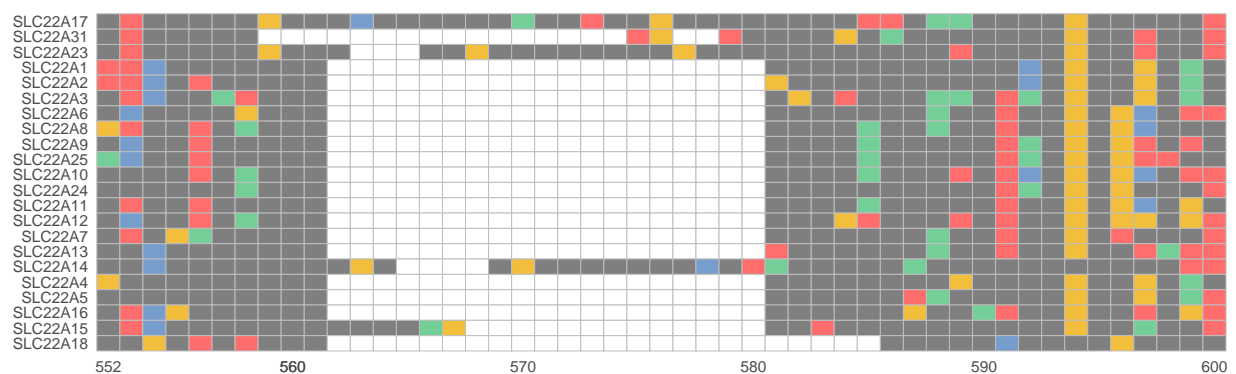
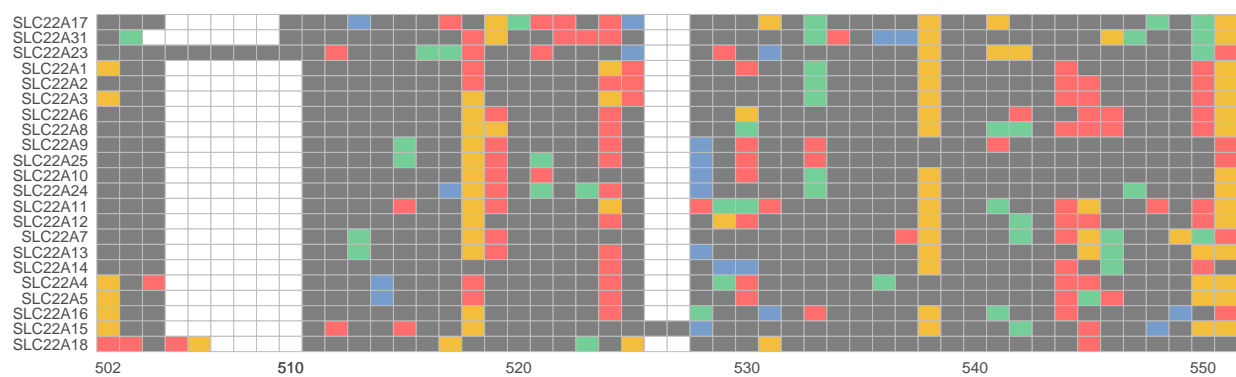
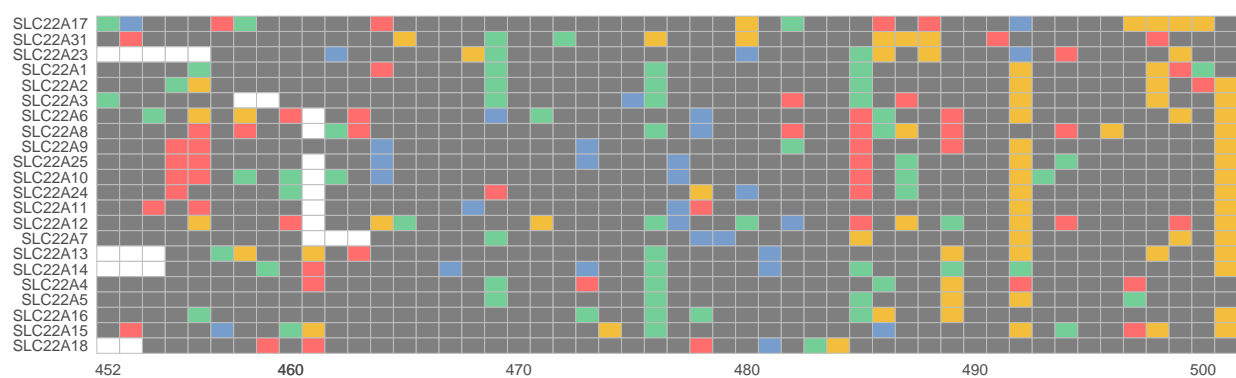
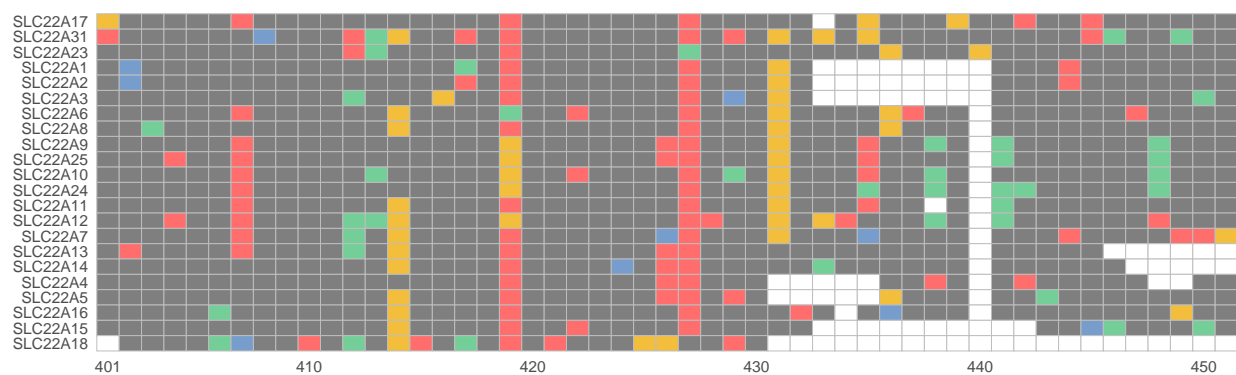



```
#change start and end for desired part of the sequence  
#changing field will change the length for each chunk  
ggmsa(ma, start = 201, end = 400, char_width = 0.7, font = NULL, color="Chemistry_NT", seq_name = TRUE)
```

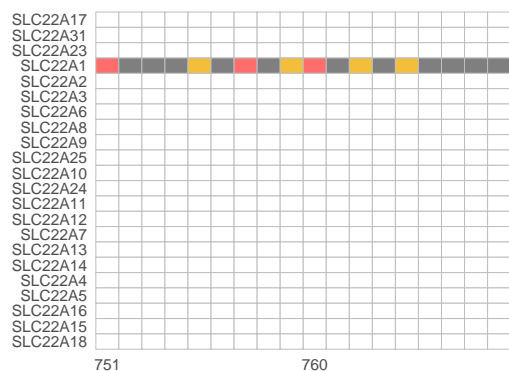
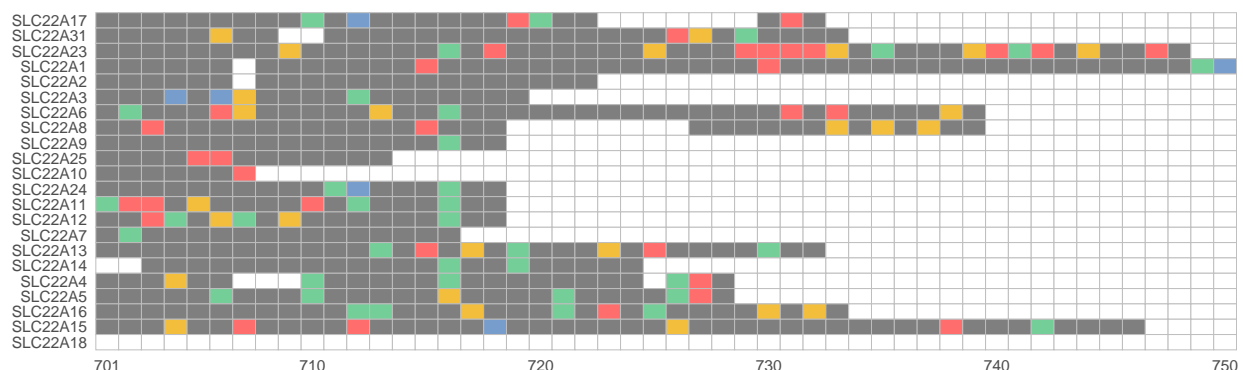
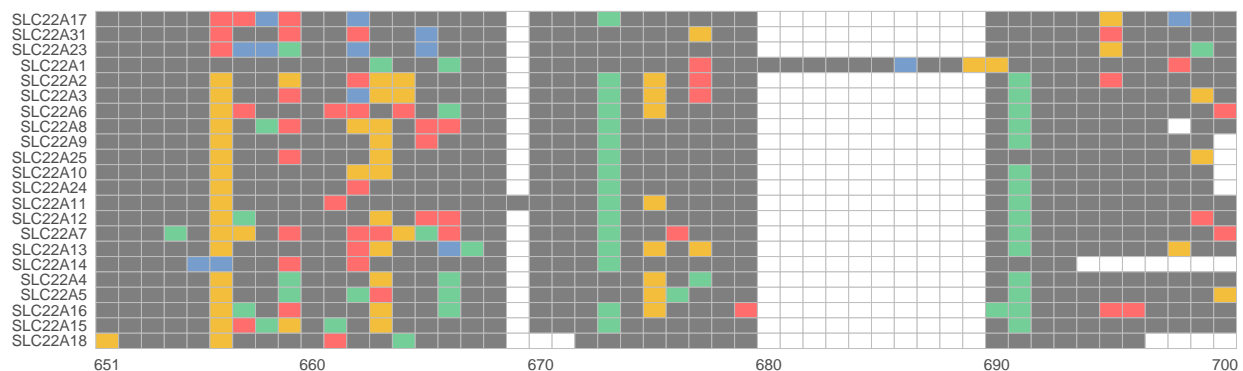
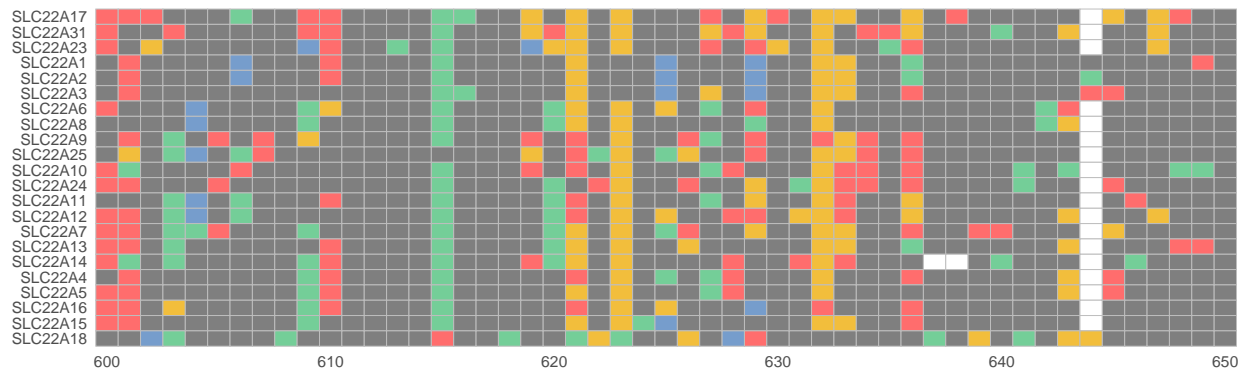


#change start and end for desired part of the sequence
#changing field will change the length for each chunk

```
ggmsa(ma, start = 401, end = 600, char_width = 0.7, font = NULL, color="Chemistry_NT", seq_name = TRUE)
```



```
#change start and end for desired part of the sequence  
#changing field will change the length for each chunk  
ggmsa(ma, start = 600, end = 800, char_width = 0.7, font = NULL, color="Chemistry_NT", seq_name = TRUE)
```



6 Plot heatmap style

```
#mention reference sequence to plot
rownames(ma)
```

```
## [1] " SLC22A17" " SLC22A31" " SLC22A23" "SLC22A1" " SLC22A2" "SLC22A3"
## [7] " SLC22A6" " SLC22A8" " SLC22A9" " SLC22A25" " SLC22A10" " SLC22A24"
## [13] " SLC22A11" " SLC22A12" " SLC22A7" " SLC22A13" " SLC22A14" "SLC22A4"
## [19] " SLC22A5" " SLC22A16" " SLC22A15" " SLC22A18"
```

```
aln = readAAMultipleAlignment(aa_sequence)
aln = unmasked(aln)
#decide the reference sequence
names(aln)[1]
```

```
## [1] " SLC22A17"
```

```
ref = aln[1]

#make the binary for where the sequences are the same as the reference
bm = sapply(1:length(aln),function(i){
  as.numeric(as.matrix(aln[i])==as.matrix(ref))
})

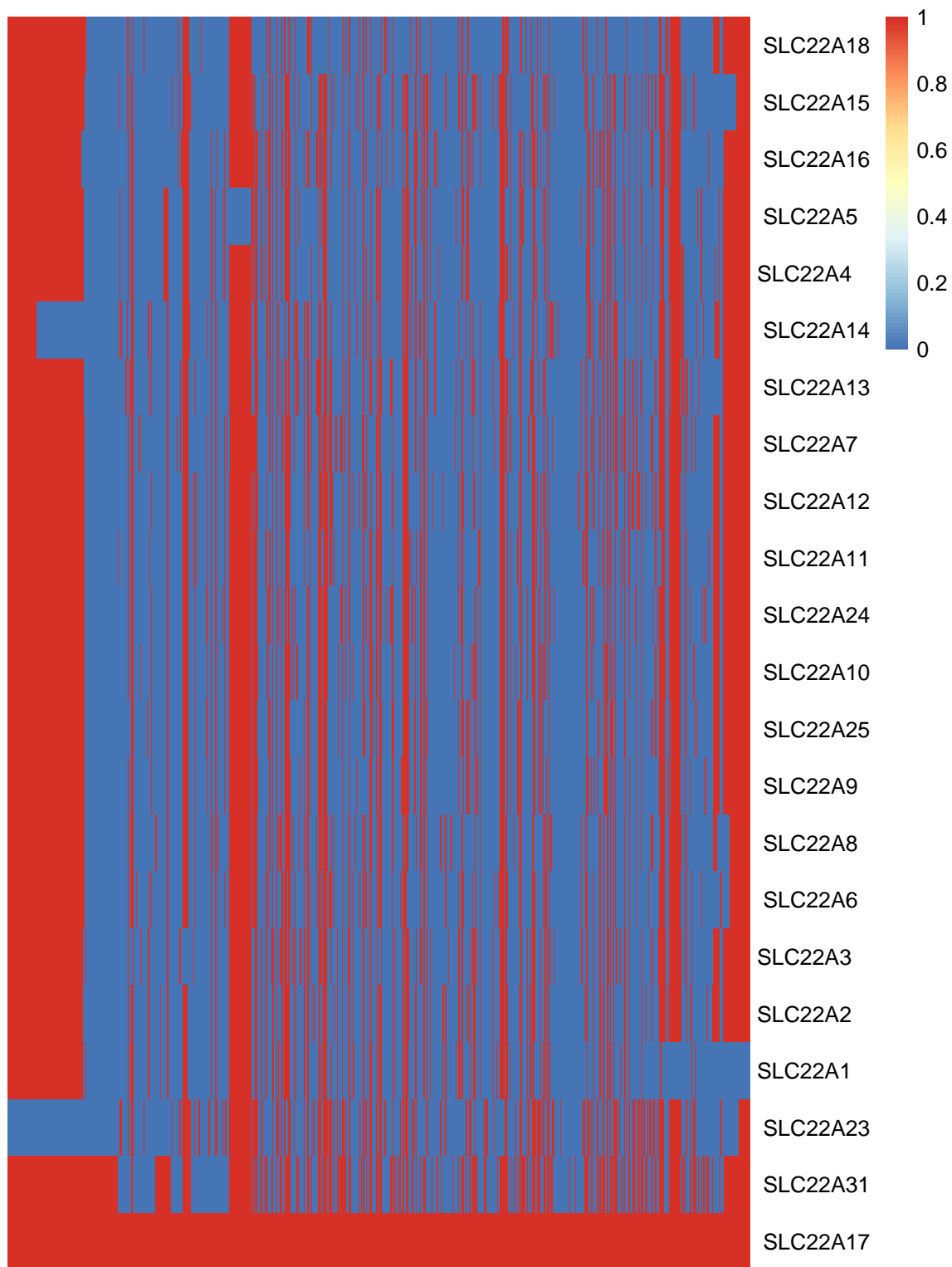
bm = t(bm)
rownames(bm) = names(aln)
```

Plotting

```
#plot heatmap
library(pheatmap)
```

```
## Warning: package 'pheatmap' was built under R version 4.1.2
```

```
#change ranges
pheatmap(bm[nrow(bm):1,1:760],cluster_rows=FALSE,cluster_cols=FALSE)
```

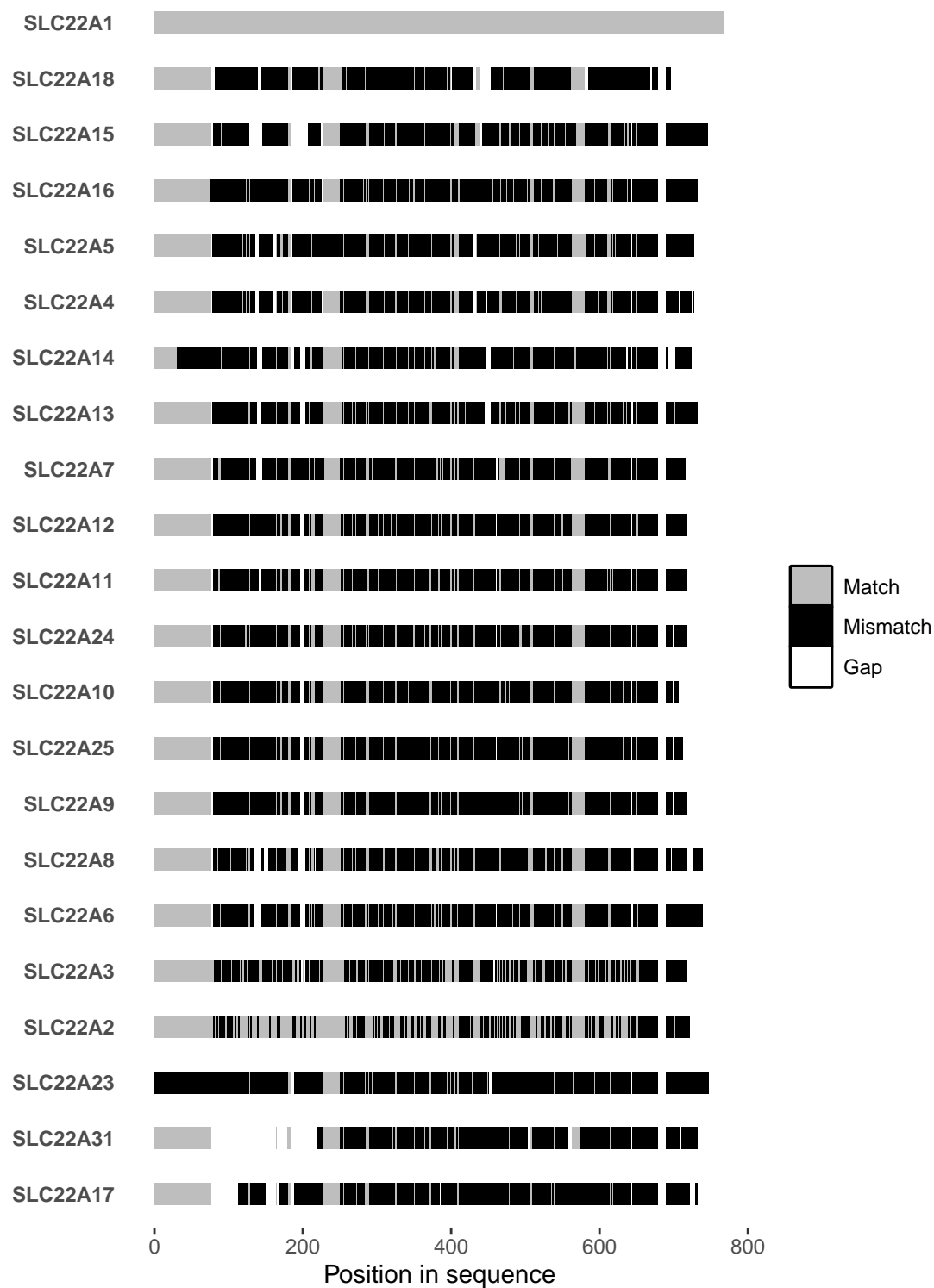


7 Bar style

```
# Plot bar style
library(seqvisr)

#load MSA file
inpmsa <- "../data/SLC22AAalignmentR.fasta"

#create plot
#mention the reference sequence
msavisr(inpmsa, "SLC22A1", refontop = TRUE, cbfcols = TRUE, basecolors = c("gray", "black", "white"))
```



```
library(seqinr)
```

```
##
## Attaching package: 'seqinr'
```

```
## The following object is masked from 'package:dplyr':
##
##     count
```

```
## The following object is masked from 'package:Biostrings':
##
##     translate
```

```
### Turn your alignment into a tree
# convert the alignment for the seqinr package
myAln2 <- msaConvert(myAln, type="seqinr::alignment")
# this object is a list object with 4 elements

# generate a distance matrix using seqinr package
d <- dist.alignment(myAln2, matrix = c("identity", "similarity"))
# have a look at the output
as.matrix(d)
```

```
##           SLC22A17 SLC22A31 SLC22A23 SLC22A1 SLC22A2 SLC22A3 SLC22A6
## SLC22A17 0.0000000 0.7647630 0.8345027 0.8928699 0.8809086 0.8692270 0.8821711
## SLC22A31 0.7647630 0.0000000 0.8178935 0.8881061 0.8628895 0.8628589 0.8775619
## SLC22A23 0.8345027 0.8178935 0.0000000 0.9041813 0.8944272 0.8892360 0.8914004
## SLC22A1  0.8928699 0.8881061 0.9041813 0.0000000 0.5856281 0.7306304 0.8549322
## SLC22A2  0.8809086 0.8628895 0.8944272 0.5856281 0.0000000 0.7012655 0.8380019
## SLC22A3  0.8692270 0.8628589 0.8892360 0.7306304 0.7012655 0.0000000 0.8347446
## SLC22A6  0.8821711 0.8775619 0.8914004 0.8549322 0.8380019 0.8347446 0.0000000
## SLC22A8  0.8841407 0.8747904 0.8836848 0.8411582 0.8243401 0.8204353 0.7071068
## SLC22A9  0.8876936 0.8944272 0.8944272 0.8923544 0.8705491 0.8819171 0.7915917
## SLC22A25 0.8862421 0.8900958 0.8993917 0.8879130 0.8743489 0.8708771 0.7882060
## SLC22A10 0.8824333 0.8751307 0.8929576 0.8801257 0.8662982 0.8449942 0.7733778
## SLC22A24 0.8783753 0.8670582 0.8942216 0.8742874 0.8638844 0.8538899 0.7726853
## SLC22A11 0.8890009 0.8793575 0.9008109 0.8662941 0.8590217 0.8554786 0.7606302
## SLC22A12 0.8831761 0.8493695 0.8995412 0.8595865 0.8598672 0.8377660 0.7414954
## SLC22A7  0.8747469 0.8566288 0.8774647 0.8608648 0.8491018 0.8339597 0.7839165
## SLC22A13 0.8759834 0.8663650 0.9037974 0.8549756 0.8489727 0.8379065 0.8112264
## SLC22A14 0.8937452 0.8823768 0.9008579 0.8781537 0.8646338 0.8513555 0.8504601
## SLC22A4  0.9069623 0.8731955 0.8960729 0.8498366 0.8297185 0.8422790 0.8595382
## SLC22A5  0.9048343 0.8697358 0.8974712 0.8462371 0.8358864 0.8419948 0.8474857
## SLC22A16 0.8948638 0.8749384 0.9128709 0.8611231 0.8583951 0.8559210 0.8655042
## SLC22A15 0.8868311 0.8747904 0.8989959 0.8687445 0.8438196 0.8439796 0.8583370
## SLC22A18 0.9358587 0.9108950 0.9475208 0.9335341 0.9313806 0.9247328 0.9251849
##           SLC22A8 SLC22A9 SLC22A25 SLC22A10 SLC22A24 SLC22A11 SLC22A12
## SLC22A17 0.8841407 0.8876936 0.8862421 0.8824333 0.8783753 0.8890009 0.8831761
## SLC22A31 0.8747904 0.8944272 0.8900958 0.8751307 0.8670582 0.8793575 0.8493695
## SLC22A23 0.8836848 0.8944272 0.8993917 0.8929576 0.8942216 0.9008109 0.8995412
## SLC22A1  0.8411582 0.8923544 0.8879130 0.8801257 0.8742874 0.8662941 0.8595865
## SLC22A2  0.8243401 0.8705491 0.8743489 0.8662982 0.8638844 0.8590217 0.8598672
## SLC22A3  0.8204353 0.8819171 0.8708771 0.8449942 0.8538899 0.8554786 0.8377660
## SLC22A6  0.7071068 0.7915917 0.7882060 0.7733778 0.7726853 0.7606302 0.7414954
## SLC22A8  0.0000000 0.7881701 0.7931350 0.7805667 0.7723930 0.7575379 0.7568215
## SLC22A9  0.7881701 0.0000000 0.5271426 0.6562651 0.6593805 0.7581672 0.7433278
## SLC22A25 0.7931350 0.5271426 0.0000000 0.6347893 0.6526559 0.7420543 0.7368593
## SLC22A10 0.7805667 0.6562651 0.6347893 0.0000000 0.6333317 0.7220909 0.7090646
```

```

## SLC22A24 0.7723930 0.6593805 0.6526559 0.6333317 0.0000000 0.7448117 0.7347483
## SLC22A11 0.7575379 0.7581672 0.7420543 0.7220909 0.7448117 0.0000000 0.6908193
## SLC22A12 0.7568215 0.7433278 0.7368593 0.7090646 0.7347483 0.6908193 0.0000000
## SLC22A7 0.7899657 0.8355526 0.8278216 0.8279487 0.8153618 0.8164966 0.8031822
## SLC22A13 0.8153293 0.8391185 0.8325754 0.8235053 0.8241204 0.8252579 0.8130490
## SLC22A14 0.8406503 0.8767226 0.8718685 0.8713756 0.8576900 0.8506518 0.8576900
## SLC22A4 0.8456455 0.8759878 0.8733890 0.8690559 0.8627635 0.8519964 0.8487934
## SLC22A5 0.8350557 0.8689661 0.8652126 0.8547223 0.8535951 0.8438895 0.8418550
## SLC22A16 0.8553989 0.8811150 0.8776221 0.8772210 0.8683884 0.8770580 0.8528029
## SLC22A15 0.8463112 0.8848940 0.8788942 0.8622264 0.8700098 0.8759329 0.8531182
## SLC22A18 0.9368229 0.9406639 0.9340608 0.9373060 0.9318911 0.9339223 0.9143481
## SLC22A7 SLC22A13 SLC22A14 SLC22A4 SLC22A5 SLC22A16 SLC22A15
## SLC22A17 0.8747469 0.8759834 0.8937452 0.9069623 0.9048343 0.8948638 0.8868311
## SLC22A31 0.8566288 0.8663650 0.8823768 0.8731955 0.8697358 0.8749384 0.8747904
## SLC22A23 0.8774647 0.9037974 0.9008579 0.8960729 0.8974712 0.9128709 0.8989959
## SLC22A1 0.8608648 0.8549756 0.8781537 0.8498366 0.8462371 0.8611231 0.8687445
## SLC22A2 0.8491018 0.8489727 0.8646338 0.8297185 0.8358864 0.8583951 0.8438196
## SLC22A3 0.8339597 0.8379065 0.8513555 0.8422790 0.8419948 0.8559210 0.8439796
## SLC22A6 0.7839165 0.8112264 0.8504601 0.8595382 0.8474857 0.8655042 0.8583370
## SLC22A8 0.7899657 0.8153293 0.8406503 0.8456455 0.8350557 0.8553989 0.8463112
## SLC22A9 0.8355526 0.8391185 0.8767226 0.8759878 0.8689661 0.8811150 0.8848940
## SLC22A25 0.8278216 0.8325754 0.8718685 0.8733890 0.8652126 0.8776221 0.8788942
## SLC22A10 0.8279487 0.8235053 0.8713756 0.8690559 0.8547223 0.8772210 0.8622264
## SLC22A24 0.8153618 0.8241204 0.8576900 0.8627635 0.8535951 0.8683884 0.8700098
## SLC22A11 0.8164966 0.8252579 0.8506518 0.8519964 0.8438895 0.8770580 0.8759329
## SLC22A12 0.8031822 0.8130490 0.8576900 0.8487934 0.8418550 0.8528029 0.8531182
## SLC22A7 0.0000000 0.8064016 0.8528029 0.8426038 0.8348808 0.8456202 0.8357109
## SLC22A13 0.8064016 0.0000000 0.7950317 0.8459497 0.8342035 0.8457709 0.8326820
## SLC22A14 0.8528029 0.7950317 0.0000000 0.8795990 0.8707223 0.8765624 0.8732557
## SLC22A4 0.8426038 0.8459497 0.8795990 0.0000000 0.4800938 0.8290191 0.8205049
## SLC22A5 0.8348808 0.8342035 0.8707223 0.4800938 0.0000000 0.8288850 0.8403723
## SLC22A16 0.8456202 0.8457709 0.8765624 0.8290191 0.8288850 0.0000000 0.8465991
## SLC22A15 0.8357109 0.8326820 0.8732557 0.8205049 0.8403723 0.8465991 0.0000000
## SLC22A18 0.9239364 0.9388240 0.9380390 0.9305126 0.9360917 0.9339462 0.9342616
## SLC22A18
## SLC22A17 0.9358587
## SLC22A31 0.9108950
## SLC22A23 0.9475208
## SLC22A1 0.9335341
## SLC22A2 0.9313806
## SLC22A3 0.9247328
## SLC22A6 0.9251849
## SLC22A8 0.9368229
## SLC22A9 0.9406639
## SLC22A25 0.9340608
## SLC22A10 0.9373060
## SLC22A24 0.9318911
## SLC22A11 0.9339223
## SLC22A12 0.9143481
## SLC22A7 0.9239364
## SLC22A13 0.9388240
## SLC22A14 0.9380390
## SLC22A4 0.9305126
## SLC22A5 0.9360917

```

```
## SLC22A16 0.9339462
## SLC22A15 0.9342616
## SLC22A18 0.0000000
```

```
# generate the tree with the ape package
# the nj() function allows neighbor-joining tree estimation
library(ape)
```

```
##
## Attaching package: 'ape'
```

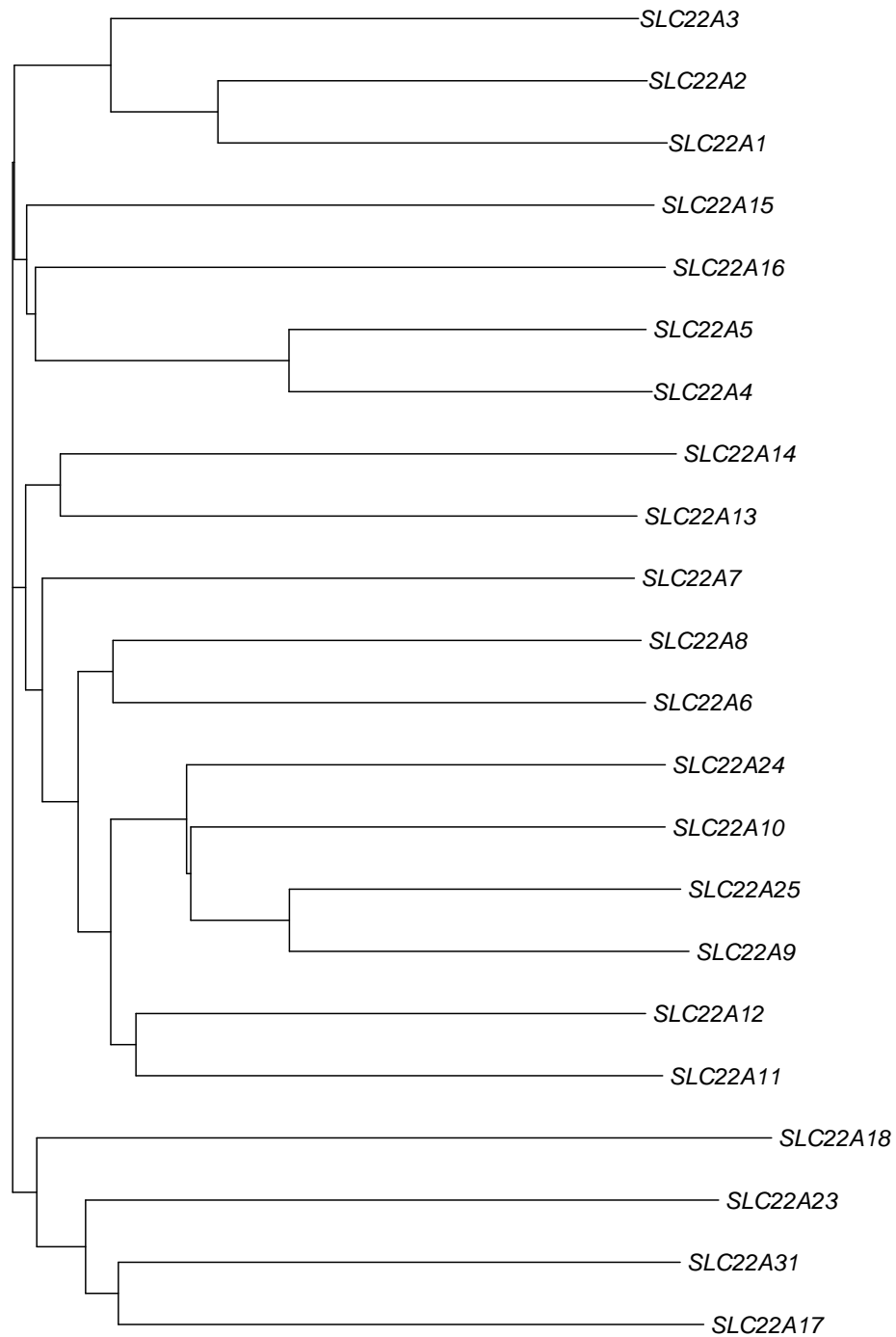
```
## The following objects are masked from 'package:seqinr':
##
## as.alignment, consensus
```

```
## The following object is masked from 'package:Biostrings':
##
## complement
```

```
myTree <- nj(d)
```

```
# plot the tree
plot(myTree, main="Phylogenetic Tree of SLC22 Sequences")
```

Phylogenetic Tree of SLC22 Sequences



8 Session Info

```
sessionInfo()
```

R version 4.1.1 (2021-08-10)

Platform: x86_64-w64-mingw32/x64 (64-bit)

Running under: Windows 10 x64 (build 18363)

Matrix products: default

locale:

```
[1] LC_COLLATE=English_United Kingdom.1252
[2] LC_CTYPE=English_United Kingdom.1252
[3] LC_MONETARY=English_United Kingdom.1252
[4] LC_NUMERIC=C
[5] LC_TIME=English_United Kingdom.1252
```

attached base packages:

```
[1] stats4    parallel  stats      graphics  grDevices  utils      datasets
[8] methods   base
```

other attached packages:

```
[1] ape_5.6-1          seqinr_4.2-8      seqvisr_0.2.5
[4] pheatmap_1.0.12    ggmsa_1.1.5       dplyr_1.0.8
[7] msa_1.24.0         Biostrings_2.60.2 GenomeInfoDb_1.28.4
[10] XVector_0.32.0     IRanges_2.26.0    S4Vectors_0.30.2
[13] BiocGenerics_0.38.0
```

loaded via a namespace (and not attached):

```
[1] viridis_0.6.2      maps_3.4.0        tidyr_1.2.0
[4] viridisLite_0.4.0  assertthat_0.2.1  highr_0.9
[7] yulab.utils_0.0.4   GenomeInfoDbData_1.2.7 yaml_2.3.5
[10] ggrepel_0.9.1      lattice_0.20-44    Rttf2pt1_1.3.10
[13] pillar_1.7.0       glue_1.6.2        extrafontdb_1.0
[16] digest_0.6.28      RColorBrewer_1.1-2 polyclip_1.10-0
[19] colorspace_2.0-3   ggfun_0.0.5       htmltools_0.5.2
[22] pkgconfig_2.0.3    zlibbioc_1.38.0    purrr_0.3.4
[25] patchwork_1.1.1    scales_1.1.1      ggplotify_0.1.0
[28] tweenr_1.0.2       ggforce_0.3.3     tibble_3.1.6
[31] generics_0.1.2     farver_2.1.0      ggplot2_3.3.5
[34] ellipsis_0.3.2     seqmagick_0.1.5   cli_3.2.0
[37] magrittr_2.0.2     crayon_1.5.0      evaluate_0.15
[40] ash_1.0-15         fansi_1.0.2       nlme_3.1-152
[43] MASS_7.3-54        tools_4.1.1       data.table_1.14.2
[46] lifecycle_1.0.1    stringr_1.4.0     aplot_0.1.2
[49] munsell_0.5.0      ade4_1.7-18       compiler_4.1.1
[52] ggalt_0.4.0        gridGraphics_0.5-1 rlang_1.0.1
[55] grid_4.1.1         RCurl_1.98-1.6    rstudioapi_0.13
[58] labeling_0.4.2     bitops_1.0-7      rmarkdown_2.11
[61] proj4_1.0-11       gtable_0.3.0      DBI_1.1.2
[64] R6_2.5.1           gridExtra_2.3     knitr_1.37
[67] fastmap_1.1.0      extrafont_0.17    utf8_1.2.2
```

[70]	KernSmooth_2.23-20	stringi_1.7.6	Rcpp_1.0.8
[73]	vctrs_0.3.8	R4RNA_1.22.0	tidyselect_1.1.2
[76]	xfun_0.29		