

All soluble NA head sequences shown below were preceded with either of the following sequences containing secretion signal, affinity tags, hVASP tetramerization domain, thrombin cleavage site and GG linker:

Only Hexa-His tag

MEFGLSWIFLAAIILKGVQCADPHHHHHSSSDYSDLQRVKQELLEEVKKELQKVKEEIEAFVQ
ELRKRGS�VPRGSGG

Both Hexa-His tag and Strep tag

MEFGLSWIFLAAIILKGVQCADPHHHHHGSAWSHPQFEKGGSSSDYSDLQRVKQELLEEVKKEL
QKVKEEIEAFVQELRKRGS�VPRGSGG

N1-CA09-WT

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAIYSKDNSVRIGSKGDVFVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSCPIGEVPSPYNSRFESVAWSASACHDGINWLTIGISGPDNGAVAVLKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGPNSGQASYKIFRIEKGKIVKSVEMNAPNY
HYEECSYCPDSSEITCVCRDNWHGNSRNPVVSFNQNLQYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGFSYKYGNVWIGRTKSISSRNGFEMIWDPNGWGTGTDNNFSIKQDIVGINEWSGY
SGSFVQHPELTGLDCIRPCFWVELIRGRPKENTIWTSGSSISFCGVNSDTVGSWPDGAELPFT
IDK

N1-MI15-WT

H1N1 A/Michigan/45/2015

VKLAGNSSLCPVSGWAIYSKDNSVRIGSKGDVFVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSCPIGEVPSPYNSRFESVAWSASACHDGINWLTIGISGPDNGAVAVLKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTIMTDGSPDQASYKIFRIEKGKIIKSVEMKAPNY
HYEECSYCPDSSEITCVCRDNWHGNSRNPVVSFNQNLQYQMGYICSGVFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRKGFEIWDPNGWGTGTDNKFSIKQDIVGINEWSGY
SGSFVQHPELTGLDCIRPCFWVELIRGRPEENTIWTSGSSISFCGVNSDTVGSWPDGAELPFT
IDK

N1-NC99-WT

H1N1 A/New_Caledonia/20/1999

VTLAGNSSLCSISGWAIYTKDNSIRIGSKGDVFVIREPFISCSHLECRTFFLTQGALLNDKHSN
GTVKDRSPYRALMSCPGEAPSPYNSKRFESVAWSASACHDGMGWLTIIGISGPDNGAVAVLKYNG
IITETIKSWKKRILRTQESEACVNGSCFTIMTDGPNSGAASYKIFKIEKGKVTKSIELNAPNF
HYEECSYCPDTGTVMCVCRDNWHGNSRNPVVSFNQNLQYQIGYICSGVFGDNPRPKDGECSNPV
TVDGADGVKGFSYKYGNVWIGRTKSNRLRKGFEIWDPNGWTDTDSDFSVKQDVVAITDWSGY
SGSFVQHPELTGLDCIRPCFWVELVRGLPRENTTIWTSGSSISFCGVNSDTANWSWPDGAELPF
TIDK

N1-WSN33-WT

H1N1 A/WSN/1933

VILTGNSSLCPIRGWAIHSDKNGIRIGSKGDVFVIREPFISCSHLECRTFFLTQGALLNDKHSR
GTFKDRSPYRALMSCPVGEAPSPYNSRFESVAWSASACHDGMGWLTIIGISGPDNGAVAVLKYNR
IITETIKSWRKNILRTQESECTCVNGSCFTIMTDGPDGLASYKIFKIEKGKVTKSIELNAPNS

HYEESCYPDTGKVMCVCRDNWHGSRNPWVSFDQNLDYKIGYICSGVFGDNPRPKDGTGSCGPV
SADGANGVKGFYSYKYGNVWIGRTKSDSSRHGFEMIWDPNGWTEETDSRFSMRQDVVAITNRSY
SGSFVQHPELTGLDCMRPCFWVELIRGLPEEDAIWTSGSIISFCGVNSDVTVDWSWPDGAELPFT
IDK

N1-BV18-WT

H1N1 A/Brevig_Mission/1/1918

VILTGNSSLCPIISGWAIYSKDNIGIRIGSKGDVFIREFPFISSSHLECRTFFLTQGALLNDKHSN
GTVKDRSPYRTLMSCPVGEAPSPYNSRFESVAWSASACHDGMWLTIGISGPDNGAVAVLKYNG
IITDTIKSWRNNILRTQESEECACVNGSCFTIMTDGPSNGQASYKILKIEKGVTKSIELNAPNY
HYEESCYPDTGKVMCVCRDNWHGSRNPWVSFDQNLDYQIGYICSGVFGDNPRPNDGTGSCGPV
SSNGANGIKGFSEFRYDNGVWIGRTKSTSSRSGFEMIWDPNGWTEETDSSFSVRQDIVAITDWSY
SGSFVQHPELTGLDCMRPCFWVELIRGQPKENTIWTSGSSISFCGVNSDVTGWSWPDGAELPFS
IDK

N1-VN04-WT

H5N1 A/Vietnam/1203/2004

VKLAGNSSLCPINGWAVYSKDNSIRIGSKGDVFIREFPFISSSHLECRTFFLTQGALLNDKHSN
GTVKDRSPHRTLMSCPVGEAPSPYNSRFESVAWSASACHDGTSWLTIGISGPDNGAVAVLKYNG
IITDTIKSWRNNILRTQESEECACVNGSCFTVMTDGPSNGQASYKIFKMEKGVVKSVELDAPNY
HYEESCYPNAGEITCVCRDNWHGSRNPWVSFNQNLLEYQIGYICSGVFGDNPRPNDGTGSCGPV
SSNGAYGVKGFSEFKYGNVWIGRTKSTNSRSGFEMIWDPNGWTEETDSSFSVKQDIVAITDWSY
SGSFVQHPELTGLDCIRPCFWVELIRGRPKESTIWTSGSSISFCGVNSDVTGWSWPDGAELPFT
IDK

N6-SI14-WT

H5N6 A/Sichuan/26221/2014

HLLNLTkPLCEVNSWHILSKDNAIRIGEDAHIIVTREPYLSCDPQGCRMFALSQGTTLRGKHAN
GTIHDRSPFRALVSWEMGQAPSPYNTRVECIGWSSTSCHDGISRMSICISGPNNNASAVVWYGG
RPVTEIPSWAGNILRTQESEECVCHGGICPVVMTDGPANNRAETKIIFYFKEGKIKKIEELKGDAQ
HIEESCYPGASEMIKICRDNWKGANRPVITIDPEMMTHTSKYLCSKILTDTSRPNPDTNGKCE
APITGGSPDPGVKGFALDGENSWLGRITISKDSRSGYEMLKVPNAETDTQSGAISHQIIVNNQN
WSGYSGAFIDYWANKECFNPCFYVELIRGRPKESSVLWTSNSIVALCGSKERLGSWSWHDGAEI
IYFK

N2-MO99-WT

H3N2 A/Moscow/10/1999

EYRNWSKPQCNIITGFAPFSKDNSIRLSAGGDIWVTREPYSVCDPDKCYQFALGQGTTLNNGHSN
DTVHDRTPYRTLMLNELGVPFHLGKQVCIWSSSSSCHDGGKAWLHVCVTGDDENATASFIYNGR
LVDSIGSWSKKILRTQESECVINGTCTVVMTDGASGKADTKILFIEEGKIVHTSPLSGSAQH
VEESCYPYRPGVRCVCRDNWKGSRNPVIDINVKDYSIVSSYVCSGLVGDTPRKNDSSSSSHCL
DPNNEEGGHGVKGFADDDGNDVVMGRTISEKLRSYETFKVIEGWSKPNKQLQINRQVIIVDRGN
RSGYSGIFSVKSCINRCFYVELIRGRKQETEVLTWTSNSIVVFCGTSGTGTGWSWPDGADINL
MPI

N4-DB16-WT

H10N4 A/Red_knot/Delaware_Bay/310/2016

VHYSSGRDLCPIRGWAPLSKDNIGIRIGSRGEVFIREFPFISSISECRTFFLTQGALLNDKHSN
GTVKDRSPFRTLMSPIGVAPSPNSRFESVAWSATACSDGPGWLTGIGITGPDSTAVAVLKYNG
IITDTLKSWKGNIMRTQESEECVCQDEFQCYTLVTDGSPDAQAFYKILKIRKGIIVSMKDVDATGF
HFEECSCYPSGTEIECVCRDNWRGSRNPWIRFNSDLDYQIGYVCSGIFGDNPRPVDGTGSCNGP
VNNGKGRYGVKGFSGFRYGDGVWIGRTKSLESRSGFEMVWDANGWVSTDKDSNGVQDIIDNDNWS
GYSGSFSIRGETTGKNCTVPCFWVEMIRGQPKEKTIWTSGSSIAFCGVNSDTTGWSWPDGALLP
FDIDK

N7-NE03-WT

H7N7 A/Netherlands/219/03

SYLLLNKSLCNVEGWVVIKDNVAVRFGSESEQIIVTREPYPVSCDPTGCKMYALHQGTTIRNKHSN
GTIHDRTAFRGLISTPLGTPPTVSNDFMVCVGSSTTCHDGIARMTICIQGNNDNATATVYYNR
RLTTTIKTWARNILRTQESEECVCHNGTCAVVMTDGSASSQAYTKVMYFHKGLVVKEEELRGSAR
HIEECSCYGHNQKVTVCVCRDNWQGANRPIIEIDMSTLEHTSRVCTGILTDTSRPGDKSSGDCS
NPITGSPGVPVKGFGFLNGDNTWLGRTISPRSRSGFEMLKI PNAGTDPNSRIAERQEIVDNNN
WSGYSGSFIDYWNDNSECYNPCFYVELIRGRPEEAKYVWWASNSLIALCGSPFPVGSFSFPDGA
QIQYFS

N8-JD13-WT

H10N8 A/Jiangxi-Donghu/346-2/2013

HFMNTEALCDAKGFAPFSKDNIGIRIGSRGHVFIREFVSCSPTECRTFFLTQGSLLNDKHSN
GTVKDRSPYRTLMSVEIGQSPNVYQARFEAVAWSATAHDGKRWMTIGVTGPDAKAVAVVHYGG
IPTDVINSWAGDILRTQESSCTCIQGEFCFWVMTDGPANRQAQYRAFKAQKQKIVGQAEISFNGG
HIEECSCYPNEGKVECVCKDNWTGTNRVPLVISPDLVSYRVGYLCAGLPSDTPRGEDSQFTGSCT
SPMGNQGYGVKGFGRQGNVWGMRTISRTSRSGFEILKVRNGWVQNSKEQIKRQVVVDNLNWS
GYSGSFTLPAELTKRNCLVPCFWVEMIRGNPEEKTIWTSSSSIVMCGVDHEIADWSWHDGAILP
FDIDKM

N9-AN13-WT

H7N9 A/Anhui/1/2013

NFNNLTKGLCTINSWHIYGKDNVAVRIGESSDVLVTREPYPVSCDPDECFYALSQGTIRGKHSN
GTIHDRSQYRALISWPLSSPPTVYNSRVEICIGWSSTSCHDGGKSRMSICISGPNNNASAVVWYNR
RPVAEINTWARNILRTQESEECVCHNGVCPVVFTDGSATGPADTRIYYFKEGKILKWESLTGTAK
HIEECSCYGERTGITCTCRDNWQGSNRPIQIDPVAMTHTSQYICSPVLTNDNRPNDPNIGKCN
DPYPGNNNNGVKGFSYLDGANTWLGRTISTASRSGYEMLKVPNALTDDRSKPIQGQTIVLNADW
SGYSGSFMDYWAEGDCYRACFYVELIRGRPKEDKVVWTSNSIVSMCSSTEFLGQWNWPDGAKIE
YFL

N2-WI05-WT

H3N2 A/Wisconsin/67/2005

EYRNWSKPQCNIITGFAPFSKDNSIRLSAGGDIWVTREPYPVSCDPDKCYQFALGQGTTLNNVHSN
DTVHDRTPYRLLMNELGVPFHLGTKQVCIAWSSSSCHDGGKAWLHVCVTGDDKNATASFIYNGR
LVDSIVSWSKEILRTQESEECVINGTCTVVMTDGSASGKADTKILFIEEGKIVHTSTLSGSAQH

VEECSCYPRYLGVRCVCRDNWKGSNRP IVDINIKDYSIVSSYVCSGLVGDTPRKNDS SSSSHCL
DPNNEEGGHGVKGWAFDDGNDVWMGRTISEKLRSGYETFKVI EGWSNPNSKLQINRQVI VDRGN
RSGYSGIFSVEGKSCINRCFYVELIRGRKEETEVLWTSNSI VVFCGTSGT YGTGSWPDGADINL
MPI

N2-IN11-WT

H3N2 A/Indiana/10/2011

EYRNWSKPQCNI TGFAPFSKDNSIRLSAGGDIWVTREPYVSCDPDKCYQFALGQGTTLNNGHSN
NTVHDRTPYR TLLMNELGVPFHLGTRQVCMAWSSSSSCHD GKAWLHVCITGNDNNATASFIYNGR
LVDSIGSWSKNILRTQESECV CINGTCTVVM TDGSASGKADTKILFVEEGKIVHISTLSGSAQH
VEECSCYPRFPGVRCVCRDNWKGSNRP IVDINVKNYSIVSSYVCSGLVGDTPRKS DSVSSSYCL
DPNNEKGGHGVKGWAFDDGNDVWMGRTINETLRLGYETFKVI EGWSKANSKLQTNRQVI VEKGD
RSGYSGIFSVEGKSCINRCFYVELIRGRKEETKVWWT SNSI VVFCGTSGT YGTGSWPDGADINL
MPI

N3-MI06-WT

H2N3 A/Swine/Missouri/2124514/2006

EEERPFSPLPLCPFRGFFPFHKDNAIRLGENKDVI VITREPYVSCDNDNCWSFALAQGALLGTK
HSNGTIKDRTPYRSLIRFPIGTAPVLGNYKEICIAWSSSSSCFDGKEWMHVCMTGNDNDASAQII
YGGRMTDSIKSWRKDILRTQESECCIDGTCVVA VTDGPAANSADYRVYWI REGKIIKYENVPK
TKIQHLEECSCYVDIDVYICIRDNWKGSNRPW MRINNETILETGYVCSKFHSDTPRPADPSTMS
CDSPSNVNGGPGVKGFGFKAGDDVWLGR TVSTSGRSGFEI IKVTEGWINS PNHVKSITQTLVSN
NDWSGYSGSFIVKAKDCFQPCFYVELIRGRPNKNDDVSWT SNSI VTFCLDNEPGSGNWP DGSN
IGFMPK

N5-DB16-WT

H10N5 A/Shorebird/Delaware_Bay/309/2016

EFLNNT EPLCNVSGFAIVSKDN GIRIGSRGHV FVIREPFVACGPTECRTFFLTQGALLNDKHSN
NTVKDRSPYRALMSVPLGSSPNAYQAKFESVAWSATA CHDGKRWLAVGISGADDDAYAVIHYGG
MPTDVVRSWRKQILRTQESSCVC MKGNCYWVMTDGPANSQASYKIFKSHKGMVTNEREV SFQGG
HIEECSCYPNLGKVECVCRDNWNGMNR PVLTFDEDLN YEVGYLCAGIPTDTPRVQDNSFIGSCT
NAVGGSGTNNYGVKGFGFRQGN SVWAGRTVSISSRSGFEI LLVEDGWVKTSKNVVKKVEVLNNK
NWSGYSGAFTIPI TMTSKQCLVPCFWLEMIRGKPEERTS IWTSSSSTVFCGVSSEVPGWSWDDG
AILPFDIDKM

B-CO17-WT

B-Victoria B/Colorado/06/2017

PEPEWTPRLS CPGSTFQKALLISPHRFGETKGN SAPLI IREPFVACGPNECKHFAL THYAAQP
GGYYNGTRGDRNKL RHLISVKLGKI PTVENSIFHMAAWSGSACHDGKEWTYIGVDGPDNNALLK
VKYGEAYTD TYHSYANNILRTQESACNCIGGNCYLMI TDGSASGVSECRFLKIREGR I I KEIFP
TGRVKHTEECTCGFASNK TIECACRDNRYTAKRPFVKLN VETDTAEIRLMCTDTYLDTPRPNDG
SITGPCESDGDKGS GGIKGGFVHQRMKSKI GRWYSRTMSQ TERMGMGLYVKYGGDPWADSDALA
FSGVMVSMKEPGWYSFGFEI KDKKCDVPCIGIEMVHDGGKETW HSAATAIYCLMGSGQLLWDTV
TGVDMAL

B-PH13-WT

B-Yamagata B/Phuket/3073/2013

PEPEWTPRLSCLPGSTFQKALLISPHRFGETKGNAPLI IREPFACGPKECKHFALTHYAAQP
GGYYNGTREDNRNKLRLHLSVVKLGKIPTVENSIFHMAAWSGSACHDGREWTYIGVDGPDSNALLK
IKYGEAYTDYHSYAKNILRTQESACNCIGGDCYLMI TDGPASGISECRFLKIREGRI I KEIFP
TGRVKHTEECTCGFASNKTIECACRDNSYAKRPFVVKLVNVEDTAEIRLMCTKTYLDTPRPNDG
SITGPCESDGDEGSGGIKGGFVHQRMASKIGRWYSRTMSKTKRMGMGLYVKYDGPWTDSEALA
LSGVMVSMEEPGWYSFGFEIKDKKCDVPCIGIEMVHDGGKTTWHSATAIYCLMGSGQLLWDTV
TGVNMTL

N9-AN13-Y170H

H7N9 A/Anhui/1/2013

NFNNTLTKGLCTINSWHIYGKDNAVRIGESSDVLVTREPYVSCDPDECRFYALSQGTTRGKHSN
GTIHDRSQYRALISWPLSSPPTVHNSRVEICIGWSSTSCHDGGKSRMSICISGPNNNASAVVWYNR
RPVAEINTWARNILRTQESECVCHNGVCPVVFVDGSAATGPADTRIYYFKEGKILKWESLTGTAK
HIEECSCYGERGTGITCTCRDNWQGSNRPIQIDPVAMTHTSQYICSPVLTDNPRPNDPNIGKCN
DPYPGNNGVKGFSYLDGANTWLGRTISTASRSGYEMLKVPNALTDDRSPKIQGQTIVLNADW
SGYSGSFMDYWAEGDCYRACFYVELIRGRPKEDKVVWTSNSIVSMCSSTEFLGQWNWPDGAKIE
YFL

N1-CA09-WT + Stalk

H1N1 A/California/07/2009

SHSIQLGNQNQIETCNQSVITYENNTWVNQTYVNI SNTNFAAGQSVVSVKLAGNSSLCPVSGWA
IYSKDNSVRIGSKGDVFIREFPISCSPLECRTFFLTQGALLNDKHSNGTIKDRSPYRTLMSCP
IGEVPSPYNSRFESVAWSASACHDGINWLTIGISGPDNGAVAVLKYNGIITDTIKSWRNNILRT
QESECACVNGSCFTVMTDGPNSGQASYKIFRIEKGKIVKSVEMNAPNYHYEECSYCPDSSEITC
VCRDNWHGNSRNPWVSFNQNLQYQIGYICSGIFGDNPRPNDKTGSCGPVSSNGANGVKGFSYKYG
NGVWIGRTKSISSRNGFEMIWDPNGWTGTDNNFSIKQDIVGINEWSGYSGSFVQHPPELTGLDCI
RPCFWVELIRGRPKENTIWTSGSSISFCGVNSDTVGSWPDGAELPFTIDK

N1-CA09-sNAp-94

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGEVFIREFPISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSCPIGSVSPSNSRFESVAWSASACHDGINWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESECACVNGSCFTVMTDGPNSGQASYKIFRIEKGKIVKSVEMNAPNY
HYEECSYCPDSSEITCVCRDNWHGNSRNPWVSFNQNLQYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRNGFEMIWDPNGWTGTDNNFSIKQDIVGINEWSGY
SGSFVMHPPELTGLDCIVPCFWVELIRGRPKENTIWTSGSSISFCGVNSDTTGSWPDGAELPFT
IDK

N1-CA09-sNAp-114

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGEVFIREFPISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSCPIGSVSPSNSRFESIAWSASACHDGINWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESECACVNGSCFTVMTDGPNSGQASYKIFRIEKGKIVKSVEMNAPNY

HYEESCYPDSSEITCVCRDNWHGSRNPVVSFNQNLEYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRNGFEMIWDPNGWGTGTDNNFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRP KENTIWTSGSSISFCGVNSDTTGWSWPDGAELPFT
IDK

N1-CA09-sNAp-130

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDV FVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSVPSYNARFESIAWSASACHDGINWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGP SNGQASYKIFRIEKGKIVKSVEMNAPNY
HYEESCYPDSSEITCVCRDNWHGSRNPVVSFNQNLEYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRNGFEMIWDPNGWGTGTDNNFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRP KENTIWTSGSSISFCGVNSDTTGWSWPDGAELPFT
IDK

N1-CA09-sNAp-155

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDV FVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSVPSYNARFESIAWSASACHDGINWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGP SNGQASYKIFRIEKGKIVKSVEMNAPNY
HYEESCYPDSSEITCVCRDNWHGSRNPVVSFNQNLEYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRNGFEMIWDPNGWGTGTDNNFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRP KENTIWTSGSSISFCGVNSDTVGWSWPDGAELPFT
IDK

N1-CA09-sNAp-131

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAPYSKDNSVRIGSKGDV FVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSVPSYNARFESIAWSASACHDGINWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGP SNGQASYKIFRIEKGKIVKSVEMNAPNY
HYEESCYPDSSEITCVCRDNWHGSRNPVVSFNQNLEYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRNGFEMIWDPNGWGTGTDNNFSIKQDIVGINEWSGY
SGSFVQHPELTGLDCIRPCFWVELIRGRP KENTIWTSGSSISFCGVNSDTTGWSWPDGAELPFT
IDK

N1-CA09-sNAp-134

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDV FVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGEVPSYNARFESIAWSASACHDGINWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGP SNGQASYKIFRIEKGKIVKSVEMNAPNY
HYEESCYPDSSEITCVCRDNWHGSRNPVVSFNQNLEYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRNGFEMIWDPNGWGTGTDNNFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRP KENTIWTSGSSISFCGVNSDTVGWSWPDGAELPFT
IDK

N1-CA09-sNAp-130 + Stalk
H1N1 A/California/07/2009

SHSIQLGNQNQIETCNQSVITYENNTWVNQTYVNI SNTNFAAGQSVVSVKLAGNSSLCPVSGWA
PLSKDNSVRIGSKGDVVFVIREPFISCSPLECRTFFLTQGALLNDKHSNGTIKDRSPYRTLMSVP
IGSVPSYPYNARFESIAWSASACHDGINWLTIGITGPDNGAVAILKYNGIITDTIKSWRNNILRT
QESECACVNGSCFTVMTDGPSNGQASYKIFRIEKGKIVKSVEMNAPNYHYEECSYCPDSSEITC
VCRDNWHGSNRPPWVSFNQNLLEYQIGYICSGIFGDNPRPNDKTGSCGPVSSNGANGVKGF SFKYG
NGVWIGRTKSISSRNGFEMIWDPNGWTGTDNNFSIKQDIVGINESGYSGSFVMHPELTGLDCI
VPCFWVELIRGRPKENTIWTSGSSISFCGVNSD'TTGWSWPDGAELPFTIDK

N8-JD13-sNAp-282
H10N8 A/Jiangxi-Donghu/346-2/2013

HFMNNTREALCDAKGFAPFSKDNIGIRIGSRGHVVFVIREPFVSCSPTECRTFFLTQGSLLNDKHSN
GTVKDRSPYRTLMSVEIGSSPNVYQARFEAVAWSATA CHDGKKWMTIGVTGPDAKAVAVVHYGG
IPTDVINSWAGDILRTQESSCTCIQGE CFWVMTDGPANRQAQYRAFKAKQGGKIVGQAEISFNNG
HIEECSCYPNEGKVECVCKDNWTGTNRPVLVISPDLSYRVGYLCAGLPDTPRGEDSQFTGSCT
SPMGNQGYGVKGFGRQGNVWVGRTISRSTRSGFEILKVRNGWVQNSKEQIKRQVVVDNLNWS
GYSGSFTLPAELTKRNCLVPCFWVEMIRGNPEEKT IWTSSSSIVMCGVDHEIADWSWHDGAILP
FDIDKM

N8-JD13-sNAp-285
H10N8 A/Jiangxi-Donghu/346-2/2013

HFMNNTREALCDAKGFAPFSKDNIGIRIGSRGHVVFVIREPFVSCSPTECRTFFLTQGSLLNDKHSN
GTVKDRSPYRTLMSVPIGSSPNVYQARFEAVAWSATA CHDGKKWMTIGVTGPDAKAVAVVHYGG
IPTDVINSWAGDILRTQESSCTCIQGE CFWVMTDGPANRQAQYRAFKAKQGGKIVGQAEISFNNG
HIEECSCYPNEGKVECVCKDNWTGTNRPVLVISPDLSYRVGYLCAGLPDTPRGEDSQFTGSCT
SPMGNQGYGVKGFGRQGNVWVGRTISRSTRSGFEILKVRNGWVQNSKEQIKRQVVVDNLNWS
GYSGSFTLPAELTKRNCLVPCFWVEMIRGNPEEKT IWTSSSSIVMCGVDHEIADWSWHDGAILP
FDIDKM

N2-WI05-desNAp-156
H3N2 A/Wisconsin/67/2005

EYRNWSKPQCNI TGFAPFSKDNSIRLSAGGDIWVTREPYVSCDPDKCYQFALGQGTTLNNVHSN
DTVHDRTPYRTLLMNELGEPFHLGTKQVCIAWSSSSCHDGKAWLHVCVGTGDDKNATASF IYNGR
LVDSIVSWSKEILRTQESECVCINGTCTVVM TDGSASGKADTKILFIEEGKIVHTSTLSGSAQH
VEECSCYPRYLGVRVCVCRDNWKGSNRP IVDINIKDYSIVSSYVCSGLVGDTPRKNDS SSSSHCL
DPNNEEGGHGVKGWAFDDGNDVWVGRTISEKLRSGYETFKVIEGWSNPNSKLQINRQVIVDRGN
RSGYSGIFSVGKSCINRCFYVELIRGRKEETEVLWTSNSIVVFCGTSGT YGTGSWPDGADINL
MPI

N2-WI05-desNAp-157
H3N2 A/Wisconsin/67/2005

EYRNWSKPQCNI TGFAPFSKDNSIRLSAGGDIWVTREPYVSCDPDKCYQFALGQGTTLNNVHSN
DTVHDRTPYRTLLMNELGVPFHLGTKQVCIAWSSSSCHDGKAWLHVCVSGDDKNATASF IYNGR
LVDSIVSWSKEILRTQESECVCINGTCTVVM TDGSASGKADTKILFIEEGKIVHTSTLSGSAQH

VEECSCYPRYLGVRCVCRDNWKGSNRP IVDINIKDYSIVSSYVCSGLVGDTPRKNDS SSSSSHCL
DPNNEEGGHGVKGWAFDDGNDVWMGRTISEKLRSGYETFKVI EGWSNPNSK LQINRQVI VDRGN
RSGYSGIFSVEGKSCINRCFYVELIRGRKEETEVLWTSNSIVVFCGTS GTYGTGSWPDGADINL
MPI

N2-WI05-desNAp-158

H3N2 A/Wisconsin/67/2005

EYRNWSKPQCNI TGF AIFSKDNSIRLSAGGDIWVTREPYVSCDPDKCYQFALGQGTTLNNVHSN
DTVHDRTPYRTL LLMNELGVPFHLGTKQVCVAWSSSSSCHD GKAWLHVCVSGDDKNATASFIYNGR
LVDSIVSWSKEILRTQESECV CINGTCTVVM TDGSASGKADTKILFIEEGKIVHTSTLSGSAQH
VEECSCYPRYLGVRCVCRDNWKGSNRP IVDINIKDYSIVSSYVCSGLVGDTPRKNDS SSSSSHCL
DPNNEEGGHGVKGWAFDDGNDVWMGRTISEKLRSGYETFKVI EGWSNPNSK LQINRQVI VDRGN
RSGYSGIFSVEGKSCINRCFYVELIRGRKEETEVLWTSNSIVVFCGTS GTYGTGSWPDGADINL
MPI

N2-WI05-desNAp-249

H3N2 A/Wisconsin/67/2005

EYRNWSKPQCNI TGF APFSKDNSIRLSAGGDIWVTREPYVSCDPDKCYQFALGQGTTLNNVHSN
DTVHDRTPYRTL LLMNELGQPFHLGTKQVCIAWSSSSSCHD GKAWLHVCVTGDDKNATASFIYNGR
LVDSIVSWSKEILRTQESECV CINGTCTVVM TDGSASGKADTKILFIEEGKIVHTSTLSGSAQH
VEECSCYPRYLGVRCVCRDNWKGSNRP IVDINIKDYSIVSSYVCSGLVGDTPRKNDS SSSSSHCL
DPNNEEGGHGVKGWAFDDGNDVWMGRTISEKLRSGYETFKVI EGWSNPNSK LQINRQVI VDRGN
RSGYSGIFSVEGKSCINRCFYVELIRGRKEETEVLWTSNSIVVFCGTS GTYGTGSWPDGADINL
MP

N2-WI05-desNAp-255

H3N2 A/Wisconsin/67/2005

EYRNWSKPQCNI TGF APFSKDNSIRLSAGGDIWVTREPYVSCDPDKCYQFALGQGTTLNNVHSN
DTVHDRTPYRTL LLMNELGQPFHLGTKQVCVAWSSSSSCHD GKAWLHVCVSGDDKNATASFIYNGR
LVDSIVSWSKEILRTQESECV CINGTCTVVM TDGSASGKADTKILFIEEGKIVHTSTLSGSAQH
VEECSCYPRYLGVRCVCRDNWKGSNRP IVDINIKDYSIVSSYVCSGLVGDTPRKNDS SSSSSHCL
DPNNEEGGHGVKGWAFDDGNDVWMGRTISEKLRSGYETFKVI EGWSNPNSK LQINRQVI VDRGN
RSGYSGIFSVEGKSCINRCFYVELIRGRKEETEVLWTSNSIVVFCGTS GTYGTGSWPDGADINL
MPI

N1-MI15-sNAp-155

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDV FVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSPVSPYNARFESIAWSASACHDGINWLTIGITGPD SGAVAILKYNG
IITDTIKSWRNNILRTQESECACVNGSCFTIMTDG PSDGQASYKIFRIEKGKIIKSVEMKAPNY
HYEECSYPDSSEITCVCRDNWHGSNRPWVSFNQNLEYQMGYICSGVFGDNPRPNDKTGSCGPV
SSNGANGVKGFSFKYGNVWIGRTKSISSRKG FEMIWDPNGWGTGDNKFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRPEENTIWTSGSSISFCGVNSD TVGWSWPDGAELPFT
IDK

N1-MI15-sNAp-174

H1N1 A/Michigan/45/2015

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDV FVIREPFISCSPLECRQFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSPVSPYNARFESIAWSASACHDGINWLTIGITGPD SGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTIMTDG PSDGQASYKIFRIEKGKIIKSVEMKAPNY
HYEECS CYPDSSEITCVCRDNWHG SNRPWVSFNQNLEYQMGYICSGVFGDNPRPNDKTGSCGPV
SSNGANGVKGF SFKYNGVWIGRTKSISSRKG FEMIWD PNGWTGTDNKFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRPEENTIWTSGSSISFCGVNSDTV GWSWPDGAELPFT
IDK

N1-MI15-sNAp-165

H1N1 A/Michigan/45/2015

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDI FVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSPVSPYNARFESIAWSASACHDGINWLTIGITG PD SGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTIMTDG PSDGQASYKIFRIEKGKIIKSVEMKAPNY
HYEECS CYPDSSEITCVCRDNWHG SNRPWVSFNQNLEYQMGYICSGVFGDNPRPNDKTGSCGPV
SSNGANGVKGF SFKYNGVWIGRTKSISSRKG FEMIWD PNGWTGTDNKFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRPEENTIWTSGSSISFCGVNSDTV GWSWPDGAELPFT
IDK

N1-MI15-sNAp-176

H1N1 A/Michigan/45/2015

VKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDI FVIREPFISCSPLECRQFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSPVSPYNARFESIAWSASACHDGINWLTIGITG PD SGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTIMTDG PSDGQASYKIFRIEKGKIIKSVEMKAPNY
HYEECS CYPDSSEITCVCRDNWHG SNRPWVSFNQNLEYQMGYICSGVFGDNPRPNDKTGSCGPV
SSNGANGVKGF SFKYNGVWIGRTKSISSRKG FEMIWD PNGWTGTDNKFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRPEENTIWTSGSSISFCGVNSDTV GWSWPDGAELPFT
IDK

N1-MI15-sNAp-183

H1N1 A/Michigan/45/2015

VKLAGNSSLCPVSGWAPLAKDNSVRIGSKGDV FVIREPFISCSPLECRMFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPLGSPVSPYNARFESIAWSASACHDGINWLTIGITG PD SGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTIMTDG PSDGQASYKIFRIEKGKIIKSVEMKAPNY
HYEECS CYPDSSEITCVCRDNWHG SNRPWVSFNQNLEYQMGYICSGVFGDNPRPNDKTGSCGPV
SSNGANGVKGF SFKYNGVWIGRTKSISSRKG FEMIWD PNGWTGTDNKFSIKQDIVGINEWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRPEENTIWTSGSIIAF CGVNSDTV GWSWPDGAELPFT
IDK

N1-VN04-sNAp-155

H5N1 A/Vietnam/1203/2004

VKLAGNSSLCPINGWAPLSKDNSIRIGSKGDV FVIREPFISCSHLECRTFFLTQGALLNDKHSN
GTVKDRSPHRTLMSVPVGSAPSPYNARFESIAWSASACHDGT SWLTIGITGPDNGAVAILKYNG

IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGPNSGQASYKIFKMEKGKVVKSVELDAPNY
HYEECSYPNAGEITCVCRDNWHGNSRNPWVSFNQNLEYQIGYICSGVFGDNPRPNDGTGSCGPV
SSNGAYGVKGFSEFKYNGVWIGRTKSTNSRSGFEMIWDPNGWETDSSFSVKQDIVAITDWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRPKESTIWTSGSSISFCGVNSDTVGWSWPDGAELPFT
IDK

N1-VN04-sNAp-354

H5N1 A/Vietnam/1203/2004

VKLAGNSSLCPIGWAPLSKDNSVRIGSKGDVFIREFPFI SC SHLECRQFFLTQGALLNDKHSN
GTVKDRSPHRTLMSVPIGSVPSYPNARFESIAWSASACHDGT SWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGPNSGQASYKIFKMEKGKVVKSVELDAPNY
HYEECSYPNAGEITCVCRDNWHGNSRNPWVSFNQNLEYQIGYICSGVFGDNPRPNDGTGSCGPV
SSNGAYGVKGFSEFKYNGVWIGRTKSTNSRSGFEMIWDPNGWETDSSFSVKQDIVAITDWSGY
SGSFVMHPELTGLDCIVPCFWVELIRGRPKESTIWTSGSSISFCGVNSDTVGWSWPDGAELPFT
IDK

N1-WSN33-sNAp-155

H1N1 A/WSN/1933

VILTGNSSLCPIRGWAPLSKDNGIRIGSKGDVFIREFPFI SC SHLECR TFFLTQGALLNDKHSR
GTFKDRSPYRALMSVPVGSAPSYPNARFESIAWSASACHDGMGWL TIGITGPDDGAVAILKYNR
IITETIKSWRKNILRTQESECTCVNGSCFTIMTDGSPDGLASYKIFKIEKGKVTKSIELNAPNS
HYEECSYPDTGKVMCVCRDNWHGNSRNPWVSFDQNLDYKIGYICSGVFGDNPRPKDGTGSCGPV
SADGANGVKGFSEFKYNGVWIGRTKSDSSRHGFEMIWDPNGWETD SRF SMRQDVVAITNRSY
SGSFVMHPELTGLDCMVPCFWVELIRGLPEEDAIWTSGSII SFCGVNSDTVDWSWPDGAELPFT
IDK

N1-WSN33-sNAp-366

H1N1 A/WSN/1933

VILTGNSSLCPIRGWAPLSKDNSVRIGSKGDVFIREFPFI SC SHLECR TFFLTQGALLNDKHSR
GTFKDRSPYRTLMSVPIGSVPSYPNARFESIAWSASACHDGMGWL TIGITGPDDGAVAILKYNG
IITETIKSWRKNILRTQESECTCVNGSCFTIMTDGSPDGLASYKIFKIEKGKVTKSIELNAPNS
HYEECSYPDTGKVMCVCRDNWHGNSRNPWVSFDQNLDYKIGYICSGVFGDNPRPKDGTGSCGPV
SADGANGVKGFSEFKYNGVWIGRTKSDSSRHGFEMIWDPNGWETD SRF SMRQDVVAITNRSY
SGSFVMHPELTGLDCMVPCFWVELIRGLPEEDAIWTSGSII SFCGVNSDTVDWSWPDGAELPFT
IDK

N1-WSN33-sNAp-367

H1N1 A/WSN/1933

VILTGNSSLCPIRGWAPLSKDNSVRIGSKGDVFIREFPFI SC SHLECRQFFLTQGALLNDKHSR
GTFKDRSPYRTLMSVPIGSVPSYPNARFESIAWSASACHDGMGWL TIGITGPDDGAVAILKYNG
IITETIKSWRKNILRTQESECTCVNGSCFTIMTDGSPDGLASYKIFKIEKGKVTKSIELNAPNS
HYEECSYPDTGKVMCVCRDNWHGNSRNPWVSFDQNLDYKIGYICSGVFGDNPRPKDGTGSCGPV
SADGANGVKGFSEFKYNGVWIGRTKSDSSRHGFEMIWDPNGWETD SRF SMRQDVVAITNRSY
SGSFVMHPELTGLDCMVPCFWVELIRGLPEEDAIWTSGSII SFCGVNSDTVDWSWPDGAELPFT
IDK

N1-WSN33-sNAp-375

H1N1 A/WSN/1933

VILTGNSSLCPIRGWAPLAKDNSVRIGSKGDV FVIREPFISCSHLECRMFFLTQGALLNDKHSR
GTFKDRSPYRTLMSVPLGSPVPSPYNARFESIAWSASACHDGMGWLTI GITGPDDGAVAILKYNG
IITETIKSWRKNILRTQESECTCVNGSCFTIMTDGPSDGLASYKIFKIEKGKVTKSIELNAPNS
HYEECSYCPDTGKVMCVCRDNWHGSRNPWVSFDQNL DYKIGYICSGVFGDNPRPKDGTGSCGPV
SADGANGVKGF SYKYGNVWIGRTKSDSSRHGFEMIWD PNGWTETDSRFSMRQDVVAITNRSY
SGSFVMHPELTGLDCMVPCFWVELIRGLPEEDAIWTS GSI IAFCGVNSDTVDWSWPDGAELPFT
IDK

N1-WSN33-sNAp-378

H1N1 A/WSN/1933

VILTGNSSLCPIRGWAPLAKDNSVRIGSKGDV FVIREPFISCSPLECRMFFLTQGALLNDKHSR
GTFKDRSPYRTLMSVPLGSPVPSPYNARFESIAWSASACHDGMGWLTI GITGPDDGAVAILKYNG
IITETIKSWRKNILRTQESEACVNGSCFTVMTDGPSDGLASYKIFKIEKGKITKSIEMNAPNS
HYEECSYCPDTGKVMCVCRDNWHGSRNPWVSFDQNL DYKIGYICSGVFGDNPRPKDGTGSCGPV
SADGANGVKGF SFKYGNVWIGRTKSDSSRHGFEMIWD PNGWTETDSRFSMRQDIVAITNRSY
SGSFVMHPELTGLDCIVPCFWVELIRGLPEEDAIWTS GSI IAFCGVNSDTVDWSWPDGAELPFT
IDK

N1-CA09-sNAp-155-T466A

H1N1 A/California/07/2009

VKLAGNSSLCPVSGWAPLSKD NSVRIGSKGDV FVIREPFISCSPLECRTFFLTQGALLNDKHSN
GTIKDRSPYRTLMSVPIGSPVPSPYNARFESIAWSASACHDGINWLTIGITGPDNGAVAILKYNG
IITDTIKSWRNNILRTQESEACVNGSCFTVMTDGPSNGQASYKIFRIEKGKIVKSVEMNAPNY
HYEECSYCPDSSEITCVCRDNWHGSRNPWVSFNQNLEYQIGYICSGIFGDNPRPNDKTGSCGPV
SSNGANGVKGF SFKYGNVWIGRTKSISSRNGFEMIWD PNGWTGTDNNFSIKQDIVGINEWSY
SGSFVMHPELTGLDCIVPCFWVELIRGRPKENTIWTS GSSISFCGVNSDTVGWSWPDGAELPFA
IDK

All membrane-anchored NA constructs shown below were tested without any added sequence features:

N1-CA09-WT full-length with C-terminal myc tag

H1N1 A/California/07/2009

MNPNQKIITIGSVCMTIGMANLILQIGNIISIWISHSIQLGNQNQIETCNQSVITYENNTWVNQ
TYVNI SNTNFAAGQSVVSVKLAGNSSLCPVSGWAIYSKDNSVRIGSKGDV FVIREPFISCSPLE
CRTFFLTQGALLNDKHSNGTIKDRSPYRTLMSCPIGEVPSPYNSRFESVAWSASACHDGINWLT
IGISGPDNGAVAVLKYNGIITDTIKSWRNNILRTQESEECACVNGSCFTVMTDGP SNGQASYKIF
RIEKGKIVKSVEMNAPNYHYEECSYPDSSEITCVCRDNWHGNSRNPWVSFNQNLEYQIGYICSG
IFGDNPRPNDKTGSCGPVSSNGANGVKGF SYKYGNVWIGRTKSISSRNGFEMIWD PNGWTGTD
NNFSIKQDIVGINEWSGYSGSFVQHP ELTGLDCIRPCFWVELIRGRP KENTIWTSGSSISFCGV
NSDTVGSWPDGAELPFTIDKGGSGSGGEQKLI SEEDL

N1-CA09-sNAp-130 full-length with C-terminal myc tag

H1N1 A/California/07/2009

MNPNQKIITIGSVCMTIGMANLILQIGNIISIWISHSIQLGNQNQIETCNQSVITYENNTWVNQ
TYVNI SNTNFAAGQSVVSVKLAGNSSLCPVSGWAPLSKDNSVRIGSKGDV FVIREPFISCSPLE
CRTFFLTQGALLNDKHSNGTIKDRSPYRTLMSVPIGSVPSPYNARFESIAWSASACHDGINWLT
IGITGPDNGAVAILKYNGIITDTIKSWRNNILRTQESEECACVNGSCFTVMTDGP SNGQASYKIF
RIEKGKIVKSVEMNAPNYHYEECSYPDSSEITCVCRDNWHGNSRNPWVSFNQNLEYQIGYICSG
IFGDNPRPNDKTGSCGPVSSNGANGVKGF SFKYGNVWIGRTKSISSRNGFEMIWD PNGWTGTD
NNFSIKQDIVGINEWSGYSGSFVMHPELTGLDCIVPCFWVELIRGRP KENTIWTSGSSISFCGV
NSDTTGWSWPDGAELPFTIDKGGSGSGGEQKLI SEEDL