We claim:

1. An adeno-associated virus (AAV) capsid variant comprising an amino acid sequence at least 95%, identical to positions 203-736 of SEQ ID NO: 981, wherein the AAV capsid variant comprises the amino acid T at position 584, D at position 586, W at position 587, H at position 588, R at position 589, and I at position 590, numbered according to SEQ ID NO: 981.

2. An adeno-associated virus (AAV) capsid variant comprising an amino acid sequence having the following formula: [N1]-[N2]-[N3] (SEQ ID NO: 4681), wherein [N2] comprises the amino acid sequence of DWHR (SEQ ID NO: 4682) and wherein:

(i) [N1] comprises positions X_1, X_2, X_3, and X_4, wherein position X_4 is Q, K, E, S, P, R, N, or H; and/or

(ii) [N3] comprises positions X_5, X_6, and X_7, wherein position X_5 is I, V, T, M, S, N, L, or F;

wherein the AAV capsid variant comprises an amino acid sequence at least 95% identical to positions 203-736 of SEQ ID NO: 981.

3. The AAV capsid variant of claim 2, wherein:

(a) [N1] comprises positions X_1, X_2, X_3, and X_4, wherein:

(i) position X_1 is T, S, R, A, I, C, N, K, L, or Q;

(ii) position X_2 is N, T, G, V, S, Y, K, I, H, D, or F;

(iii) position X_3 is T, N, K, D, I, S, P, A, Y, E, V, L, M, R, H, Q, or C; and

(iv) position X_4 is Q, K, E, S, P, R, N, or H; and/or

(b) [N3] comprises positions X_5, X_6, and X_7, wherein:

(i) position X_5 is I, V, T, M, S, N, L, or F;

(ii) position X_6 is A, Y, P, N, S, T, G, E, V, W, F, or Q; and

(ii) position X_7 is Q, G, N, K, H, R, E, L, P, or M.

4. The AAV capsid variant of claim 2 or 3, wherein:

(i) [N1] comprises TNTQ (SEQ ID NO: 4688), TNTK (SEQ ID NO: 4689), TNNQ (SEQ ID NO: 4690), SNNQ (SEQ ID NO: 4691), TNKQ (SEQ ID NO: 4692), TNNE (SEQ ID NO: 4693), SNKQ (SEQ ID NO: 4694), SNTQ (SEQ ID NO: 4695), TTNQ (SEQ ID NO: 4696), TNDQ (SEQ ID NO: 4697), TTIQ (SEQ ID NO: 4698), RNTQ (SEQ ID NO: 4699), TTKQ (SEQ ID NO: 4700), TTSQ (SEQ ID NO: 4701), TTDQ (SEQ ID NO: 4702), TNPS (SEQ ID NO: 4703), TNKE (SEQ ID NO: 4704), TTTQ (SEQ ID NO: 4705), TGKQ (SEQ ID NO: 4706), TTAQ (SEQ ID NO: 4707), TVKQ (SEQ ID NO: 4708), TNYQ (SEQ ID NO: 4709), TNTP (SEQ ID NO: 4710), STKQ (SEQ ID NO: 4711), TTEQ

(SEQ ID NO: 4712), TSKQ (SEQ ID NO: 4713), TNIQ (SEQ ID NO: 4714), TYNQ (SEQ ID NO: 4715), STIQ (SEQ ID NO: 4716), TTVQ (SEQ ID NO: 4717), TGTQ (SEQ ID NO: 4718), TNTR (SEQ ID NO: 4719), TTLQ (SEQ ID NO: 4720), TTMQ (SEQ ID NO: 4721), ANNQ (SEQ ID NO: 4722), SNIQ (SEQ ID NO: 4723), TKNQ (SEQ ID NO: 4724), TYTQ (SEQ ID NO: 4725), TNKS (SEQ ID NO: 4726), SNTE (SEQ ID NO: 4727), TNTE (SEQ ID NO: 4728), TNIE (SEQ ID NO: 4729), TTRQ (SEQ ID NO: 4730), TNSQ (SEQ ID NO: 4731), TYTK (SEQ ID NO: 4732), TTTK (SEQ ID NO: 4733), TNIK (SEQ ID NO: 4734), SNTK (SEQ ID NO: 4735), TNNK (SEQ ID NO: 4736), TNSK (SEQ ID NO: 4737), TSTK (SEQ ID NO: 4738), TITK (SEQ ID NO: 4739), INTK (SEQ ID NO: 4740), TNAK (SEQ ID NO: 4741), TKTK (SEQ ID NO: 4742), STNQ (SEQ ID NO: 4743), ANTK (SEQ ID NO: 4744), RNNQ (SEQ ID NO: 4745), TGNQ (SEQ ID NO: 4746), TSNQ (SEQ ID NO: 4747), THTK (SEQ ID NO: 4748), TDTK (SEQ ID NO: 4749), TNEQ (SEQ ID NO: 4750), CNTQ (SEQ ID NO: 4751), TNPK (SEQ ID NO: 4752), INNQ (SEQ ID NO: 4753), TYTE (SEQ ID NO: 4754), NNNQ (SEQ ID NO: 4755), KNNQ (SEQ ID NO: 4756), TNNR (SEQ ID NO: 4757), LNNQ (SEQ ID NO: 4758), TINQ (SEQ ID NO: 4759), TNHQ (SEQ ID NO: 4760), STTQ (SEQ ID NO: 4761), SNSQ (SEQ ID NO: 4762), STSQ (SEQ ID NO: 4763), TYIQ (SEQ ID NO: 4764), SGTQ (SEQ ID NO: 4765), THNQ (SEQ ID NO: 4766), TITQ (SEQ ID NO: 4767), TSTQ (SEQ ID NO: 4768), TNSN (SEQ ID NO: 4769), TNQQ (SEQ ID NO: 4770), RNIQ (SEQ ID NO: 4771), TNNP (SEQ ID NO: 4772), TITE (SEQ ID NO: 4773), TNTN (SEQ ID NO: 4774), TFSQ (SEQ ID NO: 4775), RNSQ (SEQ ID NO: 4776), INTQ (SEQ ID NO: 4777), RNTE (SEQ ID NO: 4778), TNNH (SEQ ID NO: 4779), TNMQ (SEQ ID NO: 4780), RTTQ (SEQ ID NO: 4781), SNIE (SEQ ID NO: 4782), TNTS (SEQ ID NO: 4783), KNTQ (SEQ ID NO: 4784), TNLQ (SEQ ID NO: 4785), TSMQ (SEQ ID NO: 4786), SYTQ (SEQ ID NO: 4787), TNCQ (SEQ ID NO: 4788), SSTQ (SEQ ID NO: 4789), TVTQ (SEQ ID NO: 4790), or QNTQ (SEQ ID NO: 4791);

(ii) [N1]-[N2] comprises TNTQDWHR (SEQ ID NO: 4898), TNTKDWHR (SEQ ID NO: 4899), TNNQDWHR (SEQ ID NO: 4900), SNNQDWHR (SEQ ID NO: 4901), TNKQDWHR (SEQ ID NO: 4902), TNNEDWHR (SEQ ID NO: 4903), SNKQDWHR (SEQ ID NO: 4904), SNTQDWHR (SEQ ID NO: 4905), TTNQDWHR (SEQ ID NO: 4906), TNDQDWHR (SEQ ID NO: 4907), TTIQDWHR (SEQ ID NO: 4908), RNTQDWHR (SEQ ID NO: 4909), TTKQDWHR (SEQ ID NO: 4910), TTSQDWHR (SEQ ID NO: 4911), TTDQDWHR (SEQ ID NO: 4912), TNPSDWHR (SEQ ID NO: 4913), TNKEDWHR (SEQ ID NO: 4914), TTTQDWHR (SEQ ID NO: 4915), TGKQDWHR (SEQ ID NO: 4916), TTAQDWHR (SEQ ID NO: 4917), TVKQDWHR (SEQ ID NO: 4918), TNYQDWHR (SEQ ID NO: 4919), TNTPDWHR (SEQ ID NO: 4920), STKQDWHR (SEQ ID NO: 4921), TTEQDWHR (SEQ ID NO: 4922), TSKQDWHR (SEQ ID NO: 4923), TNIQDWHR (SEQ ID NO: 4924), TYNQDWHR (SEQ ID NO: 4925), STIQDWHR (SEQ ID NO: 4926), TTVQDWHR (SEQ ID NO: 4927),

TGTQDWHR (SEQ ID NO: 4928), TNTRDWHR (SEQ ID NO: 4929), TTLQDWHR (SEQ ID NO: 4930), TTMQDWHR (SEQ ID NO: 4931), ANNQDWHR (SEQ ID NO: 4932), SNIQDWHR (SEQ ID NO: 4933), TKNQDWHR (SEQ ID NO: 4934), TYTQDWHR (SEQ ID NO: 4935), TNKSDWHR (SEQ ID NO: 4936), SNTEDWHR (SEQ ID NO: 4937), TNTEDWHR (SEQ ID NO: 4938), TNIEDWHR (SEQ ID NO: 4939), TTRQDWHR (SEQ ID NO: 4940), TNSQDWHR (SEQ ID NO: 4941), TYTKDWHR (SEQ ID NO: 4942), TTTKDWHR (SEQ ID NO: 4943), TNIKDWHR (SEQ ID NO: 4944), SNTKDWHR (SEQ ID NO: 4945), TNNKDWHR (SEQ ID NO: 4946), TNSKDWHR (SEQ ID NO: 4947), TSTKDWHR (SEQ ID NO: 4948), TITKDWHR (SEQ ID NO: 4949), INTKDWHR (SEQ ID NO: 4950), TNAKDWHR (SEQ ID NO: 4951), TKTKDWHR (SEQ ID NO: 4952), STNQDWHR (SEQ ID NO: 4953), ANTKDWHR (SEQ ID NO: 4954), RNNQDWHR (SEQ ID NO: 4955), TGNQDWHR (SEQ ID NO: 4956), TSNQDWHR (SEQ ID NO: 4957), THTKDWHR (SEQ ID NO: 4958), TDTKDWHR (SEQ ID NO: 4959), TNEQDWHR (SEQ ID NO: 4960), CNTQDWHR (SEQ ID NO: 4961), TNPKDWHR (SEQ ID NO: 4962), INNQDWHR (SEQ ID NO: 4963), TYTEDWHR (SEQ ID NO: 4964), NNNQDWHR (SEQ ID NO: 4965), KNNQDWHR (SEQ ID NO: 4966), TNNRDWHR (SEQ ID NO: 4967), LNNQDWHR (SEQ ID NO: 4968), TINQDWHR (SEQ ID NO: 4969), TNHQDWHR (SEQ ID NO: 4970), STTQDWHR (SEQ ID NO: 4971), SNSQDWHR (SEQ ID NO: 4972), STSQDWHR (SEQ ID NO: 4973), TYIQDWHR (SEQ ID NO: 4974), SGTQDWHR (SEQ ID NO: 4975), THNQDWHR (SEQ ID NO: 4976), TITQDWHR (SEQ ID NO: 4977), TSTQDWHR (SEQ ID NO: 4978), TNSNDWHR (SEQ ID NO: 4979), TNQQDWHR (SEQ ID NO: 4980), RNIQDWHR (SEQ ID NO: 4981), TNNPDWHR (SEQ ID NO: 4982), TITEDWHR (SEQ ID NO: 4983), TNTNDWHR (SEQ ID NO: 4984), TFSQDWHR (SEQ ID NO: 4985), RNSQDWHR (SEQ ID NO: 4986), INTQDWHR (SEQ ID NO: 4987), RNTEDWHR (SEQ ID NO: 4988), TNNHDWHR (SEQ ID NO: 4989), TNMQDWHR (SEQ ID NO: 4990), RTTQDWHR (SEQ ID NO: 4991), SNIEDWHR (SEQ ID NO: 4992), TNTSDWHR (SEQ ID NO: 4993), KNTQDWHR (SEQ ID NO: 4994), TNLQDWHR (SEQ ID NO: 4995), TSMQDWHR (SEQ ID NO: 4996), SYTQDWHR (SEQ ID NO: 4997), TNCQDWHR (SEQ ID NO: 4998), SSTQDWHR (SEQ ID NO: 4999), TVTQDWHR (SEQ ID NO: 5000), or QNTQDWHR (SEQ ID NO: 5001);

(iii) [N3] comprises IAQ, IAG, IYQ, VPQ, IAN, INQ, VNQ, VYQ, VAN, ISG, ISQ, VAQ, ITQ, TAQ, MAQ, SAQ, IGQ, IEQ, IVQ, NAQ, LAQ, IAK, IAH, IPQ, IAR, IAE, IAL, IAP, FAQ, VSQ, VTM, ISM, IWQ, IFQ, IQQ, VQQ, IFM, IAM, or ISN;

(iv) [N2]-[N3] comprises DWHRIAQ (SEQ ID NO: 5027), DWHRIAG (SEQ ID NO: 5028), DWHRIYQ (SEQ ID NO: 5029), DWHRVPQ (SEQ ID NO: 5030), DWHRIAN (SEQ ID NO: 5031), DWHRINQ (SEQ ID NO: 5032), DWHRVNQ (SEQ ID NO: 5033), DWHRVYQ (SEQ ID NO: 5034), DWHRVAN (SEQ ID NO: 5035), DWHRISG (SEQ ID NO: 5036), DWHRISQ (SEQ ID NO: 5037),

DWHRVAQ (SEQ ID NO: 5038), DWHRITQ (SEQ ID NO: 5039), DWHRTAQ (SEQ ID NO: 5040), DWHRMAQ (SEQ ID NO: 5041), DWHRSAQ (SEQ ID NO: 5042), DWHRIGQ (SEQ ID NO: 5043), DWHRIEQ (SEQ ID NO: 5044), DWHRIVQ (SEQ ID NO: 5045), DWHRNAQ (SEQ ID NO: 5046), DWHRLAQ (SEQ ID NO: 5047), DWHRIAK (SEQ ID NO: 5048), DWHRIAH (SEQ ID NO: 5049), DWHRIPQ (SEQ ID NO: 5050), DWHRIAR (SEQ ID NO: 5051), DWHRIAE (SEQ ID NO: 5052), DWHRIAL (SEQ ID NO: 5053), DWHRIAP (SEQ ID NO: 5054), DWHRFAQ (SEQ ID NO: 5055), DWHRVSQ (SEQ ID NO: 5056), DWHRVTM (SEQ ID NO: 5057), DWHRISM (SEQ ID NO: 5058), DWHRIWQ (SEQ ID NO: 5059), DWHRIFQ (SEQ ID NO: 5060), DWHRIQQ (SEQ ID NO: 5061), DWHRVQQ (SEQ ID NO: 5062), DWHRIFM (SEQ ID NO: 5063), DWHRIAM (SEQ ID NO: 5064), or DWHRISN (SEQ ID NO: 5065); and/or

(v) [N1]-[N2]-[N3] comprises the amino acid sequence of any one of SEQ ID NOs: 343-538.

5. The AAV capsid variant of any one of claims 2-4, which further comprises [N4], wherein [N4] comprises positions X_8, X_9, X_{10}, and X_{11}, wherein:

(i) position X_8 is T, S, N, P, A, or I;

(ii) position X_9 is G, N, D, R, V, A, S, or Q;

(iii) position X_{10} is W, S, C, R, L, or G; and/or

(iv) position X_{11} is V, A, S, I, C, G, D, F, L, or T.

6. The AAV capsid variant of claim 5, wherein [N4] comprises TGWV (SEQ ID NO: 5066), TGWA (SEQ ID NO: 5067), TNWS (SEQ ID NO: 5068), SNWV (SEQ ID NO: 5069), TNWV (SEQ ID NO: 5070), TNWI (SEQ ID NO: 5071), NNWV (SEQ ID NO: 5072), TGWS (SEQ ID NO: 5073), TGWI (SEQ ID NO: 5074), TGWC (SEQ ID NO: 5075), TGWG (SEQ ID NO: 5076), SGWV (SEQ ID NO: 5077), PGWV (SEQ ID NO: 5078), TGSV (SEQ ID NO: 5079), TDWV (SEQ ID NO: 5080), TGCV (SEQ ID NO: 5081), TGRV (SEQ ID NO: 5082), TGLV (SEQ ID NO: 5083), TGGV (SEQ ID NO: 5084), AGWV (SEQ ID NO: 5085), IGWV (SEQ ID NO: 5086), TGWD (SEQ ID NO: 5087), NGWV (SEQ ID NO: 5088), TGWF (SEQ ID NO: 5089), TRWV (SEQ ID NO: 5090), TVWV (SEQ ID NO: 5091), TGWL (SEQ ID NO: 5092), TAWV (SEQ ID NO: 5093), TSWV (SEQ ID NO: 5094), TGWT (SEQ ID NO: 5095), SVWV (SEQ ID NO: 5096), TQWV (SEQ ID NO: 5097), or PGWG (SEQ ID NO: 5098).

7. The AAV capsid variant of claim 5 or 6, wherein [N1]-[N2]-[N3]-[N4] comprises:

(i) the amino acid sequence of any one of SEQ ID NOs: 201-245, 247-250, 253-255, 257-265, 268-274, 276-286, 288, 290-297, 299-303, 305-309, 311, 313-319, 323-328, 330-337, 339-342, 539-542,

544, 546, 547, 549-557, 559-589, 592, 593, 595, 596, 598, 599, 601-608, 610-614, 616-622, 625, 628, 630, 631, 633, 636, 638, 639-646, 649, 651-657, 667, 669, 670, 672, 673, 679-683, 685-690, 692, 693, 695, 697, 699-701, 703-705, 708-710, 712-717, 719-723, 728-731, 733-738, 740, or 742;

(ii) TNTQDWHRIAQTGWV (SEQ ID NO: 201); or

(iii) TNTKDWHRIAQTGWV (SEQ ID NO: 202).

8. The AAV capsid variant of any one of claims 5-7, wherein:

(i) [N1]-[N2]-[N3] and/or [N4] is present in variable region VIII (VR-VIII), wherein VR-VIII comprises positions 580-599 of SEQ ID NO: 981;

(ii) X_1 of [N1] is present at position 582, X_2 of [N1] is present at position 583, X_3 of [N1] is present at position 584, and X_4 of [N1] is present at position 585, numbered according to SEQ ID NO: 981;

(iii) [N2] is present at positions 586-589, numbered according to SEQ ID NO: 981;

(iv) X_5 of [N3] is present at position 590, X_6 of [N3] is present at position 591, and X_7 of [N3] is present at position 592, numbered according to SEQ ID NO: 981; and/or

(v) X_8 of [N4] is present at position 593, X_9 of [N4] is present at position 594, X_{10} of [N4] is present at position 595, and X_{11} of [N4] is present at position 596, numbered according to SEQ ID NO: 981.

9. An adeno-associated virus (AAV) capsid variant comprising:

(a) the amino acid sequence of any one of the amino acid sequences provided in Tables 1, 2A, 2B, 9, 14, 15 or 16;

(b) an amino acid sequence comprising at least 7, 8, 9, 10, 11, 12, 13, or 14 consecutive amino acids from any one of the amino acid sequences provided in Tables 1, 2A, 2B, 9, 14, 15, or 16;

(c) an amino acid sequence comprising at least one, two, or three but no more than four different amino acids, relative to any one of the amino acid sequences provided in Tables 1, 2A, 2B, 9, 14, 15, or 16;

(d) an amino acid sequence comprising at least one, two, or three but no more than four substitutions, relative to any one of the amino acid sequences provided in Tables 1, 2A, 2B, 9, 14, 15, or 16;

wherein the AAV capsid variant comprises an amino acid sequence at least 95% identical to positions 203-736 of SEQ ID NO: 981.

10. The AAV capsid variant of any one of claims 1-9, which comprises:

(i) an amino acid sequence at least 98% identical to the amino acid sequence of positions 203-736 of SEQ ID NO: 981;

(ii) an amino acid sequence at least 95% or at least 98% identical to the amino acid sequence of positions 138-736 of SEQ ID NO: 981; and/or

(iii) an amino acid sequence at least 95% or at least 98% identical to the amino acid sequence of SEQ ID NO: 981.

11. The AAV capsid variant of any one of claims 1-10, which comprises:

(i) the amino acid sequence of positions 203-736 of SEQ ID NO: 981;

(ii) the amino acid sequence of positions 138-736 of SEQ ID NO: 981; and/or

(iii) the amino acid sequence of SEQ ID NO: 981.

12. An adeno-associated virus (AAV) capsid variant comprising:

(i) the amino acid sequence of positions 203-736 of SEQ ID NO: 981;

(ii) the amino acid sequence of positions 138-736 of SEQ ID NO: 981; and/or

(iii) the amino acid sequence of SEQ ID NO: 981.

13. The AAV capsid variant of any one of claims 1-12, which comprises increased tropism for a brain cell, brain tissue, spinal cord cell, or spinal cord tissue, relative to the tropism of an AAV capsid protein comprising the amino acid sequence of SEQ ID NO: 138.

14. A polynucleotide encoding the AAV capsid variant of any one of claims 1-13.

15. The polynucleotide of claim 14, which comprises the nucleotide sequence of SEQ ID NO: 983, or a nucleotide sequence at least 80% identical thereto.

16. A peptide comprising:

(a) the amino acid sequence of any one of the amino acid sequences provided in Tables 1, 2A, 2B, 14, 15, or 16;

(b) an amino acid sequence comprising at least 7, 8, 9, 10, 11, 12, 13, or 14 consecutive amino acids from any one of the amino acid sequences provided in Tables 1, 2A, 2B, 14, 15, or 16;

(c) an amino acid sequence comprising at least one, two, or three but no more than four different amino acids relative to any one of the amino acid sequences provided in Tables 1, 2A, 2B, 14, 15, or 16; or

(d) an amino acid sequence comprising at least one, two, or three but no more than four substitutions, relative to any one of the amino acid sequences provided in Tables 1, 2A, 2B, 14, 15, or 16.

17. An adeno-associated virus (AAV) capsid variant comprising the peptide of claim 16, optionally wherein the peptide is present at positions 584-590, numbered according to SEQ ID NO: 981 or 138.

18. An AAV particle comprising the AAV capsid variant of any one of claims 1-13 or 17.

19. The AAV particle of claim 18, which comprises a nucleotide sequence encoding a payload, wherein the encoded payload comprises a protein, an antibody, an enzyme, a component of a gene editing system, or an inhibitory RNA.

20. The AAV particle of claim 19, which further comprises:

(i) a 5' inverted terminal repeat (ITR) and/or a 3' ITR;

(ii) a promoter operably linked to the nucleotide sequence encoding the payload;

(iii) an enhancer;

(iv) a Kozak sequence;

(v) an intron;

(vi) an exon;

(vii) a nucleotide sequence encoding a microRNA (miR) binding site; and/or

(viii) a polyadenylation (polyA) sequence.

21. A vector comprising a polynucleotide encoding the AAV capsid variant of any one of claims 1-13 or 17, the polynucleotide of claim 14 or 15, or a polynucleotide encoding the peptide of claim 16.

22. A cell comprising the AAV capsid variant of any one of claims 1-13 or 17, the polynucleotide of claim 14 or 15, a polynucleotide encoding the peptide of claim 16, the AAV particle of any one of claims 18-20, or the vector of claim 21.

23. The cell of claim 22, wherein:

(i) the cell is a mammalian cell or an insect cell;

(ii) the cell is a cell of a brain region or a spinal cord region; and/or

(iii) the cell is a neuron, a sensory neuron, a motor neuron, an astrocyte, a glial cell, an oligodendrocyte, or a muscle cell.

24. A method of making an AAV particle, comprising:

(i) providing a host cell comprising a viral genome and the AAV capsid variant of any one of claims 1-13 or 17; and

(ii) incubating the host cell under conditions suitable to enclose the viral genome in the AAV capsid variant;

thereby making the AAV particle.

25. A pharmaceutical composition comprising the AAV particle of any one of claims 18-20, an AAV particle comprising the AAV capsid variant of any one of claims 1-13 or 17, or an AAV particle comprising the peptide of claim 16, and a pharmaceutically acceptable excipient.

26. The pharmaceutical composition of claim 25, the AAV particle of any one of claims 18-20, an AAV particle comprising the AAV capsid variant of any one of claims 1-13 or 17, or an AAV particle comprising an AAV capsid variant comprising the peptide of claim 16, for use as a medicament.

27. Use of the pharmaceutical composition of claim 25, the AAV particle of any one of claims 18-20, an AAV particle comprising the AAV capsid variant of any one of claims 1-13 or 17, or an AAV particle comprising an AAV capsid variant comprising the peptide of claim 16, in the manufacture of a medicament for delivering a payload to a cell or a tissue.

28. The use of claim 27, wherein the cell is a cell of a brain region or a spinal cord region.

29. The use of claim 27 or 28, wherein the cell is a cell of the temporal cortex, perirhinal cortex, globus pallidus, putamen, caudate, thalamus, hippocampus, geniculate nucleus, Purkinje Layer, deep cerebellar nuclei, cerebellum, cervical spinal cord region, thoracic spinal cord region, lumbar spinal cord region, heart, or muscle.

30. The use of any one of claims 27-29, wherein the cell is a neuron, a sensory neuron, a motor neuron, an astrocyte, a glial cell, or an oligodendrocyte.

31. The use of any one of claims 27-30, wherein the cell is in a subject.

32. The use of claim 31, wherein the subject has, has been diagnosed with having, or is at risk of having a genetic disorder, a neurological disorder, a neurodegenerative disorder, a neuro-oncological disorder, a muscular disorder, or a neuromuscular disorder.

33. Use of the pharmaceutical composition of claim 25, the AAV particle of any one of claims 18-20, an AAV particle comprising the AAV capsid variant of any one of claims 1-13 or 17, or an AAV particle comprising an AAV capsid variant comprising the peptide of claim 16, in the manufacture of a medicament for treating a subject having or diagnosed with having a genetic disorder, a neurological disorder, a neurodegenerative disorder, a neuro-oncological disorder, a muscular disorder, or a neuromuscular disorder.

34. The use of claim 32 or 33, wherein the genetic disorder, neurological disorder, neurodegenerative disorder, neuro-oncological disorder, muscular disorder, or neuromuscular disorder is Huntington's disease, amyotrophic lateral sclerosis (ALS), Gaucher disease, dementia with Lewy bodies, Parkinson's disease, spinal muscular atrophy, Alzheimer's disease, a leukodystrophy, Alexander disease, autosomal dominant leukodystrophy with autonomic disease (ADLD), Canavan disease, cerebrotendinous xanthomatosis (CTX), metachromatic leukodystrophy (MLD), Pelizaeus-Merzbacher disease, Refsum disease, a cancer, a HER2/neu positive cancer, or a glioblastoma.

35. The use of any one of claims 27-34, wherein the pharmaceutical composition or the AAV particle is formulated for intravenous administration, intramuscular administration, intracerebral administration, intrathecal administration, intracerebroventricular administration, intraparenchymal administration, or intra-cisterna magna injection (ICM).