WHAT IS CLAIMED IS:

1. Use of a vector in the manufacture of a medicament for intracerebroventricular (ICV) administration to a primate in need thereof, wherein the vector comprises a cell-type selective regulatory element.

2. Use of a vector in the manufacture of a medicament for intracerebroventricular (ICV) administration to a primate in need thereof, wherein the vector comprises a regulatory element, wherein the regulatory element results in increased transgene expression by at least 2 fold as compared to expression of the transgene when operably linked to a CMV promoter.

3. Use of a vector in the manufacture of a medicament for unilateral intracerebroventricular (ICV) administration to a primate in need thereof.

4. Use of a vector in the manufacture of a medicament for intracerebroventricular (ICV) administration to a primate in need thereof, wherein the vector is not a self-complementary AAV.

5. The use of claim 1, wherein the primate is a human, or a non-human primate such as an old world monkey, an orangutan, a gorilla, a chimpanzee, a crab-eating macaque, a rhesus macaque or a pig-tailed macaque.

6. The use of any one of claims 3-5, wherein the vector comprises a nucleotide sequence operably linked to a regulatory element.

7. The use of claim 2 or 6, wherein the regulatory element is selectively expressed in neuronal cells (such as unipolar, bipolar, multipolar, or pseudounipolar neurons, or GABAergic neurons).

8. The use of claim 2 or 6, wherein the regulatory element is selectively expressed in: (1) glial cells, such as astrocytes, oligodendrocytes, ependymal cells, Schwann cells, and satellite cells; or non-neuronal cells.

9. The use of any one of claims 1-8, wherein the vector is administered to more than one ventricle of the brain.

10. The use of any one of claims claim 1-2 or 4-9, wherein the vector is administered bilaterally.

11. The use of claim 9 or 10, wherein the vector is administered simultaneously or sequentially (such as sequentially administered at least 24 hours apart).

12. The use of any one of claims 1-8, wherein the vector is administered to one ventricle of the brain.

13. The use of any one of claims 1-12, wherein the primate further receives an intravenous administration of the vector.

14. The use of any one of claims 1-13, wherein the primate further receives an intrathecal administration (such as intrathecal cisternal administration or intrathecal lumbar administration) of the vector.

15. The use of any one of claims 1-14, wherein the vector comprises a nucleotide sequence encoding a polypeptide.

16. The use of claim 15, wherein the polypeptide is a DNA binding protein, such as a zinc finger protein (ZFP), a zinc finger nuclease (ZFN), or a transcription activator-like effector nuclease (TALEN).

17. The use of claim 15 or 16, wherein the nucleotide sequence is a codon-optimized variant and/or a fragment thereof.

18. The use of any one of claims 1-14, wherein the vector comprises a nucleotide sequence encoding a guide RNA (gRNA).

19. The use of any one of claims 1-18, wherein the vector comprises a nucleotide sequence encoding an interfering RNA (RNAi) that reduces expression of a target gene (for example, the RNAi reduces expression of a target gene selected from the group consisting of SOD1, HTT, Tau, or alpha-synuclein).

20. The use of any one of claims 1-19, wherein the vector comprises a nucleotide sequence encoding an antisense oligonucleotide that reduces expression of a target gene.

21. The use of any one of claims 1-20, wherein the vector is selected from the group consisting of a lentivirus, retrovirus, plasmid, or herpes simplex virus (HSV).

22. The use of any one of claims 1-3 or 5-20, wherein the vector is an adeno-associated viral (AAV) vector.

23. The use of claim 22, wherein the AAV is:

(1) a single-stranded AAV;

(2) a self-complementary AAV;

(3) any one of AAV1, scAAV1, AAV2, AAV3, AAV4, AAV5, scAAV5, AAV6, AAV7, AAV8, AAV9, scAAV9, AAV10, AAV11, AAV12, rh10, avian AAV, bovine AAV, canine AAV, equine AAV, primate AAV, non-primate AAV, or ovine AAV, or any hybrids thereof;

(4) AAV5; or

(5) AAV9.

24. The use of claim 22 or 23, wherein the vector comprises a 5’ AAV inverted terminal repeat (ITR) sequence and a 3’ AAV ITR sequence.

25. The use of any one of claims 1-24, wherein the vector is administered in a pharmaceutically acceptable carrier.

26. The use of any one of claims 1-25, wherein (1) the vector is administered in combination with a contrast agent; or (2) the vector is not administered in combination with a contrast agent.

27. The use of any one of claims 1-26, wherein the administration is by route of injection and/or infusion.

28. Use of a therapeutically effective amount of an adeno-associated virus 1 (AAV1) vector or an adeno-associated virus 5 (AAV5) vector encoding a gene of interest in the manufacture of a medicament for expressing the gene of interest or a biologically active variant and/or fragment thereof in a primate in need thereof, wherein the route of administration of said medicament is selected from the group consisting of intravenous administration, intrathecal administration, intracerebroventricular administration, intraparenchymal administration, or combinations thereof.

29. The use of claim 28, wherein the primate is a human or a non-human primate such as an old world monkey, an orangutan, a gorilla, a chimpanzee, a crab-eating macaque, a rhesus macaque or a pig-tailed macaque.

30. The use of claim 28 or 29, wherein the AAV1 vector or AAV5 vector comprises a nucleotide sequence operably linked to a regulatory element.

31. The use of claim 30, wherein the regulatory element is cell-type selective.

32. The use of claim 31, wherein the regulatory element is selectively expressed in a neuronal cell (such as unipolar, bipolar, multipolar, or pseudounipolar neurons or GABAergic neurons).

33. The use of claim 31, wherein the regulatory element is selectively expressed in glial cells (such as astrocytes, oligodendrocytes, ependymal cells, Schwann cells, and satellite cells); or non-neuronal cells.

34. The use of any one of claims 28-33, wherein the AAV1 or AAV5 is administered to more than one ventricle of the brain; and/or wherein the AAV1 or AAV5 is administered bilaterally.

35. The use of claim 33 or 34, wherein the AAV1 or AAV5 is administered simultaneously or sequentially (such as sequentially administered at least 24 hours apart).

36. The use of any one of claims 28-33, wherein the AAV1 or AAV5 is administered to one ventricle of the brain.

37. The use of any one of claims 28-36, wherein the AAV1 or AAV5 comprises a nucleotide sequence encoding a polypeptide.

38. The use of claim 37, wherein the polypeptide is a DNA binding protein, such as a zinc finger protein (ZFP), a zinc finger nuclease (ZFN), or a transcription activator-like effector nuclease (TALEN).

39. The use of any one of claims 37-38, wherein the nucleotide sequence is a codon-optimized variant and/or a fragment thereof.

40. The use of any one of claims 28-39, wherein the vector comprises a nucleotide sequence encoding a guide RNA (gRNA).

41. The use of any one of claims 28-40, wherein the AAV1 or AAV5 comprises a nucleotide sequence encoding an interfering RNA (RNAi) that reduces expression of a target gene (for example, the RNAi reduces expression of a target gene selected from the group consisting of SOD1, HTT, Tau, or alpha-synuclein).

42. The use of any one of claims 28-41, wherein the AAV1 or AAV5 comprises a nucleotide sequence encoding an antisense oligonucleotide that reduces expression of a target gene.

43. The use of any one of claims 28-42, wherein the vector is selected from the group consisting of a lentivirus, retrovirus, plasmid, or herpes simplex virus (HSV).

44. The use of any one of claims 28-43, wherein the AAV1 or AAV5 is administered in a pharmaceutically acceptable carrier.

45. The use of any one of claims 28-44, wherein the vector is administered in combination with a contrast agent; or wherein the vector is not administered in combination with a contrast agent.

46. The use of any one of claims 28-45, wherein the administration is by route of injection; or by route of infusion.

47. Use of an adeno-associated vector (AAV) in the manufacture of a medicament for inhibiting or treating one or more symptoms associated with a neuronal disease in a primate in need thereof, wherein the AAV is selected from the group consisting of adeno-associated vector 1 (AAV1) or adeno-associated vector 5 (AAV5) to the primate, and wherein the route of administration of said medicament is selected from the group consisting of intravenous administration, intrathecal administration, intracerebroventricular administration, intraparenchymal administration, or combinations thereof.

48. The use of claim 47, wherein the neuronal disease is selected from the group consisting of a lysosomal storage disease, Dravet syndrome, Alzheimer's disease, Parkinson's disease, Huntington's disease, amyotrophic lateral sclerosis (ALS), spinal muscular atrophy (SMA), epilepsy, neurodegeneration, motor disorders, movement disorders, or mood disorders.

49. The use of claim 47 or 48, wherein the primate is a human or a non-human primate such as an old world monkey, an orangutan, a gorilla, a chimpanzee, a crab-eating macaque, a rhesus macaque or a pig-tailed macaque.

50. Use of a vector in the manufacture of a medicament for intracerebroventricular (ICV) administration to a primate in need thereof, wherein the vector comprises a transgene, and wherein ICV administration results in increased transgene expression in the central nervous system (CNS).

51. Use of a vector in the manufacture of a medicament for intracerebroventricular (ICV) administration to a primate, wherein the vector comprises a transgene, and wherein ICV administration results in increased transgene expression in the central nervous system (CNS) by at least 1.25-fold as compared to expression of the transgene when the vector is administered by any other route of administration.

52. The use of claim 50 or 51, wherein:

(1) ICV administration produces at least 1.5-fold, 1.75-fold, 2-fold, 3-fold, 5-fold, 10-fold, 15-fold, 20-fold, 25-fold, 30-fold, 35-fold, 40-fold, 45-fold, 50-fold, 55-fold, 60-fold, 65-fold, 70-fold, or 75-fold greater expression of the transgene sequence in the central nervous system (CNS) as compared to expression of the transgene when the vector is administered by any other route of administration; or

(2) ICV administration produces at least 20-90 fold, 20-80 fold, 20-70 fold, 20-60 fold, 30-90

fold, 30-80 fold, 30-70 fold, 30-60 fold, 40-90 fold, 40-80 fold, 40-70 fold, 40-60 fold, 50-90 fold, 50-80 fold, 50-70 fold, 50-60 fold, 60-90 fold, 60-80 fold, 60-70 fold, 70-90 fold, 70-80 fold, 80-90 fold greater expression of the transgene sequence in the central nervous system (CNS) as compared to expression of the transgene when the vector is administered by any other route of administration.

53. The use of any one of claims 1-27 or 50-52, wherein ICV administration results in gene transfer throughout the brain (for example, the gene transfer occurs in the frontal cortex, parietal cortex, temporal cortex, hippocampus, medulla, and occipital cortex; or the gene transfer is dose dependent).

54. The use of any one of claims 50-52, wherein the vector further comprises a cell-type selective regulatory element.

55. The use of claim 54, wherein:

(1) the regulatory element is selectively expressed in the brain (for example, the regulatory element is selectively expressed in the frontal cortex, parietal cortex, temporal cortex, hippocampus, medulla, and/or occipital cortex);

(2) the regulatory element is selectively expressed in the spine (for example, the regulatory element is selectively expressed in the spinal cord and/or dorsal root ganglion);

(3) the regulatory element is selectively expressed in neuronal cells (such as unipolar, bipolar, multipolar, or pseudounipolar neurons; or GABAergic neurons);

(4) the regulatory element is selectively expressed in non-neuronal cells; or

(5) the regulatory element is selectively expressed in glial cells (such as astrocytes, oligodendrocytes, ependymal cells, Schwann cells, and satellite cells).