Claims:

1. A codon-optimized nucleic acid that encodes a SMN1 protein (survival motor neuron protein) with SEQ ID NO: 1, comprising the nucleic acid sequence of SEQ ID NO: 2.

2. An expression cassette that include the codon-optimized nucleic acid of Claim 1.

3. The expression cassette of Claim 2, including the following elements in the 5'-end to 3'-end direction:

a left (first) ITR (inverted terminal repeats);

a CMV (cytomegalovirus) enhancer;

a CMV (cytomegalovirus) promoter;

an intron of the hBG1 gene (hemoglobin subunit gamma 1 gene)

the codon-optimized nucleic acid of Claim 1;

an hGH1 polyadenylation signal (human growth hormone gene polyadenylation signal)

a right (second) ITR.

4. The expression cassette of Claim 3 that includes a nucleic acid with SEQ ID NO: 4.

5. An expression vector that includes the codon-optimized nucleic acid of Claim 1 or the cassette of Claims 2-4.

6. An AAV9 (adeno-associated virus serotype 9)-based recombinant virus for increasing the expression of the SMN1 gene in target cells, which includes a capsid and the expression cassette of any of Claims 2-4.

7. The AAV9-based recombinant virus of Claim 6, wherein the capsid comprises the AAV9 protein VP1.

8. The AAV9-based recombinant virus of Claim 7, wherein the capsid comprises the AAV9 protein VP1 having the amino acid sequence of SEQ ID NO: 5.

9. The AAV9-based recombinant virus of Claim 7, wherein the capsid comprises the AAV9 protein VP1 having the amino acid sequence of SEQ ID NO: 5 with one or more point mutations.

10. The AAV9-based recombinant virus of Claims 6-9, wherein the capsid comprises the AAV9 protein VP1 having the amino acid sequence of SEQ ID NO: 5 or the amino acid sequence of SEQ ID NO: 5 with one or more point mutations, and the expression cassette includes the following elements in the 5'-end to 3'-end direction:

a CMV enhancer;

a CMV promoter;

an intron of the hBG1 gene;

the codon-optimized nucleic acid of Claim 1;

an hGH1 polyadenylation signal;

a right ITR.

11. The AAV9-based recombinant virus of Claim 6, wherein the capsid includes the AAV9 protein VP1 having the amino acid sequence of SEQ ID NO: 5 or the amino acid sequence of SEQ ID NO: 5 with one or more point mutations, and the expression cassette includes a nucleic acid with SEQ ID NO: 4.

12. A pharmaceutical composition for delivering the SMN1 gene to target cells, including the AAV9-based recombinant virus of Claims 6-11 in combination with one or more pharmaceutically acceptable excipients.