WHAT IS CLAIMED:

1. A nucleic acid encoding an acid α-glucosidase (GAA), wherein said nucleic acid has greater than 90% sequence identity to a sequence selected from the group consisting of any of the sequences set forth as SEQ ID NOs:1-5, and comprises a bovine growth hormone (bGH) poly-adenylation sequence that is CpG reduced compared to wild type bGH poly-adenylation sequence.

2. A nucleic acid encoding GAA, wherein said nucleic acid has greater than 87% sequence identity to a sequence selected from the group consisting of any of the sequences set forth as SEQ ID NOs:1-5 and comprises a bGH poly-adenylation sequence that is CpG reduced compared to wild-type bGH poly-adenylation sequence positioned 3'thereof.

3. A nucleic acid encoding GAA, wherein said nucleic acid has at least 92% sequence identity to a sequence selected from the group consisting of any of the sequences set forth as SEQ ID NOs:11-15.

4. A nucleic acid encoding a GAA selected from the group consisting of SEQ ID NOs:1-24.

5. An expression cassette comprising the nucleic acid of any of claims 1 – 4 operably linked to an expression control element.

6. The expression cassette of claim 5, wherein said expression control element is positioned 5' of said nucleic acid.

7. The expression cassette of claim 6, wherein said expression control element is CpG reduced compared to wild-type expression control element.

8. The expression cassette of any of claims 5 - 7, wherein said expression control element comprises an ApoE/hAAT enhancer/promoter sequence.

9. The expression cassette of claim 8, wherein said ApoE/hAAT enhancer/promoter sequence is CpG reduced compared to wild-type ApoE/hAAT enhancer/promoter sequence.

10. The expression cassette of any of claims 5 - 9, further comprising an intron positioned between the 3' end of said expression control element and the 5' end of said nucleic acid.

11. The nucleic acid sequence or expression cassette of any of claims 1 – 10, wherein said GAA comprises the sequence set forth as SEQ ID NO:25.

12. An adenovirus-associated virus (AAV) vector comprising the nucleic acid or expression cassette of any of claims 1 – 11.

13. The AAV vector of claim 12, wherein said AAV vector comprises:
a) one or more of an AAV capsid, and
b) one or more AAV inverted terminal repeats (ITRs), wherein said AAV ITR(s) flanks the 5' or 3' terminus of said nucleic acid or said expression cassette.

14. The AAV vector of claim 13, further comprising an intron positioned 5' or 3' of said one or more ITRs.

15. The AAV vector of claim 13 or 14, wherein at least one or more of said ITRs or said intron is modified to have reduced CpGs.

16. The AAV vector of any of claims 12 - 15, wherein said AAV vector has a capsid serotype comprising a AAV VP1, VP2 and/or VP3 capsid having 90% or more sequence identity to AAV1, AAV2, AAV3, AAV4, AAV5, AAV6, AAV7, AAV8, AAV9, AAV10, AAV11, Rh10, Rh74, AAV3B, AAV-2i8 or SEQ ID NO:30, 31 or 32 VP1, VP2 and/or VP3 sequences, or a capsid having 95% or more sequence identity to AAV1, AAV2, AAV3, AAV4, AAV5, AAV6, AAV7, AAV8, AAV9, AAV10, AAV11, AAV12, Rh10, Rh74, AAV3B, AAV-2i8, or SEQ ID NO:30, 31 or 32 VP1, VP2 and/or VP3 sequences, or a capsid having 100% sequence identity to AAV1, AAV2, AAV3, AAV4, AAV5, AAV6, AAV7, AAV8, AAV9, AAV10, AAV11, Rh10, Rh74, AAV3B, AAV-2i8, or SEQ ID NO:30, 31 or 32 VP1, VP2 and/or VP3 sequences.

17. The AAV vector of any of claims 13 - 16, wherein said ITRs comprise one or more ITRs of any of: AAV1, AAV2, AAV3, AAV4, AAV5, AAV6, AAV7, AAV8, AAV9, AAV10, AAV11, Rh10, Rh74 or AAV3B, AAV serotypes, or a combination thereof.

18. A pharmaceutical composition comprising a plurality of AAV vectors of any of claims 12 – 17 in a biologically compatible carrier or excipient.

19. The pharmaceutical composition of claim 18, further comprising empty AAV capsids.

20. The pharmaceutical composition of claim 19, wherein the ratio of said empty AAV capsids to said AAV vector is within or between 100:1-50:1, from 50:1-25:1, from 25:1-10:1, from 10:1-1:1, from 1:1-1:10, from 1:10-1:25, from 1:25-1:50, or from 1:50-1:100.

21. The pharmaceutical composition of any of claims 19 – 20, further comprising a surfactant.

22. The AAV vector of any of claims 12 – 17, or the pharmaceutical composition of any of claims 18 – 21 for use in therapy.

23. Use of the AAV vector of any of claims 12 – 17, or the pharmaceutical composition of any of claims 18 – 21 in the manufacture of a medicament for the treatment of glycogen storage disease (GSD) type II in a human, wherein the medicament is to be administered to said human, wherein said GAA is expressed in said human.

24. The use of claim 23, wherein said GSD type II is Pompe disease.

25. The use of claim 23, wherein said GSD type II is infantile onset Pompe disease.

26. The use of claim 23, wherein said GSD type II is late onset Pompe disease.

27. The use of any of claims 23 – 26, wherein said AAV vector is to be administered to said human intravenously, intraarterially, intra-cavity, intramucosally, or via catheter.

28. The use of any of claims 23 – 27, wherein said AAV vector is to be administered in a range from $1X10^{8}$ to $1X10^{14}$ vector genomes per kilogram (vg/kg) of the weight of said human.

29. A cell comprising the nucleic acid or expression cassette of any of claims 1 – 11.

30. A cell that produces the AAV vector of any of claims 12 – 17.

31. A method of producing the AAV vector of any of claims 12 – 17, comprising
a. introducing an AAV vector genome comprising said nucleic acid or expression cassette of any of claims 12 – 17 into a packaging helper cell; and
b. culturing said helper cell under conditions to produce said AAV vector.

32. The cell of any of claims 29 or 30 or the method of claim 31, wherein said cell comprises mammalian cells.

33. The cell of any of claims 29 or 30 or the method of claim 31, wherein said cell provides AAV helper functions.

34. The cell of any of claims 29 or 30 or the method of claim 31, wherein said cell provides AAV Rep and/or Cap proteins.

35. The cell of any of claims 29 or 30 or the method of claim 31, wherein said cell comprises HEK-293 cells.