CLAIMS

What is claimed is:

1. A small activating RNA (saRNA) for activating/up-regulating the expression of SMN2 gene in a cell, comprising a sense nucleic acid fragment and an antisense nucleic acid fragment, wherein the sense nucleic acid fragment and the antisense nucleic acid fragment comprise complementary regions, wherein the complementary regions form a double-stranded nucleic acid structure that can activate the expression of the SMN2 gene in a cell, wherein the sense nucleic acid fragment or the antisense nucleic acid fragment is identical or complementary to any of nucleotide sequence selected from SEQ ID NOs: 315-471 (provided that thymine is converted to uracil).

2. The saRNA of claim 1, wherein the sense nucleic acid fragment and the antisense nucleic acid fragment are located on two different nucleic acid strands.

3. The saRNA of claim 1, wherein the sense nucleic acid fragment and the antisense nucleic acid fragment are located on an identical nucleic acid strand, wherein the complementary regions of the sense nucleic acid fragment and the antisense nucleic acid fragment form a double-stranded nucleic acid structure.

4. The saRNA of claim 3, wherein the sense nucleic acid fragment and the antisense nucleic acid fragment forms a hairpin single-stranded nucleic acid molecule.

5. The saRNA of claim 2, wherein at least one strand has a 3' overhang of 0 to 6 nucleotides in length.

6. The saRNA of claim 5, wherein both strands have a 3' overhang of 2 to 3 nucleotides in length.

7. The saRNA of any of claims 1-6, wherein the sense nucleic acid fragment and the antisense nucleic acid fragment independently have 16 to 35 nucleotides in length.

8. The saRNA of claim 1, wherein the combination of the sense nucleic acid fragment and the antisense nucleic acid fragment is selected from the group consisting of SEQ ID NO: 1 and SEQ ID NO: 158; SEQ ID NO: 2 and SEQ ID NO: 159; SEQ ID NO: 3 and SEQ ID NO: 160; SEQ ID NO: 4 and SEQ ID NO: 161; SEQ ID NO: 5 and SEQ ID NO: 162; SEQ ID NO: 6 and SEQ ID NO: 163; SEQ ID NO: 7 and SEQ ID NO: 164;

SEQ ID NO: 8 and SEQ ID NO: 165; SEQ ID NO: 9 and SEQ ID NO: 166; SEQ ID NO: 10 and SEQ ID NO: 167; SEQ ID NO: 11 and SEQ ID NO: 168; SEQ ID NO: 12 and SEQ ID NO: 169; SEQ ID NO: 13 and SEQ ID NO: 170; SEQ ID NO: 14 and SEQ ID NO: 171; SEQ ID NO: 15 and SEQ ID NO: 172; SEQ ID NO: 16 and SEQ ID NO: 173; SEQ ID NO: 17 and SEQ ID NO: 174; SEQ ID NO: 18 and SEQ ID NO: 175; SEQ ID NO: 19 and SEQ ID NO: 176; SEQ ID NO: 20 and SEQ ID NO: 177; SEQ ID NO: 21 and SEQ ID NO: 178; SEQ ID NO: 22 and SEQ ID NO: 179; SEQ ID NO: 23 and SEQ ID NO: 180; SEQ ID NO: 24 and SEQ ID NO: 181; SEQ ID NO: 25 and SEQ ID NO: 182; SEQ ID NO: 26 and SEQ ID NO: 183; SEQ ID NO: 27 and SEQ ID NO: 184; SEQ ID NO: 28 and SEQ ID NO: 185; SEQ ID NO: 29 and SEQ ID NO: 186; SEQ ID NO: 30 and SEQ ID NO: 187; SEQ ID NO: 31 and SEQ ID NO: 188; SEQ ID NO: 32 and SEQ ID NO: 189; SEQ ID NO: 33 and SEQ ID NO: 190; SEQ ID NO: 34 and SEQ ID NO: 191; SEQ ID NO: 35 and SEQ ID NO: 192; SEQ ID NO: 36 and SEQ ID NO: 193; SEQ ID NO: 37 and SEQ ID NO: 194; SEQ ID NO: 38 and SEQ ID NO: 195; SEQ ID NO: 39 and SEQ ID NO: 196; SEQ ID NO: 40 and SEQ ID NO: 197; SEQ ID NO: 41 and SEQ ID NO: 198; SEQ ID NO: 42 and SEQ ID NO: 199; SEQ ID NO: 43 and SEQ ID NO: 200; SEQ ID NO: 44 and SEQ ID NO: 201; SEQ ID NO: 45 and SEQ ID NO: 202; SEQ ID NO: 46 and SEQ ID NO: 203; SEQ ID NO: 47 and SEQ ID NO: 204; SEQ ID NO: 48 and SEQ ID NO: 205; SEQ ID NO: 49 and SEQ ID NO: 206; SEQ ID NO: 50 and SEQ ID NO: 207; SEQ ID NO: 51 and SEQ ID NO: 208; SEQ ID NO: 52 and SEQ ID NO: 209; SEQ ID NO: 53 and SEQ ID NO: 210; SEQ ID NO: 54 and SEQ ID NO: 211; SEQ ID NO: 55 and SEQ ID NO: 212; SEQ ID NO: 56 and SEQ ID NO: 213; SEQ ID NO: 57 and SEQ ID NO: 214; SEQ ID NO: 58 and SEQ ID NO: 215; SEQ ID NO: 59 and SEQ ID NO: 216; SEQ ID NO: 60 and SEQ ID NO: 217; SEQ ID NO: 61 and SEQ ID NO: 218; SEQ ID NO: 62 and SEQ ID NO: 219; SEQ ID NO: 63 and SEQ ID NO: 220; SEQ ID NO: 64 and SEQ ID NO: 221; SEQ ID NO: 65 and SEQ ID NO: 222; SEQ ID NO: 66 and SEQ ID NO: 223; SEQ ID NO: 67 and SEQ ID NO: 224; SEQ ID NO: 68 and SEQ ID NO: 225; SEQ ID NO: 69 and SEQ ID NO: 226; SEQ ID NO: 70 and SEQ ID NO: 227; SEQ ID NO: 71 and SEQ ID NO: 228; SEQ ID NO: 72 and SEQ ID NO: 229; SEQ ID NO: 73 and SEQ ID NO: 230; SEQ ID NO: 74 and SEQ ID NO: 231; SEQ ID NO: 75

and SEQ ID NO: 232; SEQ ID NO: 76 and SEQ ID NO: 233; SEQ ID NO: 77 and SEQ ID NO: 234; SEQ ID NO: 78 and SEQ ID NO: 235; SEQ ID NO: 79 and SEQ ID NO: 236; SEQ ID NO: 80 and SEQ ID NO: 237; SEQ ID NO: 81 and SEQ ID NO: 238; SEQ ID NO: 82 and SEQ ID NO: 239; SEQ ID NO: 83 and SEQ ID NO: 240; SEQ ID NO: 84 and SEQ ID NO: 241; SEQ ID NO: 85 and SEQ ID NO: 242; SEQ ID NO: 86 and SEQ ID NO: 243; SEQ ID NO: 87 and SEQ ID NO: 244; SEQ ID NO: 88 and SEQ ID NO: 245; SEQ ID NO: 89 and SEQ ID NO: 246; SEQ ID NO: 90 and SEQ ID NO: 247; SEQ ID NO: 91 and SEQ ID NO: 248; SEQ ID NO: 92 and SEQ ID NO: 249; SEQ ID NO: 93 and SEQ ID NO: 250; SEQ ID NO: 94 and SEQ ID NO: 251; SEQ ID NO: 95 and SEQ ID NO: 252; SEQ ID NO: 96 and SEQ ID NO: 253; SEQ ID NO: 97 and SEQ ID NO: 254; SEQ ID NO: 98 and SEQ ID NO: 255; SEQ ID NO: 99 and SEQ ID NO: 256; SEQ ID NO: 100 and SEQ ID NO: 257; SEQ ID NO: 101 and SEQ ID NO: 258; SEQ ID NO: 102 and SEQ ID NO: 259; SEQ ID NO: 103 and SEQ ID NO: 260; SEQ ID NO: 104 and SEQ ID NO: 261; SEQ ID NO: 105 and SEQ ID NO: 262; SEQ ID NO: 106 and SEQ ID NO: 263; SEQ ID NO: 107 and SEQ ID NO: 264; SEQ ID NO: 108 and SEQ ID NO: 265; SEQ ID NO: 109 and SEQ ID NO: 266; SEQ ID NO: 110 and SEQ ID NO: 267; SEQ ID NO: 111 and SEQ ID NO: 268; SEQ ID NO: 112 and SEQ ID NO: 269; SEQ ID NO: 113 and SEQ ID NO: 270; SEQ ID NO: 114 and SEQ ID NO: 271; SEQ ID NO: 115 and SEQ ID NO: 272; SEQ ID NO: 116 and SEQ ID NO: 273; SEQ ID NO: 117 and SEQ ID NO: 274; SEQ ID NO: 118 and SEQ ID NO: 275; SEQ ID NO: 119 and SEQ ID NO: 276; SEQ ID NO: 120 and SEQ ID NO: 277; SEQ ID NO: 121 and SEQ ID NO: 278; SEQ ID NO: 122 and SEQ ID NO: 279; SEQ ID NO: 123 and SEQ ID NO: 280; SEQ ID NO: 124 and SEQ ID NO: 281; SEQ ID NO: 125 and SEQ ID NO: 282; SEQ ID NO: 126 and SEQ ID NO: 283; SEQ ID NO: 127 and SEQ ID NO: 284; SEQ ID NO: 128 and SEQ ID NO: 285; SEQ ID NO: 129 and SEQ ID NO: 286; SEQ ID NO: 130 and SEQ ID NO: 287; SEQ ID NO: 131 and SEQ ID NO: 288; SEQ ID NO: 132 and SEQ ID NO: 289; SEQ ID NO: 133 and SEQ ID NO: 290; SEQ ID NO: 134 and SEQ ID NO: 291; SEQ ID NO: 135 and SEQ ID NO: 292; SEQ ID NO: 136 and SEQ ID NO: 293; SEQ ID NO: 137 and SEQ ID NO: 294; SEQ ID NO: 138 and SEQ ID NO: 295; SEQ ID NO: 139 and SEQ ID NO: 296; SEQ ID NO: 140 and SEQ ID NO: 297; SEQ ID NO: 141 and SEQ ID NO:

298; SEQ ID NO: 142 and SEQ ID NO: 299; SEQ ID NO: 143 and SEQ ID NO: 300; SEQ ID NO: 144 and SEQ ID NO: 301; SEQ ID NO: 145 and SEQ ID NO: 302; SEQ ID NO: 146 and SEQ ID NO: 303; SEQ ID NO: 147 and SEQ ID NO: 304; SEQ ID NO: 148 and SEQ ID NO: 305; SEQ ID NO: 149 and SEQ ID NO: 306; SEQ ID NO: 150 and SEQ ID NO: 307; SEQ ID NO: 151 and SEQ ID NO: 308; SEQ ID NO: 152 and SEQ ID NO: 309; SEQ ID NO: 153 and SEQ ID NO: 310; SEQ ID NO: 154 and SEQ ID NO: 311; SEQ ID NO: 155 and SEQ ID NO: 312; SEQ ID NO: 156 and SEQ ID NO: 313; and SEQ ID NO: 157 and SEQ ID NO: 314 .

9. The saRNA of any of claims 1-8, wherein at least one nucleotide is a chemically modified nucleotide.

10. The saRNA of claim 9, wherein the chemical modification is at least one of the following modifications:

a) modification of a phosphodiester bond connecting nucleotides in the nucleotide sequence of the saRNA;

b) modification of 2'-OH of a ribose in the nucleotide sequence of the saRNA; and

c) modification of a base in the nucleotide sequence of the saRNA.

11. The saRNA of any of claims 1-10, wherein the saRNA activates/up-regulates the expression of SMN2 gene by at least 10%.

12. A cell comprising the saRNA of any one of claims 1-11.

13. A composition comprising the saRNA of any one of claims 1-11.

14. The composition of claim 13 further comprising a pharmaceutically acceptable carrier.

15. The composition of claim 14, wherein the pharmaceutically acceptable carrier is chosen from an aqueous carrier, a liposome, a high-molecular polymer and/or a polypeptide.

16. The composition of any of claims 13-15, wherein the composition comprises 1-150 nM of the saRNA.

17. The use of the saRNA of any one of claims 1-11, or the composition of any of claims 13-16 in preparing a medicament for treating a disease or condition induced by insufficient expression of SMN protein, SMN1 gene mutation or deletion or insufficient

expression of full-length SMN1 protein, and/or insufficient expression of full-length SMN2 protein in an individual.

18. The use of claim 17, wherein the disease or condition is a hereditary neuromuscular disease.

19. The use of claim 18, wherein the hereditary neuromuscular disease is spinal muscular atrophy.

20. The use of any of claims 17-19, wherein the individual is a mammal.

21. The use of claim 20, wherein the mammal is a human.

22. The use of the saRNA of any one of claims 1-11 or the composition of any of claims 13-16 in preparing a preparation for activating/up-regulating expression of SMN2 gene in a cell.

23. The use of claim 22, wherein the saRNA of any one of claims 1-11 or the composition of any of claims 13-16 is directly introduced into the cell.

24. The use of claim 23, wherein the saRNA is self-amplified in the cell after the saRNA is introduced into the cell.

25. The use of any of claims 22-24, wherein the cell is a mammalian cell.

26. The use of claims 25, wherein the mammalian cell is a human cell.

27. The use of claim 26, wherein the cell is in a human body.

28. The use of claim 27, wherein the human body is a patient suffering from a symptom induced by insufficient expression of SMN protein, SMN1 gene mutation or SMN1 gene deletion or insufficient expression of full-length SMN1 protein, and/or insufficient expression of full-length SMN2 protein, wherein the saRNA or the composition is administered in a sufficient amount to treat the symptom.

29. The use of claim 28, wherein the symptom induced by insufficient expression of full-length SMN protein is a hereditary neuromuscular disease.

30. The use of claim 29, wherein the hereditary neuromuscular disease is spinal muscular atrophy.

31. An *in vitro* method for activating/up-regulating expression of SMN2 gene in a cell comprising: administering the saRNA of any of claims 1-11 or the composition of any of claims 13-16 to the cell, provided that the method is not a surgery or therapy

directly conducted on human.

32. The method of claim 31, wherein the saRNA of any of claims 1-11, or the composition of any of claims 13-16 is directly introduced into the cell.

33. The method of claim 32, wherein the saRNA is self-amplified in the cell after the saRNA is introduced into the cell.

34. The method of any of claims 31-33, wherein the cell is a mammalian cell.

35. The method of claim 34, wherein the mammalian cell is a human cell.

36. The composition of any of claims 13-16 for activating/up-regulating expression of SMN2 gene in the cell of a human body, wherein the human body is a patient suffering from a symptom induced by insufficient expression of full-length SMN protein, SMN1 gene mutation or deletion or insufficient expression of full-length SMN1 protein, and/or insufficient expression of full-length SMN2 protein, wherein the composition is administered in a sufficient amount to treat the symptom.

37. The composition of claim 36, wherein the symptom caused by insufficient expression of full-length SMN protein is hereditary neuromuscular disease.

38. The composition of claim 37, wherein the hereditary neuromuscular disease is spinal muscular atrophy.