

WHAT IS CLAIMED IS:

1. A recombinant nucleic acid molecule comprising:
 - a negative strand nucleic acid molecule or a pregenomic RNA (pgRNA) nucleic acid molecule encoding a chemokine, a cytokine, an apoptosis inducing protein, a diphtheria toxin A, a diphtheria toxin A fragment, or any combination thereof, flanked by a first and second viral transcription recognition signal, wherein the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a virus selected from the group consisting of hepatitis B virus, influenza virus and coronavirus
 - a first promoter upstream (5') of the first viral transcription recognition signal; and
 - a second promoter adjacent and 5' to the negative strand nucleic acid molecule or pgRNA nucleic acid molecule encoding a chemokine, a cytokine, an apoptosis inducing protein, a diphtheria toxin A, a diphtheria toxin A fragment, or any combination thereof, wherein
 - a. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a hepatitis B virus and the viral transcription recognition signal is an epsilon recognition signal of SEQ ID NO:1;
 - b. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from an influenza virus and the viral transcription recognition signal is selected from the group consisting of SEQ ID NO: 22 and SEQ ID: NO: 23; or
 - c. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a coronavirus and the viral transcription recognition signal is selected from the group consisting of: SEQ ID NO: 25, SEQ ID NO: 26, SEQ ID NO: 28, and SEQ ID NO: 30.
2. The recombinant nucleic acid molecule of claim 1, wherein the negative strand nucleic acid molecule is negative sense RNA, negative sense DNA, single or double strand DNA that expresses a non-coding, negative sense RNA, or any combination thereof.

3. The recombinant nucleic acid molecule of claim 1 or 2, further comprising a poly A tail downstream (3') of the negative strand nucleic acid molecule or pgRNA nucleic acid molecule encoding a chemokine, a cytokine, an apoptosis inducing protein, or combination thereof.
4. The recombinant nucleic acid molecule of any one of claims 1-3, wherein the negative strand nucleic acid molecule or a pgRNA nucleic acid molecule encodes an apoptosis inducing protein is selected from the group consisting of BAX, BID, BAK, BAD, caspase 2, caspase 8, caspase 9, caspase 10, caspase 11, caspase 12, cytochrome C, SMAC, and apoptosis-inducing factor, or any combination thereof.
5. The recombinant nucleic acid molecule of any one of claims 1-4, wherein the first promoter comprises a strong ubiquitous promoter or a liver-tissue-specific promoter, selected from the group consisting of TBG (Thyroxine Binding Globulin), albumin promoter and/or enhancing element, AFP (alpha-fetoprotein) promoter, AAT (Alpha-1-antitrypsin) promoter, ApoE (Apolipoprotein E) promoter or PEPCK (Phosphoenolpyruvate carboxykinase) promoter.
6. The recombinant nucleic acid molecule of any one of claims 1-5, wherein the second promoter comprises elongation factor 1 alpha binding sequence (EFS).
7. The recombinant nucleic acid molecule of any one of claims 1-6, wherein the negative strand nucleic acid molecule or a pgRNA nucleic acid molecule encodes a chemokine selected from CCL1, CCL2, CCL3, CCL4, CCL5, CCL6, CCL7, CCL8, CCL9, CCL10, CCL11, CCL12, CCL13, CCL14, CCL15, CCL16, CCL17, CCL18, CCL19, CCL20, CCL21, CCL22, CCL23, CCL24, CCL25, CCL26, CCL27, CCL28, CXCL1, CXCL2, CXCL8, CXCL9, CXCL10, CXCL11, CXCL12, CXCL13, CXCL14, CXCL15, CXCL16, CXCL17, XCL1, XCL2, and CX3CL1.
8. The recombinant nucleic acid molecule of any one of claims 1-7, wherein the negative strand nucleic acid molecule or a pgRNA nucleic acid molecule encodes a cytokine selected from the group consisting of IL-15, IL-2, IL-8, IL-10, IL-12, IL-6, IFN- α , IFN- β , IFN- γ , TNF- α , CD40L, Mig, and Crg-2.

9. A vector comprising the recombinant nucleic acid sequence of any one of claims 1-8.
10. The vector of claim 9, wherein the vector comprises a delivery vector or vehicle for delivery to a mammalian cell.
11. The vector of claim 10, wherein the delivery vector or vehicle comprises a VLP, an adeno-associated virus (AAV), a liposome, a nanoparticle, a micelle, a polymeric vesicle, or a polymersome.
12. A pharmaceutical composition comprising any one of the recombinant nucleic acid sequences of any one of claims 1-8 or a vector of any one of claims 9-11.
13. A replication incompetent virus-like particle (VLP) comprising:
 - a negative strand nucleic acid molecule or a pregenomic RNA (pgRNA) nucleic acid molecule encoding a chemokine, a cytokine, a apoptosis inducing protein, a diphtheria toxin A, a diphtheria toxin A fragment, or any combination thereof, flanked by a first and second viral transcription recognition signal;
 - a first promoter upstream (5') of the first viral transcription recognition signal; and
 - a second promoter adjacent and 5' to the negative strand nucleic acid molecule or pgRNA nucleic acid molecule encoding a chemokine, a cytokine, a apoptosis inducing protein, a diphtheria toxin A, a diphtheria toxin A fragment), or any combination thereof, wherein
 - a. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a hepatitis B virus and the viral transcription recognition signal is an epsilon recognition signal of SEQ ID NO:1;
 - b. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from an influenza virus and the viral transcription recognition signal is selected from the group consisting of SEQ ID NO: 22 and SEQ ID: NO: 23; orthe negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a coronavirus and the viral transcription recognition signal is selected from the group consisting of: SEQ ID NO: 25, SEQ ID NO: 26, SEQ ID NO: 28, and SEQ ID NO: 30.

14. A replication incompetent virus-like particle (VLP) comprising:
- a negative strand nucleic acid molecule or a pregenomic RNA (pgRNA) nucleic acid molecule encoding a chemokine, a cytokine, a apoptosis inducing protein, a diphtheria toxin A, a diphtheria toxin A fragment), or any combination thereof, flanked by a first and second target viral transcription recognition signal;
 - a first promoter upstream (5') of the first viral transcription recognition signal; and
 - a second promoter adjacent and 5' to the negative strand nucleic acid molecule or pgRNA nucleic acid molecule encoding a chemokine, a cytokine, a apoptosis inducing protein, a diphtheria toxin A, a diphtheria toxin A fragment), or any combination thereof, wherein the VLP exhibits tropism for the target virally infected cells, wherein
 - a. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a hepatitis B virus and the viral transcription recognition signal is an epsilon recognition signal of SEQ ID NO:1;
 - b. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from an influenza virus and the viral transcription recognition signal is selected from the group consisting of SEQ ID NO: 22 and SEQ ID: NO: 23; or
 - c. the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a coronavirus and the viral transcription recognition signal is selected from the group consisting of: SEQ ID NO: 25, SEQ ID NO: 26, SEQ ID NO: 28, and SEQ ID NO: 30.
15. A pharmaceutical composition comprising the replication incompetent virus-like particle of claim 13 or 14.
16. Use of the recombinant nucleic acid molecule of any one of claims 1-8, the vector of any one of claims 9-11, the pharmaceutical composition of claim 12 or 15, or the replication incompetent virus-like particle of claim 13 or 14 in the preparation of a medicament for inducing an apoptotic response against a cell infected with a virus selected from the group consisting of hepatitis B, influenza, or coronavirus in a subject in need thereof.
17. Use of the recombinant nucleic acid molecule of any one of claims 1-8, the vector of any one of claims 9-11, the pharmaceutical composition of claim 12 or 15, or the replication

incompetent virus-like particle of claim 13 or 14 in the preparation of a medicament for treating a hepatitis B, influenza, or coronavirus infection in a subject in need thereof.

18. The replication incompetent virus-like particle of claim 13, further comprising an optional translocation motif (TLM) fused to a capsid protein from a hepatitis B viral capsid or a hepatitis D viral capsid or coronavirus fusion protein.

19. A recombinant nucleic acid molecule comprising:

a negative strand nucleic acid molecule or a pregenomic RNA (pgRNA) nucleic acid molecule encoding a chemokine, a cytokine, an apoptosis inducing protein, or any combination thereof, flanked by a first and second viral transcription recognition signal, wherein the negative strand nucleic acid molecule or pgRNA nucleic acid molecule is from a virus selected from the group consisting of hepatitis B virus, influenza virus and coronavirus;

a first promoter upstream (5') of the first viral transcription recognition signal; and

a second promoter adjacent and 5' to the negative strand nucleic acid molecule or pgRNA nucleic acid molecule encoding a chemokine, a cytokine, an apoptosis inducing protein, or any combination thereof; wherein

the apoptosis inducing protein is selected from the group consisting of BAX, BID, BAK, BAD, caspase 2, caspase 8, caspase 9, caspase 10, caspase 11, caspase 12, cytochrome C, SMAC, and apoptosis-inducing factor, or any combination thereof;

the chemokine selected from CCL1, CCL2, CCL3, CCL4, CCL5, CCL6, CCL7, CCL8, CCL9, CCL10, CCL11, CCL12, CCL13, CCL14, CCL15, CCL16, CCL17, CCL18, CCL19, CCL20, CCL21, CCL22, CCL23, CCL24, CCL25, CCL26, CCL27, CCL28, CXCL1, CXCL2, CXCL8, CXCL9, CXCL10, CXCL11, CXCL12, CXCL13, CXCL14, CXCL15, CXCL16, CXCL17, XCL1, XCL2, and CX3CL1; or

cytokine selected from the group consisting of IL-15, IL-2, IL-8, IL-10, IL-12, IL-6, IFN- α , IFN- β , IFN- γ , TNF- α , CD40L, Mig, and Crg-2.