

Claims

1. A composition comprising a combination of at least three isolated or synthetic transcription factors, the first and second being isolated or synthetic PU.1 and IRF4 transcription factors at least 90% identical to a sequence of: (PU.1) SEQ. ID. 3 or SEQ. ID. 6 and (IRF4) SEQ. ID. 9 or SEQ. ID. 12 respectively, and the third being an isolated or synthetic transcription factor at least 90% identical to a sequence selected from the group consisting of: PRDM1 (SEQ. ID. 15, SEQ. ID. 18), IRF2 (SEQ. ID. 21, SEQ. ID. 24), POU2F2 (SEQ. ID. 27, SEQ. ID. 30), TGIF1 (SEQ. ID. 33, SEQ. ID. 36), RBPJ (SEQ. ID. 45, SEQ. ID. 48), and RELB (SEQ. ID. 39, SEQ. ID. 42); for use in reprogramming stem cells or differentiated cells, or mixtures thereof into conventional dendritic cells type 2 (cDC2) or CD11b-positive dendritic cells.
2. The composition for the use according to any one of the previous claims wherein the transcription factors individually are encoded by polynucleotides being at least 90% identical to the following sequences: PU.1 (SEQ. ID. 1, SEQ. ID. 2, SEQ. ID. 4, SEQ. ID. 5), IRF4 (SEQ. ID. 7, SEQ. ID. 8, SEQ. ID. 10, SEQ. ID. 11), PRDM1 (SEQ. ID. 13, SEQ. ID. 14, SEQ. ID. 16, SEQ. ID. 17), IRF2 (SEQ. ID. 19, SEQ. ID. 20, SEQ. ID. 22, SEQ. ID. 23), POU2F2 (SEQ. ID. 25, SEQ. ID. 26, SEQ. ID. 28, SEQ. ID. 29), TGIF1 (SEQ. ID. 31, SEQ. ID. 32, SEQ. ID. 34, SEQ. ID. 35), RBPJ (SEQ. ID. 43, SEQ. ID. 44, SEQ. ID. 46, SEQ. ID. 47), and RELB (SEQ. ID. 37, SEQ. ID. 38, SEQ. ID. 40, SEQ. ID. 41).
3. The composition for the use according to any one of the previous claims wherein the transcription factors individually are encoded by polynucleotide at least 95% identical to the following sequences: PU.1 (SEQ. ID. 1, SEQ. ID. 2, SEQ. ID. 4, SEQ. ID. 5), IRF4 (SEQ. ID. 7, SEQ. ID. 8, SEQ. ID. 10, SEQ. ID. 11), PRDM1 (SEQ. ID. 13, SEQ. ID. 14, SEQ. ID. 16, SEQ. ID. 17), IRF2 (SEQ. ID. 19, SEQ. ID. 20, SEQ. ID. 22, SEQ. ID. 23), POU2F2 (SEQ. ID. 25, SEQ. ID. 26, SEQ. ID. 28, SEQ. ID. 29), TGIF1 (SEQ. ID. 31, SEQ. ID. 32, SEQ. ID. 34, SEQ. ID. 35), RBPJ (SEQ. ID. 43, SEQ. ID. 44, SEQ. ID. 46, SEQ. ID. 47), RELB (SEQ. ID. 37, SEQ. ID. 38, SEQ. ID. 40, SEQ. ID.

- 41) or the isolated or synthetic transcription factors individually are at least 95% identical to the following sequences: PU.1 (SEQ. ID. 3, SEQ. ID. 6), IRF4 (SEQ. ID. 9, SEQ. ID. 12), PRDM1 (SEQ. ID. 15, SEQ. ID. 18), IRF2 (SEQ. ID. 21, SEQ. ID. 24), POU2F2 (SEQ. ID. 27, SEQ. ID. 30), TGIF1 (SEQ. ID. 33, SEQ. ID. 36), RBPJ (SEQ. ID. 45, SEQ. ID. 48), RELB (SEQ. ID. 39, SEQ. ID. 42).
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4. The composition for the use according to any one of the previous claims wherein the combination of transcription factors is selected from the following combinations:
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- PU.1, IRF4 and PRDM1;
PU.1, IRF4 and IRF2;
PU.1, IRF4 and POU2F2;
PU.1, IRF4 and TGIF1;
PU.1, IRF4 and RBPJ; and
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- PU.1, IRF4 and RELB.
5. The composition according to any one of the previous claims wherein the combination of transcription factors is: PU.1, IRF4 and PRDM1 or PU.1, IRF4 and IRF2.
6. The composition according to any one of the previous claims, wherein the
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- cell is selected from the group consisting of: pluripotent stem cell, multipotent stem cell, differentiated cell, tumor cell, cancer cell and mixtures thereof.
7. A construct or a vector encoding the combination of transcription factors according to any one of the previous claims.
8. The construct or vector according to claim 7, wherein the combination of
- 25
- encoded transcription factors is in the following sequential order from 5' to 3':
PU.1, IRF4 and PRDM1;
PU.1, IRF4 and IRF2;
PU.1, IRF4 and POU2F2;
PU.1, IRF4 and TGIF1;
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- PU.1, IRF4 and RBPJ; or
PU.1, IRF4 and RELB.

9. The construct or vector according to claims 7 to 8, wherein the vector is a viral vector; in particular a retroviral, adenoviral, lentiviral, herpes viral, pox viral, paramyxoviral, rabdoviral, alphaviral, flaviviral or adeno-associated viral vector.
- 5 10. The construct or vector according to claims 7 to 9, wherein the vector or construct is synthetic mRNA, naked alphavirus RNA replicons or naked flavivirus RNA replicons.
- 10 11. One or more vectors comprising at least three polynucleotide sequences encoding at least three transcription factors, the first and second being PU.1 and IRF4 and the third being selected from the group consisting of: PRDM1, IRF2, POU2F2, RBPJ, RELB and TGIF1, for use in reprogramming of stem cells or differentiated cells into conventional dendritic cells type 2 (cDC2) or CD11b-positive dendritic cells.
- 15 12. The one or more vectors according to claim 11, wherein the transcription factors individually are encoded by polynucleotides being at least 90% identical to the following sequences: PU.1 (SEQ. ID. 1, SEQ. ID. 2, SEQ. ID. 4, SEQ. ID. 5), IRF4 (SEQ. ID. 7, SEQ. ID. 8, SEQ. ID. 10, SEQ. ID. 11), PRDM1 (SEQ. ID. 13, SEQ. ID. 14, SEQ. ID. 16, SEQ. ID. 17), IRF2 (SEQ. ID. 19, SEQ. ID. 20, SEQ. ID. 22, SEQ. ID. 23), POU2F2 (SEQ. ID. 25, SEQ. ID. 26, SEQ. ID. 28, SEQ. ID. 29), TGIF1 (SEQ. ID. 31, SEQ. ID. 32, SEQ. ID. 34, SEQ. ID. 35), RELB (SEQ. ID. 37, SEQ. ID. 38, SEQ. ID. 40, SEQ. ID. 41) and RBPJ (SEQ. ID. 43, SEQ. ID. 44, SEQ. ID. 46, SEQ. ID. 47).
- 20 13. The one or more vectors according to claims 11 to 12, wherein the combination of encoded transcription factors is selected from the following combinations:
- 25 PU.1, IRF4 and PRDM1;
PU.1, IRF4 and IRF2;
PU.1, IRF4 and POU2F2;
PU.1, IRF4 and TGIF1;
30 PU.1, IRF4 and RBPJ; and
PU.1, IRF4 and RELB.

14. One or more vectors comprising at least three polynucleotide sequences encoding at least three transcription factors, wherein the transcription factors are PU.1, IRF4 and PRDM1.
- 5 15. The one or more vectors according to claims 11 to 13, wherein the one or more vectors are viral vectors; in particular retroviral, adenoviral, lentiviral, herpes viral, pox viral, paramyxoviral, rabdoviral, alphaviral, flaviviral or adeno-associated viral vectors.
- 10 16. The one or more vectors according to claims 11 to 15, wherein the one or more vectors or constructs are synthetic mRNA, naked alphavirus RNA replicons or naked flavivirus RNA replicons.
17. The one or more vectors according to claims 11 to 16, wherein the cell is selected from the group consisting of: pluripotent stem cell, multipotent stem cell, differentiated cell, tumor cell, cancer cell and mixtures thereof.
- 15 18. The one or more vectors according to claims 11 to 17, for use in veterinary or human medicine, particularly in immunotherapy, or in the treatment or therapy of neurodegenerative diseases, or in autoimmune diseases, immunodeficiency, or in the treatment or therapy of cancer or in the treatment or therapy of an infectious disease; intradermal and transdermal therapies; in immunotherapy, or in neurodegenerative or ageing diseases, or in cancer or in infectious diseases, as a drug screening; or for use in the treatment, therapy or diagnosis of a central and peripheral nervous system disorder, neoplasia in particular cancer, namely solid or hematological tumors, immunological diseases, in particular autoimmune diseases, hypersensitivities, or immunodeficiency; of fungal, viral, chlamydial, bacterial, 20 nanobacterial or parasitic infectious diseases; of HIV, infection with SARS coronavirus, Asian flu virus, herpes simplex, herpes zoster, hepatitis, or viral hepatitis.
- 25 19. An *in vitro* or *ex vivo* method for reprogramming or inducing a stem cell or a differentiated cell into a conventional dendritic cell type 2, comprising the following steps:
- 30 transducing a cell selected from the group consisting of: a stem cell or a differentiated cell, and mixtures thereof,

5 with one or more vectors encoding at least three transcription factors the first and second being PU.1 and IRF4 and the third being selected from the group consisting of PRDM1, IRF2, POU2F2, TGIF1, RELB and RBPJ; culturing the transduced cell in a cell media that supports growth of dendritic cells or antigen-presenting cells.

20. The method according to claim 19, culturing the transduced cells during at least 2 days, preferably at least 5 days, more preferably at least 8 days, even more preferably at least 9 days, more preferable at least 10 days.

10 21. The method according to claims 19 to 20, wherein the cell is selected from the group consisting of: mammalian cell, a non-human cell or a human cell, a mouse cell, a human or mouse fibroblast, a mammalian umbilical cord blood stem cell, a pluripotent stem cell or multipotent stem cell, differentiated cell, and mixtures thereof, wherein the pluripotent stem cell, multipotent stem cell or differentiated cell, an endoderm derived cell, a mesoderm derived cell, or
15 an ectoderm derived cell, a multipotent stem cell including mesenchymal stem cell, a hematopoietic stem cell, an intestinal stem cell, a pluripotent stem cell and a cell line.

22. The method according to claims 19 to 21, wherein the transduction step further comprises at least one vector selected from the group consisting of: a
20 nucleic acid sequence encoding IL-12; nucleic acid sequence encoding IL-4; a nucleic acid sequence encoding IFN- α ; a nucleic acid sequence encoding IFN- β ; a nucleic acid sequence encoding IFN- γ ; a nucleic acid sequence encoding TNF; nucleic acid sequence encoding GM-CSF; nucleic acid sequence encoding siRNAs targeting IL-10 RNA, and mixtures thereof,
25 preferably comprising nucleic acids encoding immunostimulatory cytokines.

23. An induced dendritic cell transduced with the construct or vector according to claims 7 to 10, or the one or more vectors according to claims 11 to 17.

24. A composition comprising the induced dendritic cell according to claim 23, or mixtures thereof, in a therapeutically effective amount and further comprising
30 a pharmaceutically acceptable excipient, preferably an anti-viral, an analgesic, an anti-inflammatory agent, a chemotherapy agent, a radiotherapy

agent, an antibiotic, a diuretic, a filler, a binder, a disintegrant, or a lubricant or mixtures thereof.

- 5 25. The composition according to any one of claims 1 to 6 and 24 for use in veterinary or human medicine, particularly in immunotherapy, or in the treatment or therapy of neurodegenerative diseases, or in autoimmune diseases, immunodeficiency, or in the treatment or therapy of cancer or in the treatment or therapy of an infectious disease; intradermal and transdermal therapies; in immunotherapy, or in neurodegenerative or ageing diseases, or in cancer or in infectious diseases, as a drug screening; or for 10 use in the treatment, therapy or diagnosis of a central and peripheral nervous system disorder, neoplasia in cancer, in particular solid or hematological tumours, immunological diseases, namely autoimmune diseases, hypersensitivities, or immunodeficiency; of fungal, viral, chlamydial, bacterial, nanobacterial or parasitic infectious diseases; of HIV, 15 infection with SARS coronavirus, Asian flu virus, herpes simplex, herpes zoster, hepatitis, or viral hepatitis.
26. A vaccine or an injectable formulation, in particular an *in-situ* injection, for cancer comprising the composition according to claims 1 to 6 and 24 to 25, or the induced dendritic cell according to claim 23, or mixtures thereof.
- 20 27. A kit comprising at least one of the following components:
the induced dendritic cell according to claim 23;
the composition according to any one of claims 1 to 6 and 24 to 25;
the vector or a construct according to claim 7 to 17;
or mixtures thereof.
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