What is claimed herein is:

1. A method of maintaining tissue *ex vivo*, the method comprising:
implanting an implantation device in a subject whereby the implantation device is colonized by at least one of stem cells, vascular cells, immune cells, differentiated cells and diseased cells;
removing the implantation device and the tissue contained in the implantation device from the subject;
providing a perfusion fluid to the tissue.

2. The method of claim 1, further comprising the step of removing the tissue from the implantation device prior to providing perfusion fluid.

3. The method of claim 2, further comprising the step of placing the tissue in a microfluidic system prior to providing perfusion fluid.

4. The method of any of claims 1-3, wherein the implantation device includes at least one cell growth chamber and at least one open port providing a passage to the cell growth chamber to enable cells to enter the cell growth chamber for cell colonization.

5. The method of claim 1, wherein the implantation device is a microfluidic device.

6. The method of claim 5, further comprising connecting the microfluidic device to a microfluidic system.

7. The method of any of claims 5-6, wherein the microfluidic device includes at least one cell growth chamber and at least one open port providing a passage to the cell growth chamber to enable cells to enter the cell growth chamber for cell colonization.

8. The method of any of claims 5-7, wherein the microfluidic device includes at least one fluid channel separated from the at least one cell growth chamber by a porous separation component.

9. The method of any of claims 5-8, wherein the microfluidic device includes at least one inlet port and at least one outlet connecting the at least one fluid channel to the microfluidic system and providing perfusion fluid to the at least one cell growth chamber through the porous separation component.

10. The method of any of claims 1-9, wherein the implantation device is implanted such that at least one port faces the muscle tissue of the subject.

11. The method of any of claims 1-10, wherein the tissue is bone marrow tissue.

12. The method of any of claims 1-12, wherein the bone marrow tissue maintained *ex vivo* is used to produce hematopoietic cells or bone marrow-derived factors.

13. The method of claim 12, wherein the hematopoietic cells are selected from the group consisting of red blood cells, white blood cells, platelets, hematopoietic stem cells, lymphocytes, eosinophils, neutrophils, monocytes, hematopoietic progenitor cells, stromal cells, and a mixture of two or more of these cell types.

14. The method of claim 12, wherein the bone marrow-derived factors are selected from the group consisting of a peptide, protein, small molecule, nucleotides, lipids, carbohydrates, cytokines and growth factors.

15. The method of any of claims 12-14, wherein the hematopoietic cells and/or bone marrow-derived factors are administered to a subject.

16. The method of claim 15, wherein the subject has a condition selected from the group consisting of a compromised immune system, a cancer, an auto-immune disease, radiation toxicity, and a hematopoietic disease.

17. The method of claim 16, wherein the cancer is selected from the group consisting of leukemia, lymphoma, Hodgkin's lymphoma, myeloproliferative disorders, Langerhans cell histiocytosis, myeloma, and myelodysplastic syndromes.

18. The method of claim 16, wherein the hematopoietic disease is selected from the group consisting of thalassemia, factor IX deficiency, hemophilia, sickle cell disease, amyloidosis, agranulocytosis, anemia, leucopenia, neutropenia, thrombocytopenia, panctyopenia, Glanzmann's thrombasthenia, uremia, platelet storage pool disease, Von Willebrand disease, and afibrinogenemia.

19. The method of claim 15, wherein the subject has undergone chemotherapy and/or radiation therapy.

20. The method of claim 12, wherein the hematopoietic cells and/or bone marrow-derived factors are provided to another tissue type being maintained *in vitro*.

21. The method of any of claims 1-11, wherein the tissue maintained *ex vivo* is used to test the effect of compounds on the tissue or interaction of compounds with the tissue, where the compound is selected from the group consisting of chemotherapeutics, radiation therapies, modifiers of differentiation, formation, function or remodeling, hormones, nucleic acids, peptides, proteins, antibodies, small molecules, drug leads, enzymes, cells, viruses, bacteria, parasites, nucleotides, markers, dyes, imaging agents, enzymes, nanoparticles, and gene silencing molecules.

22. The method of any of claims 1-11, wherein the tissue maintained *ex vivo* is at any stage of development.

23. The method of any of claims 1-22, wherein the implantation device is implanted into a non-human subject.

24. The method of any of claims 1-22, wherein the implantation device is implanted into a non-human subject having human or humanized hematopoietic cells.

25. The method of claim 24, wherein the non-human subject has human hematopoietic cells obtained from a cancer or a human having a hematopoietic disease.

26. The method of claim 25, wherein the cancer is selected from the group consisting of leukemia, lymphoma, Hodgkin's lymphoma, myeloproliferative disorders, Langerhans cell histiocytosis, myeloma, and myelodysplastic syndromes.

27. The method of claim 25, wherein the hematopoietic disease is selected from the group consisting of thalassemia, factor IX deficiency, hemophilia, sickle cell disease, amyloidosis, agranulocytosis, anemia, leucopenia, neutropenia, thrombocytopenia, panctyopenia, Glanzmann's thrombasthenia, uremia, platelet storage pool disease, Von Willebrand disease, and afibrinogenemia.

28. A method of producing tissue or cells for implantation into a subject, the method comprising:
implanting an implantation device in a first subject whereby the implantation device is colonized by tissue or cells;
removing the implantation device and the tissue contained in the implantation device from the first subject;
transplanting the implantation device or at least the tissue or cells contained in the implantation device into a second subject thereby providing tissue or cells to the second subject;
whereby the implanted tissue or cells exhibit cell growth and function in the second subject.

29. The method of claim 28, wherein the implantation device includes at least one cell growth chamber and at least one open port providing a passage to the cell growth chamber to enable cells to entire the cell growth chamber for cell colonization.

30. The method of claim 28, wherein the implantation device is a microfluidic device.

31. The method of claim 30, wherein the microfluidic device includes at least one cell growth chamber and at least one open port providing a passage to the cell growth chamber to enable cells to enter the cell growth chamber for cell colonization.

32. The method of any of claims 30-31, wherein the microfluidic device includes at least one fluid channel separated from the at least one cell growth chamber by a porous separation component.

33. The method of any of claims 30-32, wherein the microfluidic device includes at least one inlet port and at least one outlet connecting the at least one fluid channel to the microfluidic system and providing perfusion fluid to the at least one growth channel through the porous separation component.

34. The method of any of claims 28-33, wherein the implantation device is implanted such that at least one port faces the muscle tissue of the subject.

35. The method of any of claims 28-34, wherein the tissue or cells comprise bone marrow tissue or hematopoietic cells.

36. The method of any of claims 28-35, wherein the second subject receiving the transplant has been diagnosed with a condition selected from the group consisting of a compromised immune system, a cancer, an auto-immune disease, and a hematopoietic disease.

37. The method of claim 36, wherein the cancer is selected from a group consisting of leukemia, lymphoma, Hodgkin's lymphoma, myeloproliferative disorders, Langerhans cell histiocytosis, myeloma, and myelodysplastic syndromes.

38. The method of claim 36, wherein the hematopoietic disease is selected from the group consisting of thalassemia, factor IX deficiency, hemophilia, sickle cell disease, amyloidosis, agranulocytosis, anemia, leucopenia, neutropenia, thrombocytopenia, panctyopenia, Glanzmann's thrombasthenia, uremia, platelet storage pool disease, Von Willebrand disease, and afibrinogenemia.

39. The method of any of claims 28-38, wherein the second subject has undergone chemotherapy and/or radiation therapy.

40. The method of any of claims 28-39, wherein the implantation device is implanted into a non-human first subject having human or humanized hematopoietic cells.

41. The method of any of claims 28-40, wherein the first and second subjects are the same individual and the method comprises an additional step of maintaining either the implantation device containing bone marrow tissue and/or hematopoietic cells or the bone marrow tissue or hematopoietic cells after removal from the implantation device between removal from the site of implantation and transplantation into the subject.

42. The method of any of claims 28-40, wherein the method comprises an additional step of maintaining either the implantation device containing bone marrow tissue and/or hematopoietic cells or the bone marrow tissue or hematopoietic cells after removal from the implantation device between removal from the site of implantation and transplantation into the second subject.

43. The method of any of claim 28-42, wherein maintaining the implantation device containing bone marrow tissue or hematopoietic cells *ex vivo* comprises freezing or refrigerating either the implantation device containing bone marrow tissue and/or hematopoietic cells or the bone marrow tissue and/or hematopoietic cells after removal from the implantation device.

44. The method of any of claims 28-42, wherein maintaining the implantation device containing bone marrow tissue or hematopoietic cells *ex vivo* comprises:
connecting the implantation device to a microfluidic systems;
providing a perfusion fluid to the implantation device.

45. The method of any of claims 28-45, wherein the tissue or cells contained within the implantation device are genetically modified before implantation into the second subject.

46. A pharmaceutical composition comprising bone marrow tissue, hematopoietic cells, or differentiated blood cells obtained from a bone marrow tissue maintained *ex vivo* according to the method of claim 1.

47. A pharmaceutical composition comprising bone marrow tissue and/or hematopoietic cells obtained from a bone marrow tissue maintained *ex vivo* accoding to the method of claim 28.

48. The composition of any of claims 46-47, wherein the bone marrow tissue and/or hematopoietic cells are contained within an implantation device.

49. A method for producing or manufacturing hematopoietic cells, the method comprising implanting an implantation device in a subject whereby the implantation device is colonized by stem cells, vascular cells, immune cells or differentiated cells;

removing the implantation device and the tissue contained in the implantation device from the subject;

providing a perfusion fluid to the tissue;

wherein the implantation device includes at least one cell growth chamber and at least one open port providing a passage to the cell growth chamber to enable cells to enter the cell growth chamber for cell colonization;

wherein the tissue is bone marrow tissue;

and wherein the bone marrow tissue maintained *ex vivo* is used to produce hematopoietic cells.

50. The method of claim 49, wherein the hematopoietic cells are selected from the group consisting of red blood cells, white blood cells, platelets, hematopoietic stem cells, lymphocytes, eosinophils, neutrophils, monocytes, a hematopoietic progenitor cell, and a mixture of two or more of these cell types.

CLAIMS

1. A pharmaceutical composition comprising bone marrow tissue, hematopoietic cells, differentiated blood cells, or bone marrow-derived factors obtained from a bone marrow tissue maintained *ex vivo* by:

implanting an implantation device in a subject whereby the implantation device is colonized after implantation by at least one of stem cells, vascular cells, immune cells, differentiated cells and diseased cells;

removing the implantation device and the tissue contained in the implantation device from the subject; and

providing a perfusion fluid to the tissue.

2. A composition according to Claim 1, in which the bone marrow tissue and/or hematopoietic cells are contained within an implantation device.

3. A pharmaceutical composition comprising bone marrow tissue, hematopoietic cells, differentiated blood cells, or bone marrow-derived factors obtained from a bone marrow tissue maintained *ex vivo* by:

implanting an implantation device in a subject whereby the implantation device is colonized after implantation by at least one of stem cells, vascular cells, immune cells, differentiated cells and diseased cells;

removing the implantation device and the tissue contained in the implantation device from the subject;

removing the tissue from the implantation device; and

providing a perfusion fluid to the tissue.

4. A composition according to any of Claims 1, 2 or 3, in which the implantation device includes at least one cell growth chamber and at least one open port providing a passage to the cell growth chamber to enable cells to enter the cell growth chamber for cell colonization.

5. A composition according to any preceding claim, in which the tissue is placed in a microfluidic system prior to providing perfusion fluid.

6. A pharmaceutical composition comprising bone marrow tissue, hematopoietic cells, differentiated blood cells, or bone marrow-derived factors obtained from a bone marrow tissue maintained *ex vivo* by:

implanting a microfluidic implantation device in a subject whereby the microfluidic implantation device is colonized after implantation by at least one of stem cells, vascular cells, immune cells, differentiated cells and diseased cells;

removing the microfluidic implantation device and the tissue contained in the microfluidic implantation device from the subject; and

providing a perfusion fluid to the tissue.

7. A composition according to 6, in which the microfluidic device is connected to a microfluidic system after removal from the subject.

8. A composition according to any of Claims 6 or 7, in which the microfluidic device includes at least one cell growth chamber and at least one open port providing a passage to the cell growth chamber to enable cells to enter the cell growth chamber for cell colonization.

9. A composition according to any of Claims 6, 7 or 8, in which the microfluidic device includes at least one fluid channel separated from the at least one cell growth chamber by a porous separation component.

10. A composition according to any of Claims 6 to 9, in which the microfluidic device includes at least one inlet port and at least one outlet connecting the at least one fluid channel to the microfluidic system and providing perfusion fluid to the at least one cell growth chamber through the porous separation component.

11. A composition according to any preceding claim, in which the implantation device is implanted such that at least one port faces the muscle tissue of the subject.

12. A composition according to any preceding claim, in which the hematopoietic cells are selected from the group consisting of red blood cells, white blood cells, platelets, hematopoietic stem cells, lymphocytes, eosinophils, neutrophils, monocytes, hematopoietic progenitor cells, stromal cells, and a mixture of two or more of these cell types.

13. A composition according to any preceding claim, in which the bone marrow-derived factors are selected from the group consisting of a peptide, protein, small molecule, nucleotides, lipids, carbohydrates, cytokines and growth factors.

14. A composition according to any preceding claim, in which the subject is a non-human subject.

15. A composition according to any preceding claim, in which the subject is a non-human subject having human or humanized hematopoietic cells.

16. A composition according to Claim 15, in which the non-human subject has human hematopoietic cells obtained from a cancer or a human having a hematopoietic disease.

17. A composition according to Claim 16, in which the cancer is selected from the group consisting of leukemia, lymphoma, Hodgkin's lymphoma, myeloproliferative disorders, Langerhans cell histiocytosis, myeloma, and myelodysplastic syndromes.

18. A composition according to Claim 16, in which the hematopoietic disease is selected from the group consisting of thalassemia, factor IX deficiency, hemophilia, sickle cell disease, amyloidosis, agranulocytosis, anemia, leucopenia, neutropenia, thrombocytopenia, panctyopenia, Glanzmann's thrombasthenia, uremia, platelet storage pool disease, Von Willebrand disease, and afibrinogenemia.

19. A composition according to any preceding claim, in which the tissue or cells are maintained *ex vivo* at any stage of development.

20. A composition according to any preceding claim, in which the tissue or cells are genetically modified after removing the implantation device from the subject.

21. A composition according to any preceding claim for use in a method of therapy, the method comprising administering the hematopoietic cells and/or bone marrow-derived factors to a second subject.

22. A composition according to Claim 21 for a use as specified therein, in which the second subject has a condition selected from the group consisting of a compromised immune system, a cancer, an auto-immune disease, radiation toxicity, and a hematopoietic disease.

23. A composition according to Claim 22 for a use as specified therein, in which the cancer is selected from the group consisting of leukemia, lymphoma, Hodgkin's lymphoma, myeloproliferative disorders, Langerhans cell histiocytosis, myeloma, and myelodysplastic syndromes.

24. A composition according to Claim 22 for a use as specified therein, in which the hematopoietic disease is selected from the group consisting of thalassemia, factor IX deficiency, hemophilia, sickle cell disease, amyloidosis, agranulocytosis, anemia, leucopenia, neutropenia, thrombocytopenia, panctyopenia, Glanzmann's thrombasthenia, uremia, platelet storage pool disease, Von Willebrand disease, and afibrinogenemia.

25. A composition according to any of Claims 21 to 24 for a use as specified therein, in which the second subject has undergone chemotherapy and/or radiation therapy.

26. A composition according to any of Claims 21 to 25 for a use as specified therein, in which the first and second subjects are the same individual and the use further comprises an additional step of maintaining either the implantation device containing bone marrow tissue and/or hematopoietic cells or the bone marrow tissue or hematopoietic cells after removal from the implantation device between removal from the site of implantation and transplantation into the subject.

27. A composition according to any of Claims 21 to 26 for a use as specified therein, in which the use comprises an additional step of maintaining either the implantation device containing bone marrow tissue and/or hematopoietic cells or the bone marrow tissue or hematopoietic cells after removal from the implantation device between removal from the site of implantation and transplantation into the second subject.

28. A composition according to any of Claims 21 to 27 for a use as specified therein, in which maintaining the implantation device containing bone marrow tissue or hematopoietic cells *ex vivo* comprises freezing or refrigerating either the implantation device containing bone marrow tissue and/or hematopoietic cells or the bone marrow tissue and/or hematopoietic cells after removal from the implantation device.

29. A composition according to any of Claims 21 to 28 for a use as specified therein, in which maintaining the implantation device containing bone marrow tissue or hematopoietic

cells *ex vivo* comprises: connecting the implantation device to a microfluidic systems; and providing a perfusion fluid to the implantation device.