CLAIMS

~~1. A method, comprising:~~

~~contacting a plurality of renal proximal tubule cells in a fluidic device with sufficient BMP-7 or functional variants or functional fragments thereof and/or a BMP-7 agonist to inhibit tubule formation and/or improve cell performance by the plurality of renal proximal tubule cells.~~

~~2. The method of claim 1, comprising contacting a plurality of renal proximal tubule cells in a fluidic device with sufficient BMP-7 or functional variants or functional fragments thereof to inhibit tubule formation.~~

~~3. The method of claim 1, wherein the renal proximal tubule cells are genetically modified to overexpress the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.~~

~~4. The method of claim 1, wherein the renal proximal tubule cells are genetically modified to overexpress the BMP-7 or functional variants or functional fragments thereof.~~

~~5. The method of claim 2, wherein the plurality of renal proximal tubule cells are contacted with BMP-7 or functional variants or functional fragments thereof.~~

~~6. The method of claim 5, wherein the plurality of renal proximal tubule cells are contacted with BMP-7.~~

~~7. The method of claim 5, wherein the BMP-7 or functional variants or functional fragments thereof is present in a concentration of at least 0.5 nM.~~

~~8. The method of claim 1, wherein the plurality of renal proximal tubule cells are contacted with the BMP-7 agonist.~~

~~9. The method of claim 8, wherein the BMP-7 agonist is an isoform of KCP or functional variants or functional fragments thereof.~~

~~10. The method of claim 1, wherein the plurality of renal proximal tubule cells are residing on a semi-permeable membrane.~~

~~11. The method of claim 10, wherein the plurality of renal proximal tubule cells form a monolayer on the semi-permeable membrane.~~

~~12. The method of claim 1, wherein the fluidic device is an extracorporeal device for treating blood from a patient.~~

~~13. The method of claim 10, wherein the fluidic device is a bioartificial kidney comprising an ultrafiltration unit and a reabsorption unit, the reabsorption unit comprising the semi-permeable membrane.~~

~~14. The method of claim 13, wherein the plurality of renal proximal tubule cells are residing on a surface of a hollow fiber membrane.~~

~~15. The method of claim 14, wherein the surface is an inner surface of the hollow fiber membrane.~~

~~16. The method of claim 1, wherein the fluidic device further comprises at least one renal cell type selected from the group consisting of distal tubule cells, collecting duct cells, podocytes, cells of the thick ascending limb, and fibroblasts.~~

~~17. The method of claim 16, wherein the at least one renal cell expresses the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.~~

~~18. The method of claim 1, wherein the fluidic device comprises renal fibroblasts.~~

~~19. The method of claim 18, wherein the renal fibroblasts express erythropoietin.~~

~~20. A method, comprising:~~

~~contacting a plurality of renal proximal tubule cells in a fluidic device with sufficient BMP-7 or functional variants or functional fragments thereof and/or a sufficient amount of a BMP-7 agonist to inhibit de-differentiation of the renal proximal tubule cells.~~

~~21. The method of claim 20, wherein the renal proximal tubule cells are genetically modified to overexpress the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.~~

~~22. The method of claim 20, wherein the renal proximal tubule cells are genetically modified to overexpress the BMP-7 or functional variants or functional fragments thereof.~~

~~23. The method of claim 20, wherein the renal proximal tubule cells are contacted with BMP-7 or functional variants or functional fragments thereof.~~

~~24. The method of claim 23, wherein the renal proximal tubule cells are contacted with BMP-7.~~

~~25. The method of claim 20, wherein the BMP-7 or functional variants or functional fragments thereof is present in a concentration of at least 0.5 nM.~~

~~26. The method of claim 20, wherein the plurality of renal proximal tubule cells are contacted with the BMP-7 agonist.~~

~~27. The method of claim 26, wherein the BMP-7 agonist is an isoform of KCP or functional variants or functional fragments thereof.~~

~~28. The method of claim 20, wherein the renal proximal tubule cells reside on a semi-permeable membrane.~~

~~29. The method of claim 20, wherein the fluidic device is an extracorporeal device for treating blood from a patient.~~

~~30. The method of claim 28, wherein the fluidic device is a bioartificial kidney comprising an ultrafiltration unit and a reabsorption unit, the reabsorption unit comprising the semi-permeable membrane.~~

~~31. The method of claim 30, wherein the renal proximal tubule cells reside on a surface of a hollow fiber membrane.~~

~~32. The method of claim 31, wherein the surface is an inner surface of the hollow fiber membrane.~~

~~33. The method of claim 20, wherein the fluidic device further comprises at least one renal cell type selected from the group consisting of distal tubule cells, collecting duct cells, podocytes, cells of the thick ascending limb, and fibroblasts.~~

~~34. The method of claim 33, wherein the at least one renal cell expresses the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.~~

~~35. The method of claim 20, wherein the fluidic device comprises renal fibroblasts.~~

~~36. The method of claim 35, wherein the renal fibroblasts express erythropoietin.~~

~~37~~1. A method, comprising:

administering a therapeutic amount of BMP-7 or functional variants or functional fragments thereof and/or a BMP agonist systemically to a patient, wherein the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist is generated essentially continuously from cells within a fluidic device comprising said cells in fluid communication with the patient.

382. The method of claim 371, wherein the fluidic device comprises a plurality of renal proximal tubule cells.

393. The method of claim 382, wherein the plurality of renal proximal tubule cells generate the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.

404. The method of claim 393, wherein the plurality of renal proximal tubule cells generate BMP-7 or functional variants or functional fragments thereof.

415. The method of claim 404, wherein the plurality of renal proximal tubule cells generate BMP-7.

426. The method of claim 371, wherein at least some of the cells are genetically modified in order to overexpress BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.

437. The method of claim 426, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for BMP-7 or a functional variant or functional fragment thereof.

448. The method of claim 437, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for BMP-7.

459. The method of claim 448, wherein the expression vector comprises a nucleic acid molecule that hybridizes to the nucleic acid sequence set forth in SEQ ID NO: 2 under high stringency conditions, and degenerates, complements, and unique fragments thereof.

4610. The method of claim 371, wherein the cells reside on a semi-permeable membrane.

4711. The method of claim 382, wherein the plurality of renal proximal tubule cells are contacted with BMP-7.

4812. The method of claim 371, wherein the BMP-7 or functional variants or functional fragments thereof has a concentration of at least 0.5 nM.

4913. The method of claim 382, wherein the plurality of renal proximal tubule cells are contacted with the BMP-7 agonist.

5014. The method of claim 4913, wherein the BMP-7 agonist is an isoform of KCP or functional variants or functional fragments thereof.

5115. The method of claim 4610, wherein the cells form a monolayer on the semi-permeable membrane.

5216. The method of claim 371, wherein the fluidic device is an extracorporeal device for treating blood from a patient.

5317. The method of claim 4610, wherein the fluidic device is a bioartificial kidney comprising an ultrafiltration unit and a reabsorption unit, the reabsorption unit comprising the semi-permeable membrane.

5418. The method of claim 382, wherein the plurality of renal proximal tubule cells reside on a surface of a hollow fiber membrane.

5519. The method of claim 437, wherein the expression vector comprising the nucleic acid sequence is operably linked to a promoter.

5620. The method of claim 459, wherein the expression vector comprising the nucleic acid molecule or degenerate or complement thereof is operably linked to a promoter.

~~57~~21. The method of claim ~~37~~1, wherein the cells comprise at least one renal cell type selected from the group consisting of distal tubule cells, collecting duct cells, podocytes, cells of the thick ascending limb, and fibroblasts.

~~58~~22. The method of claim ~~57~~21, wherein the cells further comprise renal proximal tubule cells.

~~59~~23. The method of claim ~~37~~1, wherein the cells comprise renal fibroblasts.

~~60~~24. The method of claim ~~59~~23, wherein the renal fibroblasts express erythropoietin.

~~61~~25. The method of claim ~~42~~6, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for an isoform of KCP or a functional variant or functional fragment thereof.

~~62~~26. The method of claim ~~61~~25, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for an isoform of KCP.

~~63~~27. The method of claim ~~62~~26, wherein the expression vector comprises a nucleic acid molecule that hybridizes to the nucleic acid sequence set forth in SEQ ID NO: 4 or SEQ ID NO: 6 under high stringency conditions, and degenerates, complements, and unique fragments thereof.

~~64. An apparatus, comprising:~~

~~a fluidic device comprising a plurality of host cells genetically modified for overexpression of BMP-7 or functional variants or functional fragments thereof and/or a BMP-7 agonist.~~

~~65. The apparatus of claim 64, wherein the host cells are renal proximal tubule cells.~~

~~66. The apparatus of claim 64, wherein the fluidic device is a bioartificial kidney.~~

~~67. The apparatus of claim 64, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for BMP-7 or functional variants or functional fragments thereof.~~

~~68. The apparatus of claim 67, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for BMP-7.~~

~~69. The apparatus of claim 68, wherein the expression vector comprises a nucleic acid molecule that hybridizes to the nucleic acid sequence set forth in SEQ ID NO: 2 under high stringency conditions, and degenerates, complements, and unique fragments thereof.~~

~~70. The apparatus of claim 64, wherein the cells reside on a semi-permeable membrane.~~

~~71. The apparatus of claim 70, wherein the cells form a monolayer on the semi-permeable membrane.~~

~~72. The apparatus of claim 64, wherein the fluidic device is an extracorporeal device for treating blood from a patient.~~

~~73. The apparatus of claim 66, wherein the bioartificial kidney comprises an ultrafiltration unit and a reabsorption unit, the reabsorption unit comprising a semi-permeable membrane.~~

~~74. The apparatus of claim 73, wherein the cells reside on a surface of a hollow fiber membrane.~~

~~75. The apparatus of claim 67, wherein the expression vector comprising the nucleic acid sequence is operably linked to a promoter.~~

~~76. The apparatus of claim 69, wherein the expression vector comprising the nucleic acid sequence or degenerate or complement thereof is operably linked to a promoter.~~

~~77. The apparatus of claim 64, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for an isoform of KCP or a functional variant or functional fragment thereof.~~

~~78. The apparatus of claim 77, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for an isoform of KCP.~~

~~79. The apparatus of claim 78, wherein the expression vector comprises a nucleic acid molecule that hybridizes to the nucleic acid sequence set forth in SEQ ID NO: 4 or SEQ ID NO: 6 under high stringency conditions, and degenerates, complements, and unique fragments thereof.~~

~~80. An apparatus, comprising:~~

~~a fluidic device comprising a semi-permeable membrane, wherein a non-cellular component of the apparatus is configured for controlled release of BMP-7 or functional variants or functional fragments thereof and/or a BMP-7 agonist.~~

~~81. The apparatus of claim 80, further comprising renal proximal tubule cells seeded on the semi-permeable membrane.~~

~~82. The apparatus of claim 80, wherein the fluidic device is a hemodialysis device.~~

~~83. The apparatus of claim 80, wherein the semi-permeable membrane is configured for controlled release of the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.~~

~~84. The apparatus of claim 80, wherein the semi-permeable membrane comprises a plurality of particles configured for controlled release of the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.~~

~~85. The apparatus of claim 80, wherein the non-cellular component of the apparatus is configured for controlled release of the BMP-7 or functional variants or functional fragments thereof.~~

~~86. The apparatus of claim 85, wherein the non-cellular component of the apparatus is configured for controlled release of the BMP-7.~~

~~87. The apparatus of claim 80, wherein the non-cellular component of the apparatus is configured for controlled release of the BMP-7 agonist.~~

~~88. The apparatus of claim 87, wherein the BMP-7 agonist is an isoform of KCP or functional variants or functional fragments thereof.~~

~~89. The apparatus of claim 80, wherein the fluidic device is an extracorporeal device for treating blood from a patient.~~

~~90. The apparatus of claim 80, wherein the fluidic device is a bioartificial kidney comprising an ultrafiltration unit and a reabsorption unit, the reabsorption unit comprising the semi-permeable membrane.~~

~~91. The apparatus of claim 80, further comprising at least one renal cell type selected from the group consisting of distal tubule cells, collecting duct cells, podocytes, cells of the thick ascending limb, and fibroblasts.~~

~~92. The apparatus of claim 80, further comprising renal fibroblasts.~~

~~93. A method, comprising:~~

~~administering BMP-7 or functional variants or functional fragments thereof and/or a BMP-7 agonist systemically to a patient, wherein the BMP-7 is released from in controlled fashion from a non-cellular component within a fluidic device.~~

~~94. The method of claim 93, further comprising a plurality renal proximal tubule cells in fluid communication with the patient.~~

~~95. The method of claim 93, wherein the fluidic device is a hemodialysis device.~~

~~96. The method of claim 93, wherein the non-cellular component within the fluidic device comprises a semi-permeable membrane.~~

~~97. The method of claim 96, wherein the semi-permeable membrane comprises a plurality of particles configured for controlled release of the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.~~

~~98. The method of claim 93, wherein the non-cellular component of the apparatus is configured for controlled release of the BMP-7 or functional variants or functional fragments thereof.~~

~~99. The method of claim 98, wherein the non-cellular component of the apparatus is configured for controlled release of the BMP-7.~~

~~100. The method of claim 93, wherein the non-cellular component of the apparatus is configured for controlled release of the BMP-7 agonist.~~

~~101. The method of claim 100, wherein the BMP-7 agonist is an isoform of KCP or functional variants or functional fragments thereof.~~

~~102. The method of claim 93, wherein the fluidic device is an extracorporeal device for treating blood from a patient.~~

~~103. The method of claim 96, wherein a plurality renal proximal tubule cells reside on the semi-permeable membrane.~~

~~104. The method of claim 103, wherein the fluidic device is a bioartificial kidney comprising an ultrafiltration unit and a reabsorption unit, the reabsorption unit comprising the semi-permeable membrane.~~

~~105. The method of claim 93, further comprising at least one renal cell type selected from the group consisting of distal tubule cells, collecting duct cells, podocytes, cells of the thick ascending limb, and fibroblasts.~~

~~106. The method of claim 93, further comprising renal fibroblasts.~~

~~107. A semi-permeable membrane comprising:~~

~~at least one material configured for controlled release of BMP-7 or functional variants or functional fragments thereof and/or a BMP-7 agonist.~~

~~108. The semi-permeable membrane of claim 107, wherein the at least one material comprises particles configured for controlled release of the BMP-7 or functional fragments thereof and/or the BMP-7 agonist.~~

~~109. The semi-permeable membrane of claim 108, wherein the at least one material comprises particles configured for controlled release of the BMP-7.~~

~~110. The semi-permeable membrane of claim 108, wherein the particles are encapsulated in the membrane.~~

~~111. The semi-permeable membrane of claim 107, wherein the at least one material configured is configured for controlled release of the BMP-7 agonist.~~

~~112. The semi-permeable membrane of claim 111, wherein the BMP-7 agonist is an isoform of KCP or functional variants or functional fragments thereof.~~

~~113. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109, wherein the BMP-7 or functional variants or functional fragments thereof has the amino acid sequence set forth in SEQ ID NO. 1.~~

~~114. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109, wherein the BMP-7 or functional variants or functional fragments thereof is coded for by a nucleic acid having the nucleic acid sequence set forth in SEQ ID NO. 2 and degenerates, complements, and unique fragments thereof.~~

~~115. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109, wherein the BMP-7 or functional variants or functional fragments thereof is coded for by the complement of a nucleic acid that hybridizes to the nucleic acid sequence set forth in SEQ ID NO: 2 under high stringency conditions, and degenerates thereof, complements, and unique fragments.~~

~~116. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109, wherein the BMP-7 or functional variants or functional fragments thereof has an amino acid sequence with at least 80% homology to the amino acid sequence set forth in SEQ ID NO. 1.~~

~~117. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109 wherein the BMP-7 or functional variants or functional fragments thereof has an amino acid sequence with at least 90% homology to the amino acid sequence set forth in SEQ ID NO. 1.~~

~~118. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109, wherein the BMP-7 or functional variants or functional fragments thereof has an amino acid sequence with at least 95% homology to the amino acid sequence set forth in SEQ ID NO. 1.~~

~~119. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109, wherein the BMP-7 or functional variants or functional fragments thereof has an amino acid sequence with at least 99% homology to the amino acid sequence set forth in SEQ ID NO. 1.~~

~~120. The method or apparatus of any one of claims 1-7, 10-25, 28-48, 51-60, 64-76, 80-86, 89-99, or 102-109, wherein a nucleic acid molecule has been introduced into the cells that encodes the amino acid sequence set forth in SEQ ID NO: 1.~~

CLAIMS

1. A method, comprising:

administering a therapeutic amount of BMP-7 or functional variants or functional fragments thereof and/or a BMP agonist systemically to a patient, wherein the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist is generated essentially continuously from cells within a fluidic device comprising said cells in fluid communication with the patient.

2. The method of claim 1, wherein the fluidic device comprises a plurality of renal proximal tubule cells.

3. The method of claim 2, wherein the plurality of renal proximal tubule cells generate the BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.

4. The method of claim 3, wherein the plurality of renal proximal tubule cells generate BMP-7 or functional variants or functional fragments thereof.

5. The method of claim 4, wherein the plurality of renal proximal tubule cells generate BMP-7.

6. The method of claim 1, wherein at least some of the cells are genetically modified in order to overexpress BMP-7 or functional variants or functional fragments thereof and/or the BMP-7 agonist.

7. The method of claim 6, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for BMP-7 or a functional variant or functional fragment thereof.

8. The method of claim 7, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for BMP-7.

9. The method of claim 8, wherein the expression vector comprises a nucleic acid molecule that hybridizes to the nucleic acid sequence set forth in SEQ ID NO: 2 under high stringency conditions, and degenerates, complements, and unique fragments thereof.

10. The method of claim 1, wherein the cells reside on a semi-permeable membrane.

11. The method of claim 2, wherein the plurality of renal proximal tubule cells are contacted with BMP-7.

12. The method of claim 1, wherein the BMP-7 or functional variants or functional fragments thereof has a concentration of at least 0.5 nM.

13. The method of claim 2, wherein the plurality of renal proximal tubule cells are contacted with the BMP-7 agonist.

14. The method of claim 13, wherein the BMP-7 agonist is an isoform of KCP or functional variants or functional fragments thereof.

15. The method of claim 10, wherein the cells form a monolayer on the semi-permeable membrane.

16. The method of claim 1, wherein the fluidic device is an extracorporeal device for treating blood from a patient.

17. The method of claim 10, wherein the fluidic device is a bioartificial kidney comprising an ultrafiltration unit and a reabsorption unit, the reabsorption unit comprising the semi-permeable membrane.

18. The method of claim 2, wherein the plurality of renal proximal tubule cells reside on a surface of a hollow fiber membrane.

19. The method of claim 7, wherein the expression vector comprising the nucleic acid sequence is operably linked to a promoter.

20. The method of claim 9, wherein the expression vector comprising the nucleic acid molecule or degenerate or complement thereof is operably linked to a promoter.

21. The method of claim 1, wherein the cells comprise at least one renal cell type selected from the group consisting of distal tubule cells, collecting duct cells, podocytes, cells of the thick ascending limb, and fibroblasts.

22. The method of claim 21, wherein the cells further comprise renal proximal tubule cells.

23. The method of claim 1, wherein the cells comprise renal fibroblasts.

24. The method of claim 23, wherein the renal fibroblasts express erythropoietin.

25. The method of claim 6, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for an isoform of KCP or a functional variant or functional fragment thereof.

26. The method of claim 25, wherein at least some of the cells are genetically modified with an expression vector comprising a nucleic acid sequence coding for an isoform of KCP.

27. The method of claim 26, wherein the expression vector comprises a nucleic acid molecule that hybridizes to the nucleic acid sequence set forth in SEQ ID NO: 4 or SEQ

ID NO: 6 under high stringency conditions, and degenerates, complements, and unique fragments thereof.