

WHAT IS CLAIMED IS:

1. A computer system for identifying susceptibility of a dog to develop chronic kidney disease (CKD), the computer system comprising:
 - 5 a processor; and
 - a memory that stores code that, when executed by the processor, causes the computer system to:
 - (a) receive at least one of:
 - 10 (i) one or more biomarkers of the dog, wherein the one or more biomarkers comprises information relating to at least one of a urine specific gravity, a creatinine, a urine protein, a blood urea nitrogen (BUN); or
 - (ii) demographic information of the dog, wherein the demographic information includes at least one of age or weight of the dog;
 - 15 (b) process at least one of the one or more biomarkers or demographic information of the dog using a prediction model, wherein the prediction model comprises a recurrent neural network; and
 - (c) determine a probability risk score of the dog for developing CKD based on the processed one or more biomarkers or demographic information.
- 20 2. The computer system according to claim 1, wherein the computer system is caused to:
 - determine a customized recommendation based on the probability risk of the dog for developing CKD.
- 25 3. The computer system according to claim 1 or 2, wherein the computer system is caused to:
 - transmit the customized recommendation to a user equipment of a veterinarian, owner, or caregiver of the dog.
- 30 4. The computer system according to claim 2 or 3, wherein the customized recommendation comprises at least one of:
 - (a) one or more therapeutic interventions;

- (b) one or more dietary recommendations;
- (c) one or more renal sparing strategies; or
- (d) one or more tests for disease progression.

5 5. The computer system according to claim 4, wherein:
 (i) the one or more renal sparing strategies comprise avoidance of non-steroidal
anti-inflammatories, aminoglycosides, or any combination thereof; and/or
 (ii) the one or more tests for disease progression comprise testing of serum
parathyroid hormone levels.

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 6. The computer system according to any of claims 1-5, wherein the
recurrent neural network comprises a hidden layer architecture with three layers, the
three layers comprising a first layer with five nodes, a second layer with three nodes, and
a third layer with three nodes.

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 7. The computer system according to any of claims 1-6, wherein the
recurrent neural network undergoes a ten-fold cross-validation process and is trained
over eight or eighteen epochs.

20 8. The computer system according to any of claims 1-7, wherein the one or
more biomarker comprises information relating to an amylase.

 9. The computer system according to any of claims 1-8, wherein the
recurrent neural network is trained using a training dataset, wherein the training dataset
25 comprises the one or more biomarkers and the demographic information for a plurality of
other dogs.

 10. The computer system according to any of claims 1-9, wherein the
prediction model further comprises the recurrent neural network with long short-term
30 memory (LSTM).

 11. The computer system according to any of claims 1-10 wherein the
decision threshold for developing the CKD using the recurrent neural network is about 0
to about 1.

12. The computer system according to any of claims 1-10 wherein the decision threshold for developing the CKD using the recurrent neural network is about .5.

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13. The computer system according to any of claims 1-12, wherein the compute system is caused to:

impute one or more missing values from the one or more biomarkers of the dog or the demographic information of the dog.

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14. The computer system according to claim 13, wherein the imputation is a linear regression.

15. The computer system according to claim 13, wherein the imputation is based on an age of the dog.

16. The compute system according to claim 13, wherein the imputation is based on the number of missing values.

17. A method for identifying susceptibility of a dog to develop chronic kidney disease (CKD), the method comprising:

(a) receiving at least one of:

(i) one or more biomarkers of the dog, wherein the one or more biomarkers comprises information relating to at least one of a urine specific gravity, a creatinine, a urine protein, a blood urea nitrogen (BUN); or

(ii) demographic information of the dog, wherein the demographic information includes at least one of age or weight of the dog;

(b) processing at least one of the one or more biomarkers or demographic information of the dog using a prediction model, wherein the prediction model comprises a recurrent neural network; and

(c) determining a probability risk score of the dog for developing CKD based on the processed one or more biomarkers or demographic information.

18. The method according to claim 17, further comprising:
determining a customized recommendation based on the probability risk of the dog for developing CKD.
- 5 19. The method according to claim 17 or 18, further comprising:
transmitting the customized recommendation to a user equipment of a veterinarian, owner, or caregiver of the dog.
20. The method according to claim 18 or 19, wherein the customized
10 recommendation comprises at least one of:
(a) one or more therapeutic interventions;
(b) one or more dietary recommendations;
(c) one or more renal sparing strategies; or
(d) one or more tests for disease progression.
- 15 21. The method according to claim 20, wherein:
(i) the one or more renal sparing strategies comprise avoidance of non-steroidal anti-inflammatories, aminoglycosides, or any combination thereof; and/or
(ii) the one or more tests for disease progression comprise testing of serum
20 parathyroid hormone levels.
22. The method according to any of claims 17-21, wherein the recurrent neural network comprises a hidden layer architecture with three layers, the three layers comprising a first layer with five nodes, a second layer with three nodes, and a third
25 layer with three nodes.
23. The method according to any of claims 17-22, wherein the recurrent neural network undergoes a ten-fold cross-validation process and is trained over eight or eighteen epochs.
- 30 24. The method according to any of claims 17-23, wherein the one or more biomarker comprises information relating to an amylase.

25. The method according to any of claims 17-24, wherein the recurrent neural network is trained using a training dataset, wherein the training dataset comprises the one or more biomarkers and the demographic information for a plurality of other dogs.

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26. The method according to any of claims 17-25, wherein the prediction model further comprises the recurrent neural network with long short-term memory (LSTM).

10 27. The method according to any of claims 17-26 wherein the decision threshold for developing the CKD using the recurrent neural network is about 0.0 to about 1.0.

15 28. The method according to any of claims 17-27, wherein the decision threshold for developing the CKD using the recurrent neural network is about .5.

29. The method according to any of claims 17-28, further comprising:
imputing one or more missing values from the one or more biomarkers of the dog
or the demographic information of the dog.

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30. The method according to claim 17-29, wherein the imputation is a linear regression.

25 31. The method according to claim 17-29, wherein the imputation is based on an age of the dog.

32. The method according to an of claims 17-29 wherein the imputation is based on the number of missing values.

30 33. A computer system for identifying susceptibility of a dog to develop chronic kidney disease (CKD), the computer system comprising:
a processor; and
a memory that stores code that, when executed by the processor, causes the computer system to:

- (a) receive at least one of:
- (i) one or more biomarkers of the dog, wherein the one or more biomarkers comprises information relating to at least one of a urine specific gravity, a creatinine, a urine protein, a blood urea nitrogen (BUN); or
 - (ii) demographic information of the dog, wherein the demographic information includes at least one of age or weight of the dog;
- (b) process at least one of the one or more biomarkers or demographic information of the dog using a prediction model, wherein the prediction model comprises a recurrent neural network, wherein the recurrent neural network comprises a hidden layer architecture with three layers, the three layers comprising a first layer with five nodes, a second layer with three nodes, and a third layer with three nodes; and
- (c) determine a probability risk score of the dog for developing CKD based on the processed one or more biomarkers or demographic information.
34. The computer system according to claim 33, wherein the computer system is caused to:
- determine a customized recommendation based on the probability risk of the dog for developing CKD.
35. The computer system according to claim 33 or 34, wherein the computer system is caused to:
- transmit the customized recommendation to a user equipment of a veterinarian, owner, or caregiver of the dog.
36. The computer system according to claim 34 or 35, wherein the customized recommendation comprises at least one of:
- (a) one or more therapeutic interventions;
 - (b) one or more dietary recommendations;
 - (c) one or more renal sparing strategies; or
 - (d) one or more tests for disease progression.

37. The computer system according to claim 36, wherein:

(i) the one or more renal sparing strategies comprise avoidance of non-steroidal anti-inflammatories, aminoglycosides, or any combination thereof; and/or

(ii) the one or more tests for disease progression comprise testing of serum parathyroid hormone levels.

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38. The computer system according to any of claims 33-37, wherein the one or more biomarker comprises information relating to an amylase.

39. The computer system according to any of claims 33-38, wherein the
10 recurrent neural network is trained using a training dataset, wherein the training dataset comprises the one or more biomarkers and the demographic information for a plurality of other dogs.

40. The computer system according to any of claims 33-39, wherein the
15 prediction model further comprises the recurrent neural network with long short-term memory (LSTM).

41. The computer system according to any of claims 33-40 wherein the
20 decision threshold for developing the CKD using the recurrent neural network is about 0.0 to about 1.0.

42. The computer system according to any of claims 33-41 wherein the
decision threshold for developing the CKD using the recurrent neural network is about
.5.

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43. The computer system according to any of claims 33-42, wherein the recurrent neural network undergoes a ten-fold cross-validation process trained over eight or eighteen epochs.

44. The computer system according to any of claims 33-43, wherein the compute
30 system is caused to:

impute one or more missing values from the one or more biomarkers of the dog or the demographic information of the dog.

45. The computer system according to claim 44, wherein the imputation is a linear regression.

46. The computer system according to claim 44, wherein the imputation is based
5 on an age of the dog.

47. The compute system according to claim 44, wherein the imputation is based on the number of missing values.

10 48. A method for identifying susceptibility of a dog to develop chronic kidney disease (CKD), the method comprising:

(a) receiving at least one of:

(i) one or more biomarkers of the dog, wherein the one or more biomarkers comprises information relating to at least one of a
15 urine specific gravity, a creatinine, a urine protein, a blood urea nitrogen (BUN); or

(ii) demographic information of the dog, wherein the demographic information includes at least one of age or weight of the dog;

(b) processing at least one of the one or more biomarkers or demographic
20 information of the dog using a prediction model, wherein the prediction model comprises a recurrent neural network, wherein the recurrent neural network comprises hidden layer architecture with three layers, the three layers comprising a first layer with five nodes, a second layer with three nodes, and a third layer with three nodes; and

(c) determining a probability risk score of the dog for developing CKD based on
25 the processed one or more biomarkers or demographic information.

49. The method according to claim 48, further comprising:

determining a customized recommendation based on the probability risk of the
dog for developing CKD.

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50. The method according to claim 48 or 49, further comprising:

transmitting the customized recommendation to a user equipment of a
veterinarian, owner, or caregiver of the dog.

51. The method according to claim 49 or 50, wherein the customized recommendation comprises at least one of:

- (a) one or more therapeutic interventions;
- (b) one or more dietary recommendations;
- 5 (c) one or more renal sparing strategies; or
- (d) one or more tests for disease progression.

52. The method according to claim 51, wherein:

- (i) the renal sparing strategies comprise avoidance of non-steroidal anti-
10 inflammatories, aminoglycosides, or any combination thereof; and/or
- (ii) the tests for disease progression comprise testing of serum parathyroid hormone levels.

53. The method according to any of claims 48-52, wherein the one or more
15 biomarker comprises information relating to an amylase.

54. The method according to any of claims 48-53, wherein the recurrent neural network is trained using a training dataset, wherein the training dataset comprises the one or more biomarkers and the demographic information for a plurality of other
20 dogs.

55. The method according to any of claims 48-54, wherein the prediction model further comprises the recurrent neural network with long short-term memory (LSTM).

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56. The method according to any of claims 48-55, wherein the decision threshold for developing the CKD using the recurrent neural network is about 0.0 to about 1.0.

30 57. The method according to any of claims 48-56, wherein the decision threshold for developing the CKD using the recurrent neural network is about .5.

58. The method according to any of claims 48-57, wherein the recurrent neural network undergoes a ten-fold cross-validation process trained over eight or eighteen epochs.

5 59. The method according to any of claims 48-58, further comprising:
imputing one or more missing values from the one or more biomarkers of the dog
or the demographic information of the dog.

60. The method according to claim 59, wherein the imputation is a linear
10 regression.

61. The method according to claim 59, wherein the imputation is based on an age of the dog.

15 62. The method according to an of claims 59, wherein the imputation is based on the number of missing values.