

CLAIMS

1. 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:
 - (i) biomarkers of the dog, wherein the biomarkers comprise information relating to a urine specific gravity, a creatinine, a urine protein, and a blood urea nitrogen (BUN); and
 - (ii) demographic information of the dog, wherein the demographic information includes age and weight of the dog;
 - (b) process the biomarkers and the demographic information of the dog using a prediction model,
 - (i) wherein the prediction model comprises a recurrent neural network;
 - (ii) wherein the recurrent neural network is trained using a training dataset; and
 - (iii) wherein the training dataset comprises the biomarkers and the demographic information for a plurality of other dogs; and
 - (c) determine a probability risk score of the dog for developing CKD based on the processed biomarkers and demographic information.
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.
3. The computer system according to claim 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.

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. 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.
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.
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.
8. The computer system according to any of claims 1-7, wherein the biomarkers further comprise information relating to an amylase.
9. The computer system according to any of claims 1-8, wherein the prediction model further comprises the recurrent neural network with long short-term memory (LSTM).
10. The computer system according to any of claims 1-9, wherein a decision threshold for developing the CKD using the recurrent neural network is in the range of 0.0 to 1.0.

11. The computer system according to claim 10, wherein the decision threshold for developing the CKD using the recurrent neural network is 0.5.

12. The computer system according to any of claims 1-11, wherein the computer system is caused to:

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

13. The computer system according to claim 12, wherein the imputation is a linear regression.

14. The computer system according to claim 12, wherein the imputation is based on an age of the dog.

15. The computer system according to claim 12, wherein the imputation is based on the number of missing values.

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

(a) receiving:

(i) biomarkers of the dog, wherein the biomarkers comprise information relating to a urine specific gravity, a creatinine, a urine protein, and a blood urea nitrogen (BUN); and

(ii) demographic information of the dog, wherein the demographic information includes age and weight of the dog;

(b) processing the biomarkers and the demographic information of the dog using a prediction model,

(i) wherein the prediction model comprises a recurrent neural network;

(ii) wherein the recurrent neural network is trained using a training dataset; and

(iii) wherein the training dataset comprises the biomarkers and the demographic information for a plurality of other dogs; and

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

17. The method according to claim 16, further comprising:
determining a customized recommendation based on the probability risk of the dog for developing CKD.

18. The method according to claim 17, further comprising:
transmitting the customized recommendation to a user equipment of a veterinarian, owner, or caregiver of the dog.

19. The method according to claim 17 or 18, 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.

20. The method according to claim 19, 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.

21. The method according to any of claims 16-20, 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.

22. The method according to any of claims 16-21, wherein the recurrent neural network undergoes a ten-fold cross-validation process and is trained over eight or eighteen epochs.

23. The method according to any of claims 16-22, wherein the biomarkers further comprise information relating to an amylase.

24. The method according to any of claims 16-23, wherein the prediction model further comprises the recurrent neural network with long short-term memory (LSTM).

25. The method according to any of claims 16-24 wherein a decision threshold for developing the CKD using the recurrent neural network is in the range of 0.0 to 1.0.

26. The method according to claim 25, wherein the decision threshold for developing the CKD using the recurrent neural network is 0.5.

27. The method according to any of claims 16-26, further comprising:
imputing one or more missing values from the biomarkers of the dog and the demographic information of the dog.

28. The method according to claim 27, wherein the imputation is a linear regression.

29. The method according to claim 27, wherein the imputation is based on an age of the dog.

30. The method according to claim 27, wherein the imputation is based on the number of missing values.

31. 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:

(i) biomarkers of the dog, wherein the biomarkers comprise information relating to a urine specific gravity, a creatinine, a urine protein, and a blood urea nitrogen (BUN); and

(ii) demographic information of the dog, wherein the demographic information includes age and weight of the dog;

- (b) process the biomarkers and the demographic information of the dog using a prediction model,
 - (i) wherein the prediction model comprises a recurrent neural network;
 - (ii) wherein the recurrent neural network is trained using a training dataset;
 - (iii) wherein the training dataset comprises the biomarkers and the demographic information for a plurality of other dogs;
 - (iv) wherein the recurrent neural network comprises a hidden layer architecture with three layers; and
 - (v) wherein the three layers comprise 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 biomarkers and demographic information.

32. The computer system according to claim 31, wherein the computer system is caused to:

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

33. The computer system according to claim 32, wherein the computer system is caused to:

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

34. The computer system according to claim 32 or 33, 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.

35. The computer system according to claim 34, 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.

36. The computer system according to any of claims 31-35, wherein the biomarkers comprise information relating to an amylase.

37. The computer system according to any of claims 31-36, wherein the prediction model further comprises the recurrent neural network with long short-term memory (LSTM).

38. The computer system according to any of claims 31-37, wherein a decision threshold for developing the CKD using the recurrent neural network is in the range of 0.0 to 1.0.

39. The computer system according to claim 38, wherein the decision threshold for developing the CKD using the recurrent neural network is 0.5.

40. The computer system according to any of claims 31-39, wherein the recurrent neural network undergoes a ten-fold cross-validation process and is trained over eight or eighteen epochs.

41. The computer system according to any of claims 31-40, wherein the computer system is caused to:

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

42. The computer system according to claim 41, wherein the imputation is a linear regression.

43. The computer system according to claim 41, wherein the imputation is based on an age of the dog.

44. The computer system according to claim 41, wherein the imputation is based on the number of missing values.

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

- (a) receiving:
 - (i) biomarkers of the dog, wherein the biomarkers comprise information relating to a urine specific gravity, a creatinine, a urine protein, and a blood urea nitrogen (BUN); and
 - (ii) demographic information of the dog, wherein the demographic information includes age or weight of the dog;
- (b) processing the biomarkers and the demographic information of the dog using a prediction model,
 - (i) wherein the prediction model comprises a recurrent neural network;
 - (ii) wherein the recurrent neural network is trained using a training dataset; and
 - (iii) wherein the training dataset comprises the biomarkers and the demographic information for a plurality of other dogs;
 - (iv) wherein the recurrent neural network comprises a hidden layer architecture with three layers; and
 - (v) wherein the three layers comprise 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 the processed biomarkers and the demographic information.

46. The method according to claim 45, further comprising:
determining a customized recommendation based on the probability risk of the dog for developing CKD.

47. The method according to claim 46, further comprising:
transmitting the customized recommendation to a user equipment of a veterinarian, owner, or caregiver of the dog.

48. The method according to claim 46 or 47, 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.

49. The method according to claim 48, wherein:

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

50. The method according to any of claims 45-49, wherein the biomarkers comprise information relating to an amylase.

51. The method according to any of claims 45-50, wherein the prediction model further comprises the recurrent neural network with long short-term memory (LSTM).

52. The method according to any of claims 45-51, wherein a decision threshold for developing the CKD using the recurrent neural network is in the range of 0.0 to 1.0.

53. The method according to claim 52, wherein the decision threshold for developing the CKD using the recurrent neural network is 0.5.

54. The method according to any of claims 45-53, wherein the recurrent neural network undergoes a ten-fold cross-validation process trained over eight or eighteen epochs.

55. The method according to any of claims 45-54, further comprising:
imputing one or more missing values from the biomarkers of the dog and the demographic information of the dog.

56. The method according to claim 55, wherein the imputation is a linear regression.

57. The method according to claim 55, wherein the imputation is based on an age of the dog.

58. The method according to claim 55, wherein the imputation is based on the number of missing values.