CLAIMS

1. A computer-implemented method for predicting deep tissue injury (DTI) in a patient, the method comprising:

a) receiving, via an input device, a plurality of sub-epidermal moisture (SEM) delta values associated with the patient;

b) automatically inputting, via a processor, the plurality of SEM delta values into a trained model,

wherein the trained model is configured to calculate a probability value corresponding to the likelihood of the patient developing DTI; and

wherein the trained model is trained based on a set of training data comprising SEM delta data from a set of patients; and

c) outputting, via an output device, a prediction of the likelihood of the patient developing DTI based on the probability value.

2. The method of claim 1, wherein the trained model is trained by performing the steps comprising:

a) receiving a set of training data comprising:

1) a plurality of SEM delta values associated with a set of patients, wherein each patient in the set of patients has a known DTI status, and

2) a threshold value, wherein the threshold value is a number between 0 and 1;

b) automatically inputting the training data into an optimization algorithm to receive a plurality of optimal weight values; and

c) automatically updating the trained model with the plurality of optimal weight values.

3. The method of claim 2, wherein the optimization algorithm is configured to:

a) generate a plurality of ascending random numbers between 0 and 2 as a plurality of weight values;

b) input the training data and the plurality of weight values into the trained model to receive a set of predicted DTI statuses associated with the set of patients;

c) compare the predicted DTI statuses with the known DTI statuses associated with the set of patients;

d) calculate a true positive rate (TPR) and a false positive rate (FPR) based on the comparison, wherein the TPR is calculated as percentage of patients in the set of patients whose predicted DTI status matches their known DTI status, and the FPR is calculated as percentage of patients in the set of patients whose predicted DTI status does not match their known DTI status;

e) repeat steps a) to d) for a predetermined number of iterations to obtain a plurality of TPRs and FPRs;

f) identify an optimal TPR and FPR from the iterations; and

g) output the optimal plurality of weight values associated with the optimal TPR and FPR.

4. The method of any one of claims 1-3, wherein the plurality of SEM delta values comprises SEM delta values from a predetermined number of days preceding the prediction.

5. The method of any one of claims 1-4, wherein identifying the optimal TPR and FPR comprises minimizing the objective function of 1-TPR+FPR and satisfying the constraint of TPR>>FPR.

6. The method of any one of claims 1-5, wherein the input device is a SEM scanner.

7. The method of claim 6, wherein the SEM scanner is connected to a computer by cable or by wireless technology.

8. A method for assessing risk of deep tissue injury (DTI) of a patient, the method comprising:

a) obtaining a plurality of sub-epidermal moisture (SEM) delta values associated with the patient;

b) inputting the plurality of SEM delta values into a trained model to receive a probability value,

wherein the trained model is configured to calculate a probability value corresponding to the likelihood of the patient developing DTI,

wherein the trained model is trained based on a set of training data comprising SEM delta values from a set of patients; and

c) assessing the risk of the patient developing DTI based on the probability value.

9. The method claim 8, wherein the risk of the patient developing DTI is categorized as no DTI, low likelihood of DTI, high likelihood of DTI, or suspected DTI.

10. The method of claim 9, further comprising selecting an intervention for the patient based on the assessed risk of DTI.

11. The method of claim 10, wherein the selected intervention is selected from the group consisting of reducing pressure, cleaning and dressing wounds, removing damaged tissue, drug administration, and surgery.

12. The method of claims 10 or 11, wherein the intervention comprises at least one of: reducing pressure, repositioning the patient, changing the patient's support surface, providing a low-friction padded mattress, providing a silicon pad, providing a heel boot, cleaning and dressing wounds, removing damaged tissue, applying a topical cream, applying a barrier cream, applying neuro-muscular stimulation, drug administration, and surgery.

13. The method of any one of claims 8-12, wherein the DTI occurs at a location selected from the group consisting of the back of the head, the sacrum, the shoulder, the elbow, the lower back, the tailbone, the buttock, the hip, the inner knee, and the heel.

14. The method of any one of claims 8-13, wherein the plurality of SEM delta values associated with the patient is obtained periodically over a predetermined time interval preceding the risk assessment.

15. The method of claim 14, wherein the predetermined time interval is 6 days.

16. The method of any one of claims 8-15, wherein the plurality of SEM delta values associated with the patient is obtained once daily for 6 days preceding the risk assessment.

17. The method of 16, further comprising transmitting the risk to the patient or a clinician.

18. The method of any one of claims 8-17, further comprising selecting a treatment for the patient based on the assessed risk of PI.

19. The method of any one of claims 8-17, further comprising transmitting the selected treatment to the patient or a clinician.

20. A system for predicting deep tissue injury (DTI), comprising:

a) a Sub-Epidermal Moisture (SEM) scanner configured to make SEM measurements;

b) a processor electronically coupled to the SEM scanner and configured to receive the SEM measurements; and

c) a non-transitory computer readable media that is electronically coupled to the processor and comprises instructions stored thereon that, when executed on the processor, performs the steps of:

i) calculating a plurality of SEM delta values from the SEM measurements,

ii) automatically inputting, via a processor, the plurality of SEM delta values into a trained model to receive a probability value, wherein the trained model is configured to predict a probability value corresponding to a future occurrence of the patient developing DTI, and wherein the trained model is trained based on a set of training data comprising a plurality of SEM delta values associated with a set of patients;

iii) outputting, via an output device, a prediction of the future occurrence of the patient developing DTI based on the probability value.

21. The system of claim 20, wherein training the trained model comprises:

a) receiving, via an input device, the set of training data comprising:

i) a plurality of SEM delta values associated with a set of patients, and

ii) a threshold value, wherein each patient in the set of patients has a known DTI status, and wherein the threshold value is a number between 0 and 1;

b) automatically inputting, via a processor, the training data into an optimization algorithm to receive a plurality of optimal weight values; and

c) automatically updating, via a processor, the trained model with the plurality of optimal weight values.

22. The system of claim 21, wherein the optimization algorithm is configured to:

a) generate a plurality of ascending random numbers between 0 and 2 as a plurality of weight values;

b) input the training data and the plurality of weight values into the model to receive a set of predicted DTI statuses associated with the set of patients;

c) compare the predicted DTI statuses with the known DTI statuses associated with the set of patients;

d) calculate a true positive rate (TPR) and a false positive rate (FPR) based on the comparison, wherein the TPR is calculated as percentage of patients in the set of patients whose predicted DTI status matches their known DTI status, and the FPR is calculated as

percentage of patients in the set of patients whose predicted DTI status does not match their known DTI status;

e) repeat steps a) to d) for a predetermined number of times as the number of iterations;

f) identify optimal TPR and FPR from all calculated TPRs and FPRs from the iterations; and

g) output the plurality of optimal weight values associated with the identified optimal TPR and FPR.

23. The system of claim 22, wherein the plurality of SEM delta values comprises SEM delta values from a predetermined number of days before the day of predicting PI.

24. The system of claim 22 or 23, wherein identifying optimal TPR and FPR comprises minimizing the objective function of 1-TPR+FPR and satisfying the constraint of PR>>FPR.

25. The system of any one of claims 21-24, wherein the input device is the SEM scanner.

26. The system of any one of claims 21-25, wherein the input device is a database or computer.

27. The system of any one of claims 20-26, wherein the DTI occurs at a location selected from the group consisting of the back of the head, the sacrum, the shoulder, the elbow, the lower back, the tailbone, the buttock, the hip, the inner knee, the heel, and a combination thereof.

28. The system of any one of claims 20-27, wherein the prediction of the future occurrence of the patient developing DTI comprises likely to develop DTI and not likely to develop PI.

29. A system for assessing risk of deep tissue injury (DTI), comprising:

a) a Sub-Epidermal Moisture (SEM) scanner configured to make SEM measurements;

b) a processor electronically coupled to the SEM scanner and configured to receive the SEM measurements; and

c) a non-transitory computer readable media that is electronically coupled to the processor and comprises instructions stored thereon that, when executed on the processor, performs the steps of:

i) calculating a plurality of SEM delta values from the SEM measurements,

ii) automatically inputting, via the processor, the plurality of SEM delta values into a trained model to receive a probability value, wherein the trained model is configured to predict a probability value corresponding to a future occurrence of the patient developing DTI, and wherein the trained model is trained based on a set of training data comprising a plurality of SEM delta values associated with a set of patients;

d) outputting, via an output device, a likelihood of future occurrence of DTI based on the probability value.

30. The system of claim 29, wherein the likelihood of future occurrence of DTI is categorized as no DTI, low likelihood of DTI, high likelihood of DTI, or suspected PI.

31. The system of claim 29 or 30, wherein the likelihood of future occurrence of DTI is the calculated probability of developing PI.

32. The system of any one of claims 29-31, wherein the non-transitory computer readable media further performs the step:

a) selecting, via the processor, a treatment for the patient based on the likelihood of future occurrence of DTI, and

b) outputting, via the output device, a notification of the selected treatment.

33. The system of any one of claims 29-32, wherein the selected treatment is selected from the group consisting of reducing pressure, cleaning and dressing wounds, removing damaged tissue, drug administration, and surgery.

34. The system of any one of claims 29-33, wherein the DTI is deep tissue pressure injury (DTPI).

35. The system of any one of claims 29-34, wherein the DTI occurs at a location selected from the group consisting of the back of the head, the sacrum, the shoulder, the elbow, the lower back, the tailbone, the buttock, the hip, the inner knee, the heel, and a combination thereof.

36. The system of any one of claims 29-35, wherein the non-transitory computer readable media further performs the steps of generating or updating a report from performing the method of assessing risk and storing the report.

37. The system of any one of claims 29-36, further comprising transmitting the report to the patient or a clinician.

38. The system of any one of claims 29-37, wherein the output device is a computer display.