CLAIMS

What is claimed is:

1. A computerized system for monitoring a respiratory condition of a human subject, the system comprising: one or more processors; and computer memory having computer-executable instructions stored thereon for performing operations when executed by the one or more processors, the operations comprising: receiving first audio data comprising voice information of the human subject, determining a first phoneme feature set comprising at least one acoustic feature characterizing a first portion of the first audio data, the first portion including a first phoneme; monitoring the respiratory condition by comparing the first phoneme feature set to a second phoneme feature set determined from second audio data.

2. The computerized system of claim 1 further comprising an acoustic sensor configured to capture audio information.

3. The computerized system of claim 2, wherein the acoustic sensor is integrated into a smart speaker.

4. The computerized system of claim 1, wherein the first phoneme feature set comprises acoustic features characterizing at least one phenome that comprises */a/*, */e/*, */n/*, or */m/*.

5. The computerized system of claim 1, wherein the first phoneme feature set comprises acoustic features characterizing a first phoneme associated with the first portion of the first audio data, a second phoneme associated with a second portion of the first audio data, and a third phoneme associated with a third portion of the first audio data, wherein the first phoneme comprises */a/*, the second phoneme comprises */n/*, and the third phoneme comprises */m*/.

6. The computerized system of claim 5, wherein: the acoustic features for the */a/* phoneme comprise at least one of: standard deviation of formant 1 (F1) bandwidth, pitch interquartile range, spectral entropy determined for 1.6 to 3.2 kilohertz (kHz) frequencies, jitter, standard deviation of mel-frequency cepstral coefficient MFCC9 and MFCC12, mean of mel-frequency cepstral coefficient MFCC6, and spectral contrast determined for 3.2 to 6.4 kHz frequencies, the acoustic features for the */n/* phoneme comprise at least one of: harmonicity, standard deviation of F1 bandwidth, pitch interquartile range, spectral entropy determined for 1.5 to 2.5 kHz and 1.6 to 3.2 kHz frequencies, spectral flatness determined for 1.5 to 2.5 kHz frequencies, standard deviation of mel-frequency cepstral coefficients MFCC1, MFCC2, MFCC3, and MFCC11, mean of mel-frequency cepstral coefficient MFCC8, and spectral contrast determined for 1.6 to 3.2 kHz frequencies, and the acoustic features for the */m/* phoneme comprise at least one of: harmonicity, standard deviation of F1 bandwidth, pitch interquartile range, spectral entropy determined for 1.5 to 2.5 kHz and 1.6 to 3.2 kHz frequencies, spectral flatness determined for 1.5 to 2.5 kHz frequencies, standard deviation of mel-frequency cepstral coefficients MFCC2 and MFCC10, mean of mel-frequency cepstral coefficient MFCC8, shimmer, spectral contrast determined for 3.2 to 6.4 kHz frequencies, and standard deviation of 200 hertz (Hz) third-octave band.

7. The computerized system of claim 1, wherein the operations further comprise: performing automatic speech recognition on the first portion of the first audio data to determine a first phoneme; and associating the first portion of the first audio data with the first phoneme.

8. The computerized system of claim 7, wherein performing automatic speech recognition comprises: determining a text corresponding to the first portion of the first audio data; and determining the first phoneme based on the text.

9. The computerized system of claim 1, wherein the first audio data is associated with a first time interval corresponding to a first date-time value and the second audio data is associated with a second time interval corresponding to a second date-time value, and wherein monitoring the respiratory condition of the human subject comprises: determining a feature distance measurement of at least a portion of features in the first and second phoneme feature sets; and based on the feature distance measurement, determining that the respiratory condition of the human subject has changed between the second date-time value and the first date-time value.

10. The computerized system of claim 9, wherein the second date-time value occurs between 18 and 36 hours after the first date-time value.

11. The computerized system of claim 1, wherein the operations further comprise: receiving a first physiological data for the human subject, the first physiological data being

associated with a first time interval that is associated with the first audio data; and storing the physiological data in the record.

12. The computerized system of claim 1, wherein the first audio data is associated with a first time interval and wherein the operations further comprise determining first contextual data for the human subject, the first contextual data being associated with a first time interval and comprising at least one of physiological data about the human subject, information about a location of the human subject during the first time interval, or contextual information associated with the first time interval, wherein the first phoneme feature set is further determined based on the first contextual data.

13. The computerized system of claim 1, wherein the first phoneme feature set is determined from a plurality of other phoneme feature sets, each of the other phoneme feature sets being associated with a first date-time value occurring before a second time interval associated with the second audio data.

14. The computerized system of claim 1, wherein comparing the first phoneme feature set to the second phoneme feature set comprises determining a Euclidian or Levenshtein distance between at least a portion of the first phoneme feature set and at least a portion of the second phoneme feature set.

15. The computerized system of claim 1, wherein comparing the first phoneme feature set to the second phoneme feature set comprises performing a comparison between at least a first feature of the first phoneme feature set and a corresponding second feature of the second phoneme feature set.

16. The computerized system of claim 1, wherein monitoring the respirator condition of the human subject comprises: performing a comparison of the first phoneme feature set and the second phoneme feature set to determine a first feature-set distance; and determining that the respiratory condition of the human subject has changed by comparing the first feature-set distance to a threshold distance.

17. The computerized system of claim 16, wherein the threshold distance is pre-determined by a clinician or is automatically determined based on one or more of: physiological data of the user, a user setting, or historical respiratory-condition information of the user.

18. The computerized system of claim 16, wherein the operations further comprise: receiving a third phoneme feature set representing a baseline at a time when the human subject is determined to not have the respiratory condition; and wherein monitoring the respirator condition of the human subject comprises: performing a comparison of the first phoneme feature set and the second phoneme feature set to determine a first feature-set distance; performing a second comparison between the second phoneme feature set and the third phoneme feature set to determine a second feature-set distance; perform a third comparison between the first phoneme feature set and the third phoneme feature set to determine a third feature-set distance; perform a fourth comparison of the second feature-set distance and the third feature-set distance; and based on the fourth comparison, perform one of: providing an indication that the human subject's respiratory condition is improving if the second feature-set distance is less than the third feature-set distance, providing an indication that the human subject's respiratory condition is worsening if the second feature-set distance is greater than the third feature-set distance or providing an indication that the human subject's respiratory condition is not changing if the second feature-set distance equals the third feature-set distance.

19. The computerized system of claim 2, wherein the third phoneme feature set representing the baseline comprises phoneme features having feature values determined based on an average of a set of phoneme feature values, each phoneme feature value within the set of phoneme feature values determined from a different time interval during the time when the human subject is determined to not have the respiratory condition.

20. The computerized system of claim 1, wherein the operations further comprise initiating an action based on a change in the respiratory condition determined by comparing the first phoneme feature set to the second phoneme feature set.

21. The computerized system of claim 20, wherein initiating an action based on the change in the respiratory condition of the human subject comprises issuing a notification to at least one of: a user device associated with the human subject or a clinician of the human subject; scheduling an appointment between the human subject and the clinician of the human subject; providing a recommendation to modify treatment of the respiratory condition; and requesting a prescription medication refill.

22. The computerized system of claim 1 further comprising a user device associated with the human subject, wherein monitoring the respiratory condition of the human subject comprises determining a respiratory condition-score based at least on comparing the first phoneme feature set to the second phoneme feature set, and wherein the operations further comprise causing for display, on a user interface of the user device, the respiratory condition score.

23. The computerized system of claim 1 further comprising a user device associated with the human subject, wherein monitoring the respiratory condition of the human subject comprises determining a transmission risk level indicating a risk of the human subject transmitting an infectious agent associated with the respiratory condition based at least on comparing the first phoneme feature set to the second phoneme feature set, and wherein the operations further comprise causing for display, on a user interface of the user device, the transmission risk level.

24. The computerized system of claim 1 further comprising a user device associated with the human subject, wherein monitoring the respiratory condition of the human subject comprises determining a trend in the respiratory condition of the human subject based at least on comparing the first phoneme feature set to the second phoneme feature set, and wherein the operations further comprise causing for display, on a user interface of the user device, the trend in the respiratory condition of the human subject.

25. The computerized system of claim 1, wherein the first portion of the first audio data comprises a sustained phonation of a cardinal vowel phoneme and wherein the first phoneme feature set is based on a maximum phonation time.

26. The computerized system of claim 1, wherein the first audio data comprises a recording of a spoken passage that includes multiple phonemes and wherein the first phoneme feature set comprises one or more of a speaking rate, an average pause length, a pause count, and a global signal-to-noise ratio.

~~27. A method for treating a respiratory condition utilizing an acoustic sensor device, the method comprising: receiving first audio data that is associated with a first time interval, the first audio data comprises voice information of a human subject; determining a first phoneme feature set comprising at least one acoustic feature characterizing a first portion of the first audio data, the first portion including a first phoneme; performing a comparison of the first phoneme feature set to a second phoneme feature set determined from second audio data associated with a second time interval; and based on at least the comparison, initiating a treatment protocol for the human subject to treat the respiratory condition.~~

~~28. The method of claim 27, wherein initiating the treatment protocol includes determining at least one of a therapeutic agent, a dosage, and a method of administration of the therapeutic agent.~~

29. The method of claim 28, wherein the therapeutic agent is selected from a group consisting of: a PLpro inhibitor, Apilomod, EIDD-2801, Ribavirin, Valganciclovir, β-Thymidine, Aspartame, Oxprenolol, Doxycycline, Acetophenazine, Iopromide, Riboflavin, Reproterol, 2,2′-Cyclocytidine, Chloramphenicol, Chlorphenesin carbamate, Levodropropizine, Cefamandole, Floxuridine, Tigecycline, Pemetrexed, L(+)-Ascorbic acid, Glutathione, Hesperetin, Ademetionine, Masoprocol, Isotretinoin, Dantrolene, Sulfasalazine Anti-bacterial, Silybin, Nicardipine, Sildenafil, Platycodin, Chrysin, Neohesperidin, Baicalin, Sugetriol-3,9-diacetate, (−)-Epigallocatechin gallate, Phaitanthrin D, 2-(3,4-Dihydroxyphenyl)-2-[[2-(3,4-dihydroxyphenyl)-3,4-dihydro-5,7-dihydroxy-2H-1-benzopyran-3-yl]oxy]-3,4-dihydro-2H-1-benzopyran-3,4,5,7-tetrol, 2,2-di(3-indolyl)-3-indolone, (S)-(1S,2R,4aS,5R,8aS)-1-Formamido-1,4a-dimethyl-6-methylene-5-((E)-2-(2-oxo-2,5-dihydrofuran-3-yl)ethenyl)decahydronaphthalen-2-yl-2-amino-3-phenylpropanoate, Piceatannol, Rosmarinic acid, and Magnolol; a 3CLpro inhibitor, Lymecycline, Chlorhexidine, Alfuzosin, Cilastatin, Famotidine, Almitrine, Progabide, Nepafenac, Carvedilol, Amprenavir, Tigecycline, Montelukast, Carminic acid, Mimosine, Flavin, Lutein, Cefpiramide, Phenethicillin, Candoxatril, Nicardipine, Estradiol valerate, Pioglitazone, Conivaptan, Telmisartan, Doxycycline, Oxytetracycline, (1S,2R,4aS,5R,8aS)-1-Formamido-1,4a-dimethyl-6-methylene-5-((E)-2-(2-oxo-2,5-dihydrofuran-3-yl)ethenyl)decahydronaphthalen-2-yl5-((R)-1,2-dithiolan-3-yl) pentanoate, Betulonal, Chrysin-7-O-β-glucuronide, Andrographiside, (1S,2R,4aS,5R,8aS)-1-Formamido-1,4a-dimethyl-6-methylene-5-((E)-2-(2-oxo-2,5-dihydrofuran-3-yl)ethenyl)decahydronaphthalen-2-yl 2-nitrobenzoate, 2β-Hydroxy-3,4-seco-friedelolactone-27-oic acid (S)-(1S,2R,4aS,5R,8aS)-1-Formamido-1,4a-dimethyl-6-methylene-5-((E)-2-(2-oxo-2,5-dihydrofuran-3-yl)ethenyl) decahydronaphthalen-2-yl-2-amino-3-phenylpropanoate, Isodecortinol, Cerevisterol, Hesperidin, Neohesperidin, Andrograpanin, 2-((1R,5R,6R,8aS)-6-Hydroxy-5-(hydroxymethyl)-5,8a-dimethyl-2-methylenedecahydronaphthalen-1-yl)ethyl benzoate, Cosmosiin, Cleistocaltone A, 2,2-Di(3-indolyl)-3-indolone, Biorobin, Gnidicin, Phyllaemblinol, Theaflavin-3,3′-di-O-gallate, Rosmarinic acid, Kouitchenside I, Oleanolic acid, Stigmast-5-en-3-ol, Deacetylcentapicrin, and Berchemol; an RdRp inhibitor, Valganciclovir, Chlorhexidine, Ceftibuten, Fenoterol, Fludarabine, Itraconazole, Cefuroxime, Atovaquone, Chenodeoxycholic acid, Cromolyn, Pancuronium bromide, Cortisone, Tibolone, Novobiocin, Silybin, Idarubicin Bromocriptine, Diphenoxylate, Benzylpenicilloyl G, Dabigatran etexilate, Betulonal, Gnidicin, 2β,30β-Dihydroxy-3,4-seco-friedelolactone-27-lactone, 14-Deoxy-11,12-didehydroandrographolide, Gniditrin, Theaflavin 3,3′-di-O-gallate, (R)-((1R,5aS,6R,9aS)-1,5a-Dimethyl-7-methylene-3-oxo-6-((E)-2-(2-oxo-2,5-dihydrofuran-3-yl)ethenyl)decahydro-1H-benzo[c]azepin-1-yl)methyl2-amino-3-phenylpropanoate, 2β-Hydroxy-3,4-seco-friedelolactone-27-oic acid, 2-(3,4-Dihydroxyphenyl)-2-[[2-(3,4-dihydroxyphenyl)-3,4-dihydro-5,7-dihydroxy-2H-1-benzopyran-3-yl]oxy]-3,4-dihydro-2H-1-benzopyran-3,4,5,7-tetrol, Phyllaemblicin B, 14-hydroxycyperotundone, Andrographiside, 2-((1R,5R,6R,8aS)-6-Hydroxy-5-(hydroxymethyl)-5,8a-dimethyl-2-methylenedecahydro

naphthalen-1-yl)ethyl benzoate, Andrographolide, Sugetriol-3,9-diacetate, Baicalin, (1S,2R,4aS,5R,8aS)-1-Formamido-1,4a-dimethyl-6-methylene-5-((E)-2-(2-oxo-2,5-dihydrofuran-3-yl)ethenyl)decahydronaphthalen-2-yl 5-((R)-1,2-dithiolan-3-yl)pentanoate, 1,7-Dihydroxy-3-methoxyxanthone,1,2,6-Trimethoxy-8-[(6-O-β-D-xylopyranosyl-β-D-glucopyranosyl)oxy]-9H-xanthen-9-one, and/or 1,8-Dihydroxy-6-methoxy-2-[(6-O-β-D-xylopyranosyl-β-D-glucopyranosyl)oxy]-9H-xanthen-9-one, 8-(β-D-Glucopyranosyloxy)-1,3,5-trihydroxy-9H-xanthen-9-one; Diosmin, Hesperidin, MK-3207, Venetoclax, Dihydroergocristine, Bolazine, R428, Ditercalinium, Etoposide, Teniposide, UK-432097, Irinotecan, Lumacaftor, Velpatasvir, Eluxadoline, Ledipasvir, a combination of Lopinavir/Ritonavir and Ribavirin, Alferon, and prednisone; dexamethasone, azithromycin, remdesivir, boceprevir, umifenovir and favipiravir; an α-ketoamides compound; an RIG-1 pathway activator; a protease inhibitor; and remdesivir, galidesivir, favilavir/avifavir, molnupiravir (MK-4482/EIDD-2801), AT-527, AT-301, BLD-2660, favipiravir, camostat, SLV213 emtrictabine/tenofivir, clevudine, dalcetrapib, boceprevir, ABX464, (3S)-3-({N-[(4-methoxy-1H-indol-2-yl)carbonyl]-L-leucyl}amino)-2-oxo-4-[(3S)-2-oxopyrrolidin-3-yl]butyl dihydrogen phosphate; and a pharmaceutically acceptable salt, solvate or hydrate thereof (PF-07304814), (1R,2S,5S)-N-{(1S)-1-Cyano-2-[(3S)-2-oxopyrrolidin-3-yl]ethyl}-6,6-dimethyl-3-[3-methyl-N-(trifluoroacetyl)-L-valyl]-3-azabicyclo[3.1.0]hexane-2-carboxamide or a solvate or hydrate thereof (PF-07321332), S-217622, glucocorticoids, convalescent plasma, a recombinant human plasma, monoclonal antibody, ravulizumab, VIR-7831/VIR-7832, BRII-196/BRII-198, COVI-AMG/COVI DROPS (STI-2020), bamlanivimab (LY-CoV555), mavrilimab, leronlimab (PRO140), AZD7442, lenzilumab, infliximab, adalimumab, JS 016, STI-1499 (COVIGUARD), lanadelumab (Takhzyro), canakinumab (Ilaris), gimsilumab, otilimab, antibody cocktail, recombinant fusion protein, anticoagulant, IL-6 receptor agonist, PIKfyve inhibitor, RIPK1 inhibitor, VIP receptor agonist, SGLT2 inhibitor, TYK inhibitor, kinase inhibitor, bemcentinib, acalabrutinib, losmapimod, baricitinib, tofacitinib, H2 blocker, anthelmintic, and a furin inhibitor.

30. The method of claim 28, wherein the therapeutic agent is (3S)-3-({N-[(4-methoxy-1H-indol-2-yl)carbonyl]-L-leucyl}amino)-2-oxo-4-[(3S)-2-oxopyrrolidin-3-yl]butyl dihydrogen phosphate, or a pharmaceutically acceptable salt, solvate or hydrate thereof (PF-07304814).

31. The method of claim 38, wherein the therapeutic agent is (1R,2S,5S)-N-{(1S)-1-Cyano-2-[(3S)-2-oxopyrrolidin-3-yl]ethyl}-6,6-dimethyl-3-[3-methyl-N-(trifluoroacetyl)-L-valyl]-3-azabicyclo[3.1.0]hexane-2-carboxamide or a solvate or hydrate thereof (PF-07321332).

~~32. The method of claim 27, wherein initiating administration of the treatment protocol includes generating a graphic user interface element provided for display on a user device, the graphic user interface element indicating a recommendation of the treatment protocol that is based on at least the comparison of the first phoneme feature set to the second phoneme feature set.~~

~~33. The method of claim 32, wherein the user device is separate from the acoustic sensor device.~~

~~34. The method of claim 32 further comprising applying the treatment protocol to the human subject based on the recommendation.~~

~~35. The method of claim 27, wherein the respiratory condition comprises coronavirus disease 2019 (COVID-19).~~

27~~36~~. A computerized method of tracking efficacy of a therapeutic agent for treating a respiratory condition in a human subject, the computerized method comprising: receiving a first phoneme feature set and a second phoneme feature set, each of the first phoneme feature set and the second phoneme feature set representing voice information of the human subject, the second phoneme feature set being associated with a second date-time value occurring after a first date-time value associated with the first phoneme feature set, wherein a time period in which the therapeutic agent is being administered to the human subject includes at least the second date-time value; performing a first comparison of the first phoneme feature set and the second phoneme feature set to determine a first feature-set distance; and based on the first feature-set distance, determining whether there is a change in the respiratory condition of the human subject.

28~~37~~. The computerized method of claim 27~~36~~, wherein the respiratory condition is a respiratory infection, and wherein the therapeutic agent is an antimicrobial medication.

29~~38~~. The computerized method of claim 28~~37~~, wherein the therapeutic agent is an antibiotic medication.

30~~39~~. The computerized method of claim 28~~37~~ further comprising, based at least on determining whether there is a change in the respiratory condition of the human subject, determining a change in efficacy of the antibiotic medication.

31~~40~~. The computerized method of claim 27~~36~~, wherein determining whether there is a change in the respiratory condition of the human subject comprises determining whether the respiratory condition has improved, worsened, or not changed.

3241. The computerized method of claim 2736 further comprising: based on the determination of whether there is a change in the respiratory condition of the human subject, initiating an action for treating the human subject.

3342. The computerized method of claim 3241, wherein the action for treating the human subject is initiated upon determining that the respiratory condition has worsened.

3443. The computerized method of claim 3241, wherein the action for treating the human subject is initiated upon determining that the respiratory condition has either worsened or not changed.

3544. The computerized method of claim 3241, wherein the action for treating the human subject comprising changing a treatment protocol of the human subject.

3645. The computerized method of claim 3544, wherein changing the treatment protocol of the human subject comprises initiating a recommendation to adjust one or more of the therapeutic agent or dosage of the therapeutic agent.

3746. The computerized method of claim 3544, wherein changing the treatment protocol of the human subject comprises sending a message to a care provider of the human subject, the message requesting a modification of the treatment protocol of the human subject.

3847. The computerized method of claim 3241, wherein the action for treating the human subject comprising electronically initiating a refill request for the therapeutic agent with a pharmacy determined from an electronic health record (EHR) of the human subject.