Claims

1. An inhalation therapy management system ~~for managing~~configured to manage aspects of ~~respiratory therapy, including~~ inhalation therapy, for each of a set of patients, comprising:

a set of intelligent valved holding chamber (IVHC) devices, each IVHC device corresponding to a particular patient and providing:

a distal receiver portion couplable with a pressurized metered dose inhaler (pMDI), and providing:

a set of air inlets fluidically coupled to an external environment of the IVHC device; and

a lumen structure into which a medical aerosol dose discharged from the pMDI is introducible;

an intermediate sleeve member extending proximal to the receiver portion and providing:

a chamber fluidically couplable to the air inlets and the lumen of the receiver portion, into which the medical aerosol dose can travel in a proximal direction after discharge from the pMDI, wherein the chamber has a volume greater than that of the lumen structure; and

an exit aperture fluidically coupled to the chamber;

a mouthpiece portion extending proximal to the receiver portion and providing an inhalation / exhalation aperture at a proximal end thereof, which is fluidically couplable to the chamber of the intermediate sleeve member, and which is insertable into the patient's mouth, by which the patient can draw air from the external environment into the and through the IVHC device and inhale the medical aerosol dose into their respiratory passages;

a one-way valve structure configured for enabling proximal to distal flow of gases through the intermediate sleeve member, and preventing distal-to-proximal flow of gases through the intermediate sleeve member;

a set of sensors, including at least one gas flow sensor configured for detecting air inflow into a portion of the IVHC device;

a first processing unit;

a power source coupled to the first processing unit;

a user interface panel providing a set of patient selectable controls and a set of visual feedback elements; ~~and~~

at least one communication unit coupled to the first processing unit;

a memory coupled to the set of sensors and the first processing unit and storing first program instructions executable by the first processing unit, which when executed cause the first processing unit to:

obtain from the set of sensors data values including sampled air inflow data values sensed by the at least one gas flow sensor;

determine whether an inhalation therapy session is occurring by way of:

determining whether an inhalation event is occurring by way of determining whether sampled air inflow data values have reached or exceed a predetermined threshold air inflow rate; and

determining whether a medical aerosol dose discharge has occurred during an inhalation event; and

during the inhalation therapy session, for each inhalation event of the inhalation therapy session store multiple date and time stamped sampled air inflow data values; ~~and~~

~~following the inhalation therapy session, determine and store a date and time stamped inhalation technique score for the inhalation therapy session based on the multiple date and time stamped sampled air inflow data values~~

for each IVHC device, a mobile / portable computing device associated with the patient and configured for communication with the IVHC device, wherein the mobile / portable computing device comprises:

a second processing unit;

a user interface device that includes a display;

at least one type of data communication unit; and

a memory coupled to the second processing unit, the memory storing:

an inhalation therapy regimen for the patient as established or defined by the patient's physician or clinician, which specifies (i) a number of medical aerosol inhalation sessions that the patient is to undergo each day, where each medical aerosol inhalation session involves the patient's inhalation of a medical aerosol dose by way of their IVHC device; (ii) a target time of day at which each medical aerosol inhalation session is to occur; and (iii) a time period across which the inhalation therapy regimen is to be followed; and

second program instructions executable by the second processing unit, wherein the second program instructions when executed cause the second processing unit to:

communicate with the IVHC device to obtain a set of date and time stamped inhalation technique scores stored in the memory of the IVHC device;

process multiple date and time stamped inhalation technique scores obtained from the IVHC device to generate composite inhalation technique scores, wherein each composite inhalation technique score represents overall patient inhalation technique across a time period spanning multiple inhalation therapy sessions;

present visual representations of composite inhalation technique scores on the user interface device;

analyze date and time stamps of inhalation technique scores and composite inhalation techniques scores relative to a time period corresponding to an inhalation therapy schedule established by the inhalation therapy regimen;

determine an inhalation therapy regimen compliance score for the time period corresponding to the inhalation therapy schedule, which represents an extent or measure of patient compliance with their inhalation therapy regimen across the time period corresponding to the inhalation therapy schedule; and

present visual representations of inhalation therapy regimen compliance scores on the user interface device;

and

a remote therapy management server configured for communication with each mobile / portable computing device and a reward / award database, the remote therapy management server comprising:

a third processing unit; and

a memory storing third program instructions executable by the third processing unit, wherein the third program instructions when executed cause the third processing unit to, for each mobile / portable computing device associated with a patient:

communicate with the mobile / portable computing device;

obtain from the mobile / portable computing device inhalation therapy regimen compliance scores and composite inhalation technique scores for the patient;

analyze inhalation therapy regimen compliance scores and composite inhalation technique scores for the patient corresponding to a particular time period relative to stored criteria;

and at least one of:

(a) determine whether inhalation therapy regimen compliance scores and/or composite inhalation technique scores for the particular time period for the patient meet or exceed an incentive points award threshold;

selectively award or allocate a number of incentive points to the patient;

transfer a current incentive points total for the patient to the mobile / portable computing device; and

selectively transfer an inhalation therapy regimen compliance incentive award or a notification thereof to the mobile / portable computing device in the event that (i) an inhalation therapy regimen compliance score exceeds a minimum inhalation

therapy regimen compliance threshold or target for the particular time period; and/or (ii) a composite inhalation technique score corresponding to a minimum threshold or target percentage of inhalation sessions throughout the particular time period is rated as suitable, good, or excellent; and

(b) provide the patient associated with the mobile / computing device access to an inhalation therapy relevant social media platform corresponding to the remote therapy management server and associated with an inhalation therapy relevant social media app executable on the mobile / computing device; and establish and/or adjust a social media standing, rating, categorization, or communication capability of the patient on the inhalation therapy relevant social media platform based on the patient's inhalation therapy regimen compliance scores and/or patient composite inhalation technique scores.

2. The system of claim 1, wherein the inhalation therapy session corresponds to a single medical aerosol discharge and multiple inhalation events associated with a tidal breathing protocol, and wherein the inhalation technique score provides a single value that represents patient inhalation technique across the multiple inhalation events.

3. The system of claim 1 or claim 2, wherein the lumen structure includes structural elements configured for creating a spiral flow of medical aerosol and inhaled air passing through the lumen structure.

4. The system of claim 3, wherein the structural elements comprise a plurality of curved structures disposed nonlinearly with respect to an IVHC central axis defined along a proximal to distal direction through the IVHC, and wherein the plurality of curved structures guide or deflect inhaled air and medical aerosol passing through the lumen structure along spiral pathways.

~~5. The system of any one of claims 1 – 4, further comprising for each IVHC device, a mobile / portable computing device associated with the patient and configured for communication with the IVHC device, wherein the mobile / portable computing device comprises:~~

~~a second processing unit;~~

~~a user interface device that includes a display; and~~

~~a memory coupled to the second processing unit, the memory storing second program instructions executable by the second processing unit, which when executed cause the second processing unit to:~~

~~communicate with the IVHC device to obtain a set of date and time stamped inhalation technique scores stored in the memory of the IVHC device;~~

~~process multiple date and time stamped inhalation technique scores obtained from the IVHC device to generate at least one composite inhalation technique score, wherein each composite inhalation technique score represents patient inhalation technique across multiple inhalation therapy sessions corresponding to a predetermined or selectable time period; and~~

~~present visual representations of composite inhalation technique scores on the user interface device.~~

~~6. The system of claim 5, wherein the memory of the mobile / portable computing device further stores an inhalation therapy regimen for the patient corresponding to the IVHC device, and wherein the second program instructions when executed cause the second processing unit to further:~~

~~analyze date and time stamps of inhalation technique scores relative to a set of time periods corresponding to an inhalation therapy schedule established by the inhalation therapy regimen;~~

~~determine a set of inhalation therapy regimen compliance scores for each time period under consideration, wherein each inhalation therapy regimen compliance score represents an extent or measure of patient compliance with their inhalation therapy regimen across a particular time period; and~~

~~present visual representations of inhalation therapy regimen compliance scores on the user interface device.~~

~~7~~5. The system of ~~6~~1, ~~further comprising a remote therapy management server configured for communication with each mobile / portable computing device, the remote therapy management server comprising:~~

~~a third processing unit; and~~

~~a memory storing~~wherein the third program instructions ~~executable by the third processing unit, which~~ when executed further cause the third processing unit to:

~~for each mobile / portable computing device, communicate with the mobile / portable computing device to:~~

~~obtain from the mobile / portable computing device inhalation therapy regimen compliance scores and composite inhalation technique scores for the patient associated with the mobile / portable computing device;~~

~~analyze inhalation therapy regimen compliance scores and composite inhalation technique scores corresponding to a particular time period relative to stored criteria;~~

~~and at least one of:~~

~~(a) selectively transfer an inhalation therapy regimen compliance incentive award or a notification thereof to the mobile / portable computing device in the event that the stored criteria are met;~~

~~(b) determine whether inhalation therapy regimen compliance scores and composite inhalation technique scores for the patient associated with the mobile / computing device for a particular time period meet or exceed an incentive points award threshold;~~

~~selectively award or allocate a particular number of incentive points to the patient; and~~

~~transfer a current incentive points total for the patient to the mobile / portable computing device;~~

(c) provide the patient associated with the mobile / portable computing device access to a set of ~~games~~game apps executable on the mobile / portable computing device and playable by the patient, wherein for at least one ~~game~~game app within the set of ~~games~~game apps a level of game play, aspects of a game avatar, game player characteristics or capabilities, and/or game player accessories are established, adjusted, or varied based on inhalation therapy regimen compliance scores and/or composite inhalation technique scores corresponding to the patient~~; and~~

~~(d) provide the patient associated with the mobile / computing device and/or a caretaker associated with the patient access to a social media platform; and~~

~~establish and/or adjust a social media standing, rating, categorization, or communication capability of the patient based on patient inhalation therapy regimen compliance scores and/or inhalation patient composite inhalation technique scores~~.

~~8. The system any claim 7, further comprising a set of physician computing devices configured for communication with the remote therapy management server, wherein each physician computing device corresponds to a physician responsible for one or more patients having IVHC devices corresponding thereto, and each physician computing device comprises: a fourth processing unit; a user interface including a display device; and a memory storing fourth program instructions executable by the fourth processing unit for causing the fourth processing unit to: communicate with the remote therapy management unit to obtain inhalation therapy regimen compliance scores and composite inhalation technique scores corresponding to patients for whom the physician is responsible; and present on the user interface visual representations of inhalation therapy regimen~~

~~compliance scores and/or inhalation therapy technique scores corresponding to individual patients or groups of patients based on predetermined or physician-selectable criteria.~~

~~9~~6. The system of claim ~~7~~5, wherein the third program instructions when executed further cause the third processing unit to process inhalation therapy regimen related data corresponding to patients of physicians associated with the system, and generate associated analytical data including categorical information, trend information, and statistical measures correlated with patients' inhalation therapy regimen compliance scores and inhalation technique scores;
and wherein the system further ~~comprising~~comprises:
a set of physician computing devices configured for communication with the remote therapy management server, wherein each physician computing device corresponds to a physician responsible for one or more patients having IVHC devices corresponding thereto, and each physician computing device comprises: a fourth processing unit; a user interface including a display device; and a memory storing fourth program instructions executable by the fourth processing unit for causing the fourth processing unit to: communicate with the remote therapy management ~~unit~~server to obtain inhalation therapy regimen compliance scores and composite inhalation technique scores corresponding to patients for whom the physician is responsible; and present on the user interface of the physician computing device visual representations of inhalation therapy regimen compliance scores and/or inhalation therapy technique scores corresponding to individual patients or groups of patients based on predetermined or physician-selectable criteria selected by way of a physician / clinician interface, wherein the third program instructions and the fourth program instructions provide physician access to the inhalation therapy relevant social media platform, such that physicians can interact with patients and/or caretakers associated with patients by way of the inhalation therapy relevant social media platform.

7. The system of claim 1, wherein the third program instructions when executed further cause the third processing unit to:

apply an above-unity multiplier to the patient's current incentive point total in response to sequentially uninterrupted or unbroken patient attainment of multiple incentive points award thresholds; and/or

allocate a quasi-random incentive points bonus to the patient's current incentive points total if one or more inhalation therapy regimen compliance scores and/or composite inhalation technique scores exceed a bonus threshold level.

8. The system of claim 1, wherein the second program instructions when executed further cause the second processing unit to generate or present a set of user / visual interfaces on the display of the mobile / portable computing device which are responsive to patient input and by which (i) one or more current inhalation therapy regimen compliance rewards associated with the patient can be selected, chosen, or defined; and (ii) incentive points associated with the patient can be tracked, managed, and redeemed for incentive points awards.

9. The system of claim 8, wherein the set of user / visual interfaces includes an inhalation therapy regimen compliance incentive reward creation / selection interface that provides:

multiple selectable visual / graphical objects corresponding to different categorical types of rewards; and

an upload picture interface, which in response to patient or parent interaction therewith the mobile / portable computing device uploads an image corresponding to a reward that is custom-defined by the patient or parent; a describe reward interface responsive to patient or parent input that describes the reward corresponding to the uploaded image; a reward duration interface responsive to patient or parent input for defining a start date and an end date across which the reward corresponding to the uploaded image remains valid and can be obtained by the patient; and an inhalation therapy regimen compliance measure interface responsive to patient or parent input for defining or establishing a target or threshold patient inhalation therapy regimen compliance measure that the patient must reach in order to obtain the reward corresponding to the uploaded image.

10. The system of claim 1, wherein the second program instructions when executed further cause the second processing unit to:

present user / visual interfaces on the display of the mobile / portable computing device (500), which visually, graphically, or pictorially represent particular scores, ratings, or measures indicating the patient's current, recent, and/or historical inhalation therapy technique and inhalation therapy regimen compliance;

receive patient input defining respiratory attack indications, and annotations or notes corresponding to respiratory attacks which the inhalation therapy manager stores as respiratory attack data, wherein a respiratory attack indication includes a date or date and time of a respiratory attack, and a respiratory attack severity rating; and

communicate patient data, scores, ratings, or measures to the remote therapy management server.

11. The system of claim 1, wherein the IVHC device further comprises:

a geolocation unit providing a micro-GPS or nano-GPS integrated circuit chip coupled to the first processing unit, and which is configured for capturing satellite generated signals to facilitate or enable the determination of the geospatial or geographic location of the receiver portion on a real time or near-real time basis; and

wherein the at least one communication unit comprises a wireless communication unit including cellular data network communication circuitry providing a cellular modem coupled to a subscriber identity module (SIM) card and a cellular communication antenna, and wherein the wireless communication unit is configured for wireless signal communication by way of a Bluetooth™ or a WiFi network, and is also configured for wireless signal communication by way of a cellular data network using the cellular data network communication circuitry when communication by way of the Bluetooth™ or the WiFi network is unreliable or unavailable but communication with the cellular data network is available.

12. The system of claim 11, wherein the IVHC device further comprises a set of emergency alert / SOS buttons activatable by the patient to indicate that they are currently experiencing a respiratory attack, and wherein the IVHC device is configured to communicate an emergency alert / SOS notification to one or more electronic / computing destinations by way of wireless data communication using the wireless communication unit in response to patient activation of the set of emergency alert / SOS buttons, wherein the emergency alert / SOS notification comprises a date and time stamp, a patient ID, and a current geolocation corresponding to the IVHC device.

13. The system of claim 12, wherein the mobile / portable computing device provides a visual / graphical emergency alert SOS button activatable by the patient or their parent, and wherein in response to activation of the virtual / graphical emergency alert SOS button the mobile / portable computing device communicates an emergency alert / SOS notification to the remote therapy management server.

14. The system of claim 1, wherein the set of sensors further comprises a set of exhaled breath sensors including a chemical composition sensor configured for sensing nitric oxide, and optionally at least one of a set of inhaler discharge detection transducers / sensors and a spatial orientation sensor.