herein facilitate patient interaction, consistent use, and heath care provider tracking of patient progress and quantifiable results. In particular implementations, the systems, devices, and methods described herein can include an airflow assembly with a pressure sensor that facilitates obtaining sensor data from a plurality of inspiration repetitions (e.g., when a patient or user interfaces with a mouthpiece).

[0006] While incentive spirometry has been shown to reduce risk of post-operative pulmonary complications, shorten hospital stay lengths, and decrease readmission rates, a number of shortcomings prevent the potential benefits of incentive spirometry from being fully realized, including issues with patient adherence and significant monitoring requirements that create time-burdens for healthcare providers.

[0007] Some embodiments described herein include an incentive spirometer system. The system includes a housing including an electronic visual indicator, one or more processors, one or more storage devices and an airflow assembly, the airflow assembly including: a first end configured to connect to the housing; a second end opposite the first end; an air inlet at the first end; an air outlet at the second end; an air flow chamber including an inlet portion, a constriction portion, and an outlet portion, the constriction portion having a constriction diameter smaller than a diameter of the inlet portion and the outlet portion, the constriction portion having a lateral opening; a sensor connected to the lateral opening of the constriction portion. The housing also includes a mouthpiece configured to connect to the second end of the airflow assembly, the mouthpiece including a one-way valve that permits air flow from a mouthpiece inlet connected to the second end of the airflow assembly to a mouthpiece outlet opposite the mouthpiece inlet; where the one or more storage devices store instructions that are operable, when executed by the one or more processors, to cause the one or more processors to perform operations may include: obtaining sensor data, the sensor data including data obtained from a plurality of inspiration repetitions; generating one or more inspiration signatures using the sensor data, the one or more inspiration signatures including an air flow rate and air volume for each of a plurality of inspiration repetitions; providing a result of the

one or more inspiration signatures to one or more of (i) the electronic visual indicator; (ii) a user device; and (iii) a provider device.

[0008] Such a system can include one or more of the following optional features. The incentive spirometer system where the operations may include simultaneously displaying the one or more inspiration signatures in real time at the user device. The operations may include receiving a treatment protocol from the provider device. The operations may include sending alerts to the user device according to the treatment protocol. A plurality of inspiration signatures are obtained according to the treatment protocol, and the operations include may include sending the plurality of inspiration signatures to the provider device. Air flow is prevented from entering the housing. The housing may include an electrical port that interfaces with the first end of the airflow assembly. The airflow assembly and the mouthpiece are disposable. The housing is re-useable. The air inlet may include laser-cut letters. Implementations of the described techniques may include hardware, a method or process, or computer software on a computer-accessible medium.

[0009] Some embodiments described herein include an incentive spirometry method. The incentive spirometry method also includes connecting an airflow assembly to a housing of an incentive spirometry device, the airflow assembly including: a first end configured to connect to the housing; a second end opposite the first end; an air inlet at the first end; an air outlet at the second end; an air flow chamber including an inlet portion, a constriction portion, and an outlet portion, the constriction portion having a constriction diameter smaller than a diameter of the inlet portion and the outlet portion, the constriction portion having a lateral opening; a sensor connected to the lateral opening of the constriction portion. The method also includes obtaining sensor data from the sensor, the sensor data including data obtained from a plurality of inspiration repetitions; generating one or more inspiration signatures using the sensor data, the one or more inspiration signatures including an air flow rate and air volume for each of a plurality of inspiration repetitions; providing a result of the one or more inspiration signatures to one or more of (i) a electronic visual indicator of the

incentive spirometry device; (ii) a user device; and (iii) a provider device. Other embodiments of this aspect include corresponding computer systems, apparatus, and computer programs recorded on one or more computer storage devices, each configured to perform the actions of the methods.

[0010] Such a method can include one or more of the following optional features. The incentive spirometry method may include simultaneously displaying the one or more inspiration signatures in real time at the user device. The simultaneous display includes motivational icons. May include receiving a treatment protocol from the provider device. The incentive spirometry method may include sending alerts to the user device according to the treatment protocol. The incentive spirometry method may include sending the one or more inspiration signatures from a plurality of inspiration spirometry devices to the provider device. The plurality of inspiration signatures are obtained from a plurality of patients. Implementations of the described techniques may include hardware, a method or process, or computer software on a computer-accessible medium.

[0011] Some embodiments described herein include an incentive spirometer device. The incentive spirometer device also includes a housing including an electronic visual indicator, one or more processors, and one or more storage devices; an airflow assembly, the airflow assembly including: a first end configured to connect to the housing; a second end opposite the first end; an air inlet at the first end; an air outlet at the second end; an air flow chamber including an inlet portion, a constriction portion, and an outlet portion, the constriction portion having a constriction diameter smaller than a diameter of the inlet portion and the outlet portion, the constriction portion having a lateral opening; a sensor connected to the lateral opening of the constriction portion. The device also includes a mouthpiece configured to connect to the second end of the airflow assembly, the mouthpiece including a one-way valve that permits air flow from a mouthpiece inlet connected to the second end of the airflow assembly to a mouthpiece outlet opposite the mouthpiece inlet; where the one or more storage devices store instructions that are operable, when executed by the one or more processors, to cause the one or more processors to perform operations

may include: obtaining sensor data from the sensor, the sensor data including data obtained from a plurality of inspiration repetitions; generating one or more inspiration signatures using the sensor data, the one or more inspiration signatures including an air flow rate and air volume for each of a plurality of inspiration repetitions. Other embodiments of this aspect include corresponding computer systems, apparatus, and computer programs recorded on one or more computer storage devices, each configured to perform the actions of the methods.

[0012] Such a device can include one or more of the following optional features. The incentive spirometer device where air flow is prevented from entering the housing. The airflow assembly and the mouthpiece are disposable. Implementations of the described techniques may include hardware, a method or process, or computer software on a computer-accessible medium.

[0013] Among other benefits, some systems and methods described herein can advantageously provide a hygienic and reusable system that includes modular components where some of the components (e.g., the airflow assembly and mouthpiece) can be disposable while other components (e.g., the housing) can be re-useable and remain hygienic. Additionally, some embodiments described in more detail below can digitally integrate components such as one or more sensors and communication systems that facilitate real-time tracking of patient outcomes, patient performance, adherence and administration of customized treatment protocols, improved patient interaction and frequency of use, which lead to improved patient outcomes. Additionally, some embodiments described in more detail below can facilitate an efficient and informed allocation of medical resources, personnel, treatment, and time in clinical and non-clinical environments. For example, the systems, devices, and methods described herein can facilitate the efficient allocation of medical staff (e.g., nurses, doctors, therapists, others) that are responsible for ensuring patient adherence to treatment protocols, along with identifying patients that are most at risk for postoperative pulmonary complications (PPCs).