

Issues with Current Incentive Spirometers



Voldyne 5000 Incentive Spirometer

- Unintuitive → no instructions on device
- Non-reusable
- Unable to record activity
- No information on importance of using the device



MIR Desktop Spirometer

- Expensive (currently \$2,500)
- Requires training to use
- Overwhelms patients with information/Overly complicated
- Specifically targeted for mobile/office spirometry usage

Cost To Mass Produce

Device Component	Function/Value	Cost
Disposable filtered mouthpiece	Hygiene	\$0.15
Turbine flowmeter	Converts inspiratory flow to angular frequency	\$2
Arduino Feather 32u4	Transmits data via Bluetooth	\$3
3.7 V 1000mAh LiPo battery	Rechargeable power source	\$1
3D printed housing and adaptors	Universal adaptability	\$0.30
7" tablet	Digital display	\$15
Gooseneck bed mount	Accessory component for accessibility	\$3



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Inspired Inspiration to Prevent Hospital-Acquired Pneumonia



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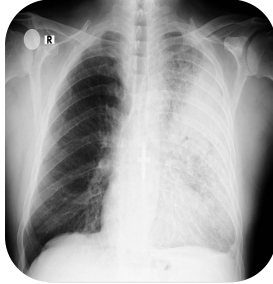
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Hospital-Acquired Pneumonia

- Most common & fatal hospital infection in the United States
- **Incidence rate:** 1.6%
- **Mortality rate:** 18.6%.



Hospital-Acquired Pneumonia (HAP):

- An infection in the lungs that occurs more than 48 hours after admission to a hospital.
- Common among patients who are recovering from a major surgery. Lungs are partially collapsed following anesthesia and do not inflate well while patients remain in bed.
- Patients are instructed to perform deep breathing exercises with an **incentive spirometer** as part of their recovery in order to prevent HAP by keeping the lungs well-inflated and airways clear of mucus.

Current incentive spirometers given to patients in hospitals are **ineffective** because:

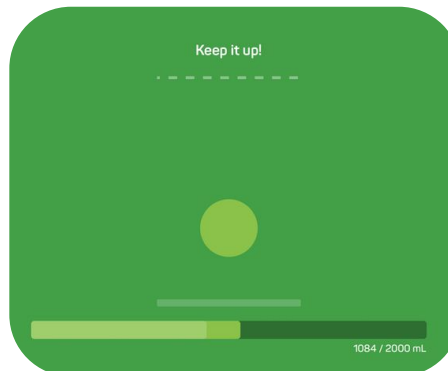
- Lack of feedback – the device fails to indicate if patients perform exercises properly.
- Lack of reminders – the device fail to reminding patients when to use it
- Lack of incentives – the device is fails to engage patients to keep using the device.

SpiroSMART



Project Objectives

1. Present patients' inspiratory flow rate and volume
2. Instruct and correct patients in real-time
3. Provide adjustable alarm system to remind patients
4. Educate patients
5. Reward and incentivize patients' activity
6. Track and record patients' usage history for clinicians
7. Adapt in clinical environment
 - a. Feasible power supply
 - b. Attachable to patient bed-rail
 - c. Hardware protected by durable case
 - d. Easily cleaned with disinfecting wipes
 - e. Economically viable



SpiroSMART Flowmeter:

Dimensions:	180 x 75 x 45 mm
Mass:	140 g
Battery Life:	6.5 - 8 hrs

Components:	<ul style="list-style-type: none">• Arduino Feather• 3.7 V 1000mAh LiPo battery• 3D printed housing & adaptors• Disposable filtered mouthpiece
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SpiroSMART App:

Made with	React Native
Built for	iOS devices
Home Screen	Ball rises as patient breathes in & progress bar to track volume.
Info Screen	Information about HAP & device
Badges Screen	List of various achievements patients completed during use
History Screen:	Tracking patient usage and results of each session
Setting Screen:	Options for nurses to set volume goal for patient & language settings

Conclusion

SpiroSMART serves as a proof of concept that an incentive spirometer can be redesigned to encourage patient engagement and help protect them from hospital acquired pneumonia.