

Product Design Specification

Periodic measurement of nighttime weight change while asleep

Updated: October 15, 2006

Team Members:

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Problem Statement:

Dr. Juergens would like to be able to measure this weight change accurately on people who are in hospital beds, and be able to view and record the weight changes over various intervals through the night (such as weighing a person who agrees to lay in bed all night at intervals of every 10-15 minutes). These weight readings should be sent to some digital storage software such Microsoft Excel. This is important from a research perspective on numerous potential variables that may affect this weight change, such as medications as well as sleep stage changes. He would also use this to potentially track and eventually predict those at higher risk of developing obesity, correlate this with body fat measurements, activity, and assess for metabolic changes when he does things to improve/correct sleep problems. There is popular concern in the most recent sleep literature about various sleep stages, insomnia, and their impact on obesity. This scale would likely have to support a hospital bed, which sits on 4 legs, and read at an accuracy ideally around 0.02- 0.05 lbs (many scales on the market record to such accuracy, the more accurate the better). Ideally it would be a device which could be moved to a different bed without too much difficulty (such as in 1-2 hours time), and without too complex recalibration.

Client Requirements:

- Accurate to 0.05 lbs
- No discomfort to patient
- Quick (1-2 hours) transfer time between beds
- 300 lb maximum weight
- Price range of \$300 - \$500
- Provide digital readout of data to computer software, preferably Microsoft Excel

Design Requirements:

1. Physical and Operational Characteristics

a. Performance Requirement: The device must be operational for up to 12 consecutive hours. The maximum usage would be 12 hours in a 24 hours period.

b. Safety: The device should not provide any discomfort to the patient. It should be stable, meaning it should not be possible for it to malfunction and cause the patient any injury.

c. Accuracy and Reliability: The device must be accurate to 0.05 lbs. It should be able to obtain readings for a 200 to 300 lb patient, also taking into account the weight of the bed. Readings should be taken at least every 10-15 minutes.

d. Life in Service: The device must be operational for 12 hours. It must also be capable of repeated use on consecutive day. The life expectancy will depend upon the durability of the parts being used in the device but it should not need replacement within the next 10 years.

e. Operating Environment: The device will be used in a bedroom type setting in the VA hospital (Department of Veterans Affairs). There should be no harmful conditions it undergoes.

f. Ergonomics: The device must be comfortable for the patient. The programming aspect should be simple enough training of no more than several minutes is required. It should also be capable of being moved within 1 to 2 hours.

g. Size and Shape: The device must be of minimal size. No part of it should protrude from either the top or bottom of the bed. Its interaction with the bed must minimize any sleeping distractions.

h. Weight: The device must be a minimal weight so that transfer is not difficult (maximum 20 kg).

i. Materials: Materials should minimize cost, discomfort, noise, and visibility.

j. Aesthetics, Appearance, and Finish: The device should be appropriate for a hospital setting. It should not interfere with the patient's ability to sleep comfortably.

2. Product Characteristics:

a. Quantity: One device is required.

b. Target Product Cost: The prototype should cost less than \$500 to build.

3. Miscellaneous:

a. Standards and Specifications: The device should comply with all regulations established by the FDA for medical instruments. More information can be found on the FDA website.

b. Customer: The typical customer would be doctors researching sleep. We are designing it more for this specific study, as opposed to producing it for mass production.

c. Patient-related concerns: The patient must feel comfortable, and the device must not prevent sleep in any way.

d. Competition: No similar device currently exists.