Product Design Specifications

Exercise device for child with profound weakness for use in a wheelchair
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Function:

The device should be designed to help children with neuromuscular diseases such as Spinal Muscular Atrophy (SMA) find simple methods to exercise and gain or maintain their strength. The device should be compatible with the available Ki Mobility chair and will need to be capable of adjusting exercise intensity by different angles of flexion and extension.

Client Requirements:

- Device must exercise muscles in the legs and arms, mainly focusing on extensions of the muscles and in all planes of motion
- Device must be removable from the wheelchair.
- Device must be usable when the client is in a laying down position in Ki Mobility chair.
- Device needs to be positioned above the frame of Ki Mobility chair.
- Device needs to fit to the size of the client.
- Device should be lightweight

Design Requirements:

1. **Physical and Operational Characteristics:**

a. *Performance requirements:*

The device must effectively exercise a patient with SMA Type 1. This includes working all muscles involved in arm and leg flexion/extension and abduction/adduction. The patient must be able to fit easily into the device when in a laying down position. The device should also be attachable and detachable from the Ki Mobility wheelchair. Finally, the device should be reusable and have a consistent function.

b. *Safety:* Since the device serves child with SMA, the materials used must have no detrimental effects on patient's health. The device must have no sharp edges that might hurt the

patient. The attachment to the patient must be comfortable since she still has full feelings in her body.

c. *Accuracy and Reliability:*

The device should fit and have the capability to be used by a 10 year old with Type 1 SMA. The device should be reliable and able to withstand the movement of the arms legs after continuous use. The section of the model that attaches to the patient should fit precisely for every use while causing no pain to the patient. The device should have a uniformly smooth surface to prevent injury to the patient when using the device.

d. *Life in Service:* The device should last the lifetime of the patient, although parts may need to be adjusted as the patient grows.

e. *Shelf Life:* The device should be able to withstand multiple movements of the arms and legs. The main apparatus of the device should last the lifetime of the patient, while some parts may need to be adjusted for the growth of the patient. The device should not be big and bulky and also easily stored.

f. *Operating Environment:* The model will mostly be used in a controlled, indoor environment. Under normal circumstances the device should not have to withstand extreme temperatures.

g. *Ergonomics:* The device should be able to handle movement in all directions of the arms and legs while comfortably attaching to the patient.

h. *Size:* Since the device should last the lifetime of the patient, length of the device should be designed as adjustable within a proper range that can fit length of arms and legs at any ages of the patients.

i. *Weight:* The device should be lightweight and should be light enough to transport and store with relative ease while having enough weight to support patients arms and legs.

j. *Materials:* Firstly, the device should be light enough so that SMA patients with profound weakness can use it to exercise effectively. Secondly, the material that may contact patient's skin should be antibacterial since the device is designed to last the lifetime of patients. Also,the material used should be affordable to common families.

k. *Aesthetics, Appearance, and Finish:* The device should be colorful as opposed to a bland color. Our patient has a personality in which they like things that are colorful. The texture should be smooth to minimize the risk of injury due to the fact that the device will be in direct contact with the patient.

2. Production Characteristics:

a. *Quantity: 1*

b. *Target Product Cost:* Unknown at this time. Need to apply for funding since there is a pot of money in Engineering that is dedicated to use for developing rehabilitation projects. Our group will have to write a proposal to receive funding from the source.

3. Miscellaneous:

a. *Standards and Specifications*: No regulatory requirements exist for this project at this time

b. *Customer:* The client wants a device that can be used to exercise patient's legs and arms (universal)

c. *Patient-related concerns:* Needs to be comfortable for patient

d. *Competition*: The exercise device for patients of SMA type I is not common in market.