HIV Barrier Model

Mid-Semester Report

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Fall 2010

1.0 Introduction

1.1 Background

Many studies have been done that have shown the effectiveness of condoms and condom use. The University of Texas has led research in this field of study. Taking volunteer couples with one partner HIV positive and the other HIV negative, they have followed these couples over extended periods of time. Consistent condoms users saw 0%, 1%, and 0% of HIV infecting the partner in the US, Haiti, and England respectively. While inconsistent condom users saw their partner get infected 10%, 6.8%, and 4.8% of the time in the US, Haiti, and England respectively.

1.2 Current Testing Techniques

The Food and Drug Administration, as well as private condom companies, perform a variety of tests on condoms to make sure they are up to federal regulated standards. If 5 condoms out of 1000 fail these tests, the whole batch cannot be sold and is discarded. One such test is the tensile or strength test. In this test, the condom is cut into circular disks and each disk is tested to see how far it can stretch. Another test is the water leak test, where the condom is filled with water to see if there are any pores in the condom that allow water to pass through the condom. The airburst test fills the condom with air to see the total volume and pressure it can withstand. In the electrical conductance test, the condom is filled with a small amount of liquid and an electrical current is passed through the liquid to see if it is passed through the condom.

1.3 Current Model

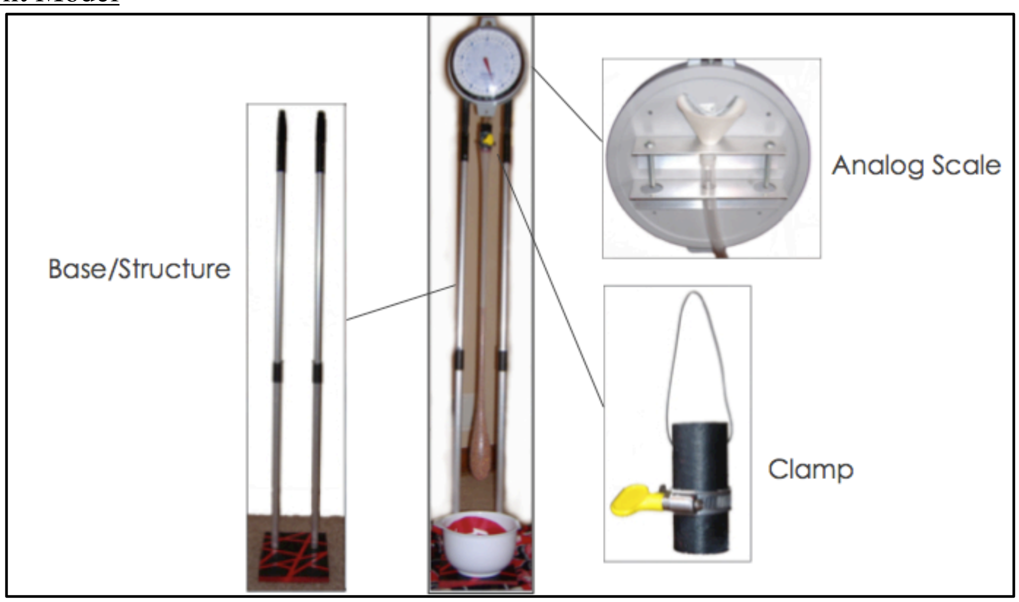

Figure 1: Current Model Apparatus. The current model is consisted of three main structures: the analog scale, the clamp, and the base/structure. These structural components were evaluated and chosen by the former BME student team in 2009 (Adapted from 2009 Spring BME student team).

The current device (showed in Figure 1) that we obtained from our client was designed and made by another design team of BME students. The base of the device is consisted of a wooden base, and two hollow aluminum poles (about 4 ft in height). An analog scale is attached at the top of the two poles, with a clamp hang at the bottom of the scale. To perform the demonstration, the condom is first tightened to the bottom of the scale by using the clamp. Then, metal beads are slowly poured into the condom via an attached tube and funnel at the back of the scale. The scale instantaneously shows how much weight has been added to the condom as the beads are pouring in.

1.4 Motivation

The motivation behind this project is all directed at promoting safer sex. We want to educate people of all ages about the effectiveness, strength, and durability of the condom. Educating people about condoms, will led to more consistent condom use and therefore, safer sex. When our client went to Africa, she said that many people there believed that condoms had worms in them and that government condoms were not as good as others. She used a similar device to the one we are making to educate the people their on condoms. They were shown that condoms do not have worms and that the government issued condoms were as strong as any other condom. Students in her class, *Contemporary Issues is HIV/AIDS*, may know these facts already, but they still underestimate the condom's strength. After the demonstration of our model, we hope to improve on the older version of this design. We want to show just how strong and stretchy the condom actually is to make more students consistent condom users. With more consistent condom users, it will be less likely to transmit a sexually transmitted disease. This will help create an even more healthy campus social life.

2.0 Design Specifications

The current model that previous design group made has several problems that our client wants us to improve. First of all, the new design must have significant improvement on its portability. For the current model, the device needs to be break into several individual parts while it is being transported. This method causes trouble for our client because the previous group didn't provide any carrier to transport the individual parts. In addition, some parts are really bulky, and some are really heavy, thus it further increases the difficulty for transportation. In order to let the new device become more mobile, the new device must be compact while transport, easy to carry, and lighter in weight. But at the same time, the model still has to be large enough for big classroom demonstration. Second, the new device certainly has to be more user-friendly than the current version. This includes several things. The current testing method involves pouring metal beads into the condom to show the strength of condom. Once the condom reaches its limit and eventually breaks, the metal beads would splash all over the place, making the operator difficult to clean up. It also has the chance of losing great amount of metal beads, which are really expensive to replace. Even though the current model provides a collecting bowl to collect the falling beads, it is ineffective because it is too small and unstable. Both the collecting bowl and metal beads need to be changed or improved. However, the material (or other testing methods) that replaces the original testing with metal beads should still dramatically show the effectiveness and toughness of condom. The new model also must be easy to assemble, set up, and operate for everyone because our client wants everyone who even without any prior knowledge would be able to set up and operate the device with ease. Lastly, the new model should be able to perform the demonstration either on the ground or a table, depending on the environment of where the demonstration takes place. The idea of making our new device into both standing and table model is crucial since it increases the device's adaptability to different environments, such as classroom or outdoor. With all the new improvements we are adding, the new model should still be inexpensive in cost, which is less than $100, and easily reproduced.

3.0 Design Alternatives

Our design process is split into two divisions. One set of ideas is aimed to improve the presentation mechanism of our design, while the second set is for the apparatus that maintains the structure and functionality of our device. There are four alternatives evaluated under the Presentation Mechanism category: Pouring Beads, Water Dye, Combination, and Free Fall mechanism. The major difference to distinguish the four alternatives is the different material used as weight to fill the condom, which will cause different levels of dramatic visual effect to the audience during the demonstration. Under the Apparatus category, two options are included: Folding Poles and Telescoping Poles. Although the overall structure is similar to the original, but the different supporting component, in this case we are evaluating different types of poles, will play the most crucial role regarding to the easiness of operation and the transportability.

3.1 Presentation Mechanism

The presentation mechanism division deals with how the strength and durability of the condom will be revealed to the audience.

3.1.1 Pouring Beads (Original)

The pouring beads method was the first to be considered because it is the way in which the current device is operated. During a demonstration, the presenter opens and unravels a condom. The condom is then placed on the opening of a spout attached to a weight scale. The attachment is then made secure by a hose clamp that can be tightened by hand. Once the condom is secured in place, tiny, round lead beads are poured into a funnel at the back of the scale that leads to the spout inside the condom (see Figure 2). As the lead balls are poured in, the condom stretches and the scale measures the increasing weight. The pouring continues slowly until the condom bursts. This process leads to impressive displays because the weight of the beads causes the condom to stretch upwards of four feet. Another great feature of the pouring beads method is the fact that the beads can be distributed to the students in the classroom; this way they can physically feel just how much weight the condom will hold. Additionally, given our relatively small budget of $100, using this design would allow us to use many of the same parts from the original device. However, the pouring beads method has one major drawback. The geometry of the beads causes them to creep up the condom as they

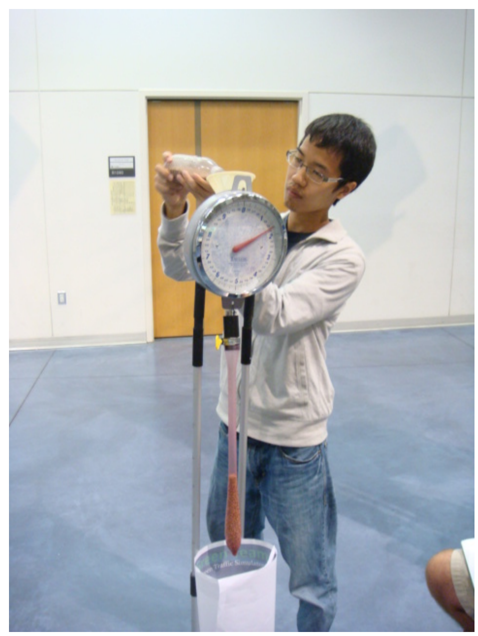

Figure 2. The Demonstration Mechanism of Pouring Beads. One of the team members is performing the demonstration by pouring the medal beads into the current device.

are being dispensed. This is not a problem as far as the visual effect of the presentation is concerned, but when the condom bursts the beads that are at the middle and upper portions of the condom (furthest from the ground) tend to scatter in an uncontrollable manner. This unfortunate effect leads to the loss of beads, and a difficult clean up. The original design would need to be improved by making a better 'bead catching' mechanism, which may lead to less visibility of the actual presentation.

3.1.2 Water Dye

The water dye design uses the same basic mechanism as the pouring beads method, but incorporates water as the weight entering the condom instead of beads. Through some preliminary testing we found that condoms of many varieties consistently held more water weight than bead weight. This is most likely due to the fact that the water load is more evenly distributed against the condom walls than the beads' load. Furthermore, since the water is less dense than the beads a much greater volume of water can be held by the condom. As one might imagine, the dramatic effect caused by the greater weight and volume of the water is notable. The water dye presentation mechanism also benefits from the fact that it can be used in two separate, but equally effective ways. The first technique would be the standard procedure, in which the water is poured slowly into the condom until the condom breaks. The second technique would involve using food coloring to dye the water that is being poured into the condom, preferably a color noticeably different from clear water (i.e. red, blue, green, etc.). The condom would be filled to a predetermined volume that would ensure that the condom would not break but would also make certain that the condom was fully stretched. Many tests would need to be performed before first presentation to ensure that the volume chosen satisfied both the above categories. Not to mention the possibility that different brands of condoms may need to have specific water volumes. Nevertheless, after the condom is filled to the preset volume of dyed liquid, the large bulb that forms at the end of the condom would be placed in a water-tight vessel containing clear water (Figure 3 shows the water bulb that forms); As the condom sits in the pool of water it will become obvious to the observer that the condom is sufficient barrier between the dyed liquid and the clear water. That is, even under the tremendous strain of the large volume of dyed liquid suspended inside, the condom is still able to fulfill its purpose of preventing transmission. This presentation is powerfully dramatic because it focuses the observers' attention on the most important quality of the condom. With this mechanism in place a number of other improvements could also become real possibilities. For example, instead of using just dyed water one could imagine using a substance that mimics the HIV virus. Specifically, a substance with small particles (on the same order of magnitude as the virus) could be poured into the condom to prove its effectiveness. This type of demonstration would give our client a much more realistic way of looking at the strength of a condom. Although water is what makes this design appealing, it may also be its downfall. Water is difficult to transport, and spills are a real concern. A water-tight basin to catch the water after the condom bursts is essential and it needs to be large enough to prevent any spill because these presentations are generally held in classroom and other places where floor drains are not present. A positive feature of the water used in this presentation is the fact that it creates a large bulb at the bottom, unlike the beads that creep up to the top of the condom. This characteristic ensures that after the condom bursts the majority of the water is contained in a small area directly below the scale. This makes unwanted spills much less likely.

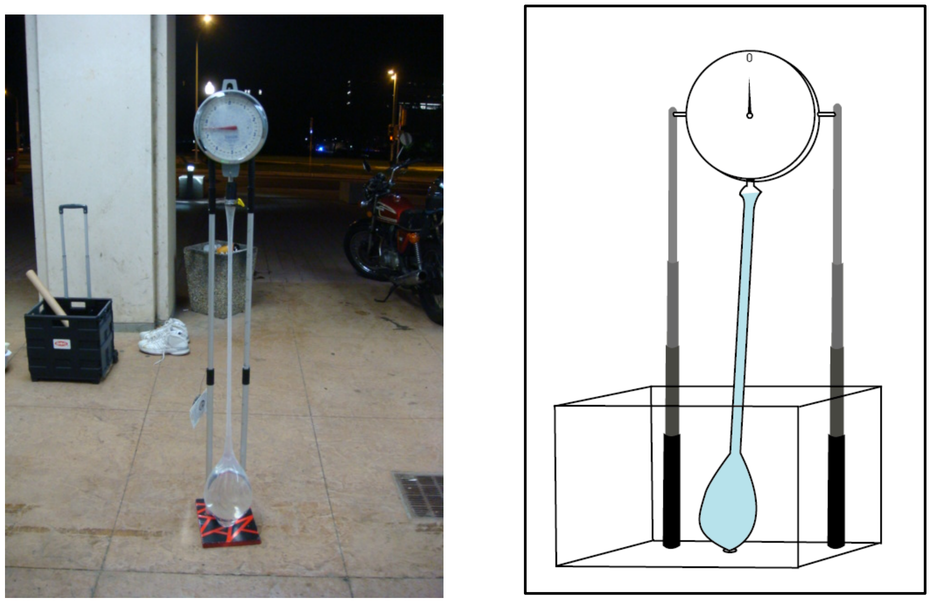

Figure 3. The demonstration mechanism using water weight.
During the preliminary testing session, the team uses the water instead of metal beads and receives an unexpected but greater visual effect, compare to the pouring beads method.

3.1.3 Combination (Beads & Water)

Our third proposal for a presentation mechanism is a combination of the first two. Again, the same basic mechanism would be used, with a scale attached to a funnel system, which is linked to a spout leading to a condom. The idea is to use some water and some beads. This would allow our client to still give the students an idea of how much weight was going into the condom with the beads, but still give the impressive effects of the water. It would also allow for the beads to be involved in the dye testing explained above which would lead to a more dramatic representation of the condoms strength. This combination might also cause problems however, as separating the beads from the water in the basin after the condom has burst may prove to be quite difficult and time consuming. Finding the perfect combination on beads and water is also a concern.

3.1.4 Free Fall

This final design proposal is completely different from the first three. It involves dropping metal rods of increasing weight into the condom until a rod with enough mass to generate enough force to break the condom is used. This type of action may be a more realistic representation of what actually happens to the condom during intercourse. It obviously would not put the exact same kind of stress on the condom, but it seems it would do a better job than water or beads at creating an appropriate imitation. A major problem with this design is that the force created by the three or four foot drop of a relatively small metal rod (one that can fit into a condom) may not be enough to actually ever break the condom. If this was the case, a motor of some sort would need to be built to shoot the rod and building a motor may be well out of our price range.

3.2 Apparatus

Apparatus in this case means the general structure of the device, for example, how the device will be carried, and what material will support the model. The two options under Apparatus are Folding Poles and Telescoping Poles. Different collapsing method of the pole plays an important role in increasing the mobility of the entire device, as well as the adjustability of different heights of the device. In addition, both Apparatus options will be integrated within a hand trolley for the purpose of mobility.

3.2.1 Folding Poles

Our first option in Apparatus is using the Folding Poles (Figure 4). To make the poles foldable, several joints are built to connect each segment of the pole together. Embedding this folding mechanism in the poles within our model can increase the transportability because it is easily folded into a compact space to carry. The first problem with this folding mechanism is that it is not variable enough in height during the presentation. Although adding more joints within one pole might increase the adjustability of height, but the joints might cause the device not stable enough to carry a heavy weight when performing the demonstration.

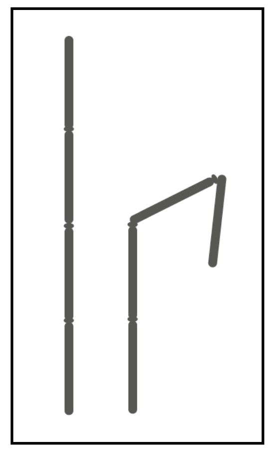

Figure 4. Folding Poles.
There are several joints connected along the poles to increase its mobility.

3.2.2 Telescoping Poles

Another option for the new model Apparatus is using Telescoping Poles as the supporting component (Figure 5). To shorten the poles by telescoping mechanism is easy to operate, and it can not only maintain the high transportability when carrying, but also increase the adjustability in different height. The drawback of using this material will be the accessibility of such kind of poles, and the weight of this type of poles is a subject to be evaluated as well.

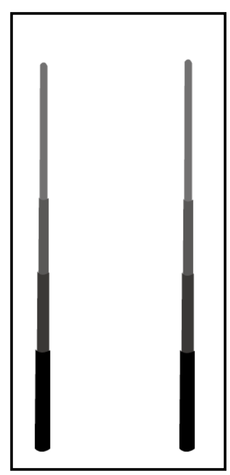

Figure 5. Telescoping Poles.
The telescoping mechanism embedded within the supporting poles but not only increases its mobility but also the adjustability of its heights.

4.0 Design Matrices

During the design process, we generate two design matrices to evaluate the two main categories, Presentation Mechanism and Apparatus, separately. There are seven subcategories within the first matrix and three within the second matrix. Both category weights are given and distributed by out client in her preference and opinions about the degrees of importance on different categories.

4.1 Presentation Mechanism Matrix

Our client was able to rate the categories that we defined for our design matrix from most important to least important. As you can see from Table 1, Dr. Sutinen is most concerned with how easy it is to use the presentation mechanism. She would like the device to be easily operated by anyone, even without prior knowledge of the device. Dramatics also held a great deal of importance. This means it is important for the presentation to capture the audience. The students should be impressed by the strength of the condom after seeing the demonstration. Functionality was another key component of our decision-making. The device must be able to perform whenever and wherever it is needed. It must also be consistent on every trial. The other four criteria are explained in the description of the design matrix and were also quite important. After rating each mechanism in each category a final score was tabulated. As seen in Table 1, the water weight design was chosen. The water weight mechanism is what we intend to move forward with because of its great dramatic display and its versatility.

Table 1. Design Matrix (I): Presentation Mechanism. This matrix consists of seven different categories and these categories were weighed by our client, Dr. Sutinen. Descriptions: Visibility: Can be seen from a long distance, Size: Small enough to be easily transported Cost: Under $100 Assembly/Disassembly Time: Time is takes for the average person to set-up and dismantle the design.

Category	Pouring Beads	**Water Dye**	Combination (Beads + Water)	Free Fall
Ease of Use (25)	25	22	20	10
Dramatics (20)	15	**19**	17	9
Functionality (20)	15	20	20	15
Visibility (15)	13	14	13	10
Size (10)	10	7	8	10
Cost (5)	5	3	2	1
Assembly/Disassembly Time (5)	3	2	1	3
Total (100)	86	**87**	81	58

4.2 Apparatus Matrix

Our Apparatus Matrix consists of three main categories: Ease of Use, Adjustability, and Size. Table 2 shows the matrix and the score of the two design options. The Adjustability results as the defining category out of this matrix, and the Telescoping Poles option results in an overall higher advantage for our final design.

Table 2. Design Matrix (II): Apparatus. There are three categories within the Apparatus design matrix: Ease of Use, Adjustability, and Size. The Telescoping Poles win over mainly because of its higher adjustability than the Folding Poles.

Category	Folding Poles	**Telescoping Poles**
Ease of Use (50)	43	43
Adjustability (25)	20	**25**
Size (25)	24	24
Total (100)	87	**92**

4.2.1 Ease of Use (50)

The first category and weighed the most in this matrix is the Ease of use, meaning how easily it can be operated for average users. Since one of the design requirements is to allow everyone to access and operate this device, the ease of use tends to be the major concern to our client. Not only our client can perform the demonstration, but all audience should also be able to simply conduct the experiment. As a result, this category is weighed 50 out of the total point of 100. To evaluate which type of poles are better than the other, the team members and the client gave the score and the final score of this category is the average of all scores. The result of same score indicates that both poles are easy to operate for average user and might be suitable for our final design.

4.2.2 Adjustability (25)

The second category in this matrix is the Adjustability. By adjustability regarding to different types of pole, we mean the adjustability to different desire heights during the demonstration. Being adjustable is important in this model because during the preliminary testing, the team has found out that different brands of condoms have various breaking points. The higher adjustability can prevent the case of unexpected breaking and falling particles all around the place. For this category, our client gives a score of 25 out of the total 100. Based on the structure of both poles, the average score was calculated out of the scores given by the team members and our client. The Telescoping Poles perfectly obtain the function of varying its height, compare to the Folding Poles. As a result, the Telescoping Poles get a higher score and this category is the defining category in the evaluation of Apparatus.

4.2.3 Size (25)

The last category in this matrix is the Size of the poles. This category is included because it is an important concern regarding to the transportability of the entire device. More precisely speaking, it is the compacted size that each type of poles can be plays the role in increasing the mobility of the device. For this category, our client gives a 25 out of the total 100, which is equally important as Adjustability. After taking the average of the different scores given by the team members and the client, both types obtain the same score, which implies that these two options both can be collapsed into a smaller size for the purpose of transportability.

5.0 Final Design

The final design incorporates the Water Dye presentation mechanism and the apparatus of the Telescoping Poles within a Hand Trolley. Figure 6 shows the design apparatus of the final design. In general, the overall structure and measure method will be similar to the current model built by the former BME students, but new ideas and improvements are added into the new model. In this section, the general procedure of the demonstration using this model will be outlined and explained, as well as the different purposes and reasons of adding the new components into the final design.

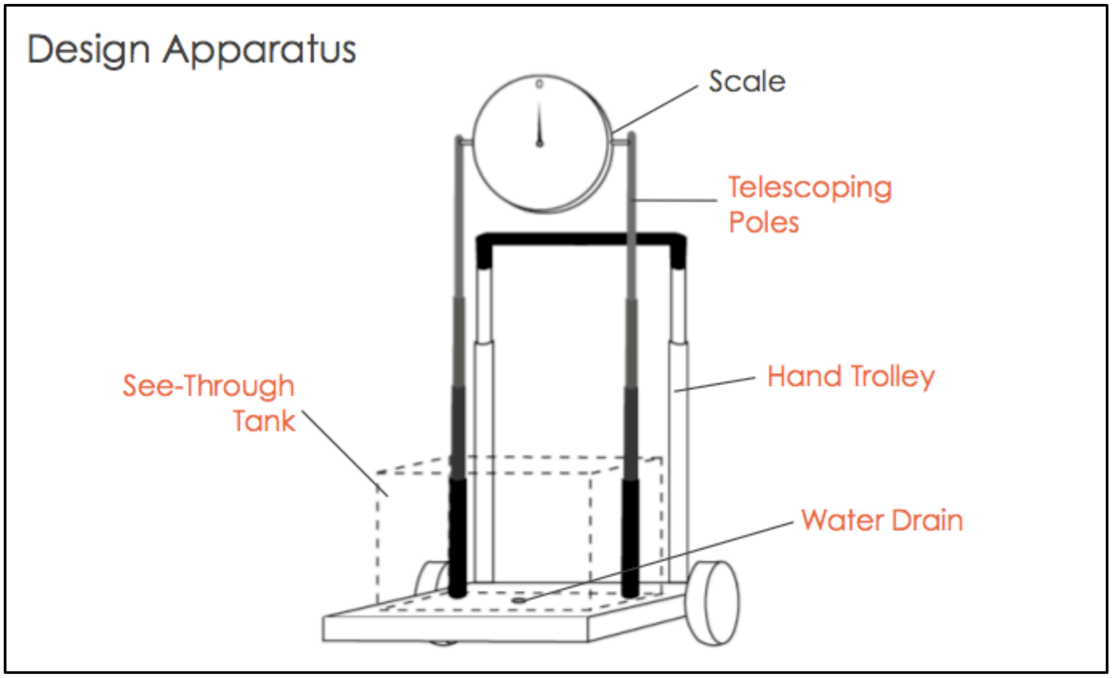

Figure 6. The Final Design Apparatus. The final design model will be similar to the original but consists of several new add-ons: telescoping poles, hand trolley, water drain, see-through tank.

5.1 Apparatus/Structures

As shown in Figure 6, the new model consists of several important components, and each component serves an important purpose in order to achieve client's requirements and expectations. The weights and dimensions are not taken into account up to this point, but will be the major evaluations of the model material selection process (See 6.0 Future Work).

5.1.1 Hand Trolley

In order to increase the transportability for our client's convenience, the new model will be carried by a hand trolley. One might be concerned about transporting our device up or down the stairs without the use of an elevator. Our water tank will be removable from the entire device, which creates an additional option for the user to hand-carry the whole device.

5.1.2 Telescoping Poles

Using the telescoping poles as the supporting component has several advantages to the new model. First of all, since the poles will be fixed inside the water tank, it is easy to make the device into a compact space simply by shortening the telescoping poles and folding the attached scale into the tank (Figure 7). To set the device up, the user can also simply unfold the scale and extend the poles to the desired height. Another advantage of using telescoping poles is that it is flexible for different heights and breaking points of different condom brands. When using a table model, a shorter length of the poles will be more favorable for the demonstrator to perform the experiment. Being adjustable can also prevent the water from splashing by have the condom in the tank area before it breaks. If the demonstrator can know when a certain condom will break at what length beforehand, the water-splashing problem will be reduced. This is the reason why the new model should be adjustable in height using the telescoping poles.

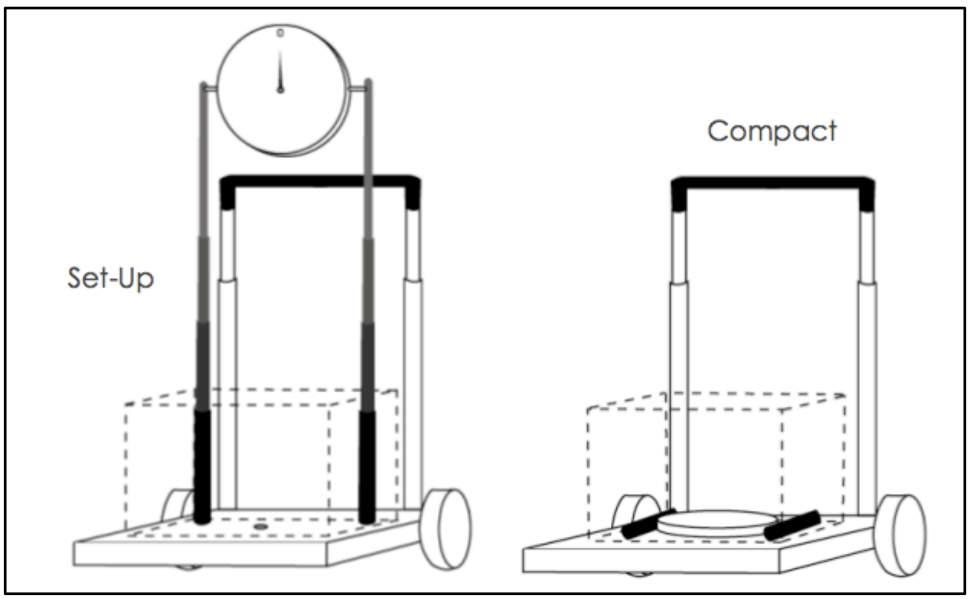

Figure 7. Two modes of the model: Set-up and Compact. The left-hand side of the figure shows a completed set-up of the model for demonstration as a standing model. The right-hand side of the figure shows the compacted version of the device.

5.1.3 See-Through Tank

A see-through tank should be placed at the bottom of the device for several purposes. First of all, the tank can catch the spilling water if the condom breaks. Secondly, the water tank should be see-through, or clear, to increase the visibility to the audience. For a demonstration with this new model, the results should examine not only the maximum weight that the condom can hold, but also whether or not the water inside the condom will leak before reaching its breaking point. Using the dye to color the water inside the condom can allow the demonstrator to show the non-leaking condom from the see-through tank. In addition, making the device as a one-piece design, meaning the poles will be fixed inside the water tank and the tank is removable, is another advantage to increase the adaptability of the model to different teaching environments (Figure 8). Since our client has requested a possible table model design, the team has come up with the idea of a one-piece removable design to meet this requirement.

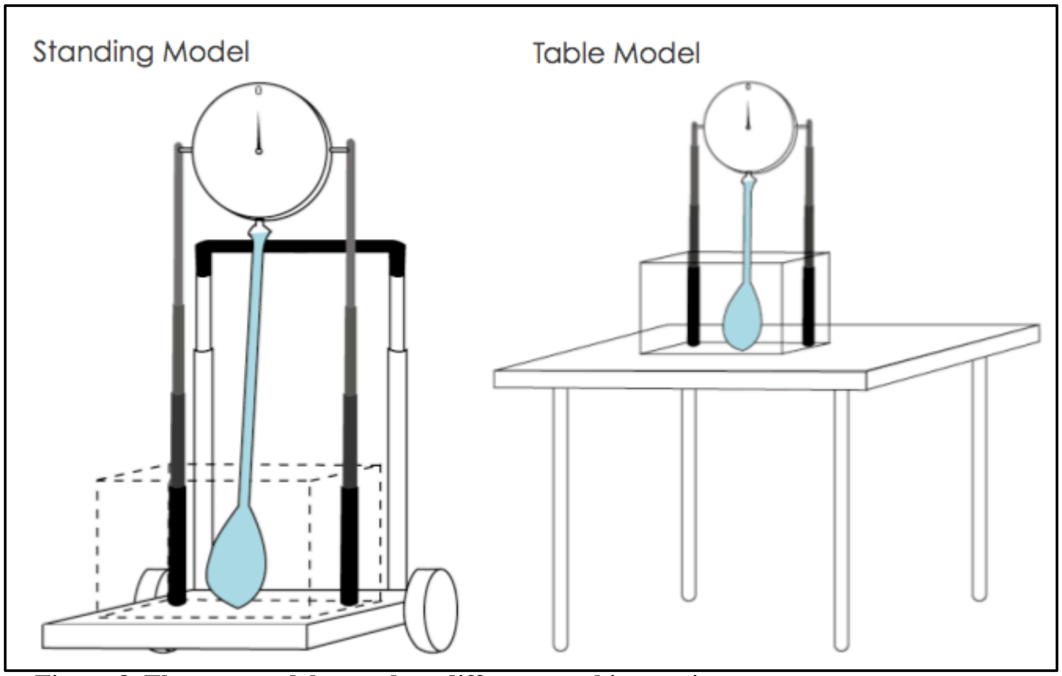

Figure 8. The new model can adapt different teaching environments.
The figure on the left-hand side indicates the standing mode of the device, whereas the right-hand side shows the model being a table model if needed.

5.1.4 <u>Water Drain</u>

Although replacing the beads with water weight will result in a greater dramatic visual effect, the major drawback is the water-releasing problem after each demonstration. To solve this problem, a small water drain will be placed at the bottom of the water tank. During the demonstration, the water drain will be closed. When the demonstration is completed and the demonstrator wants to release the water from the tank, s/he can simply move the tank to a sink and open the water drain to release the water. It is also possible to connect a water tube to the water drain if the tank filled with water is too heavy to carry.

5.2 <u>Demonstration Procedure</u>

Similar to the current method but instead of pouring medal beads into the condom, the new model will favor the water as the weight source for the demonstration. To start the demonstration, the performer should first adjust the telescoping pole to the desired height. There will be a reference sheet provided with the new model for the performer to set the device up to the correct height in prevent of unexpected breaking point and spilling of water. The reference sheet will indicate the different condom brands and their corresponding breaking points. After setting up the device, the performer will attach a testing condom to the clamp tightly below the scale (not shown in figures), and the scale should be calibrated to zero for accurate weight measurement. Meanwhile, the see-through water tank should be filled with some amount of clear water. The purpose of filling water in the water tank is to clearly see if the water dye inside the condom will be leaked out even though the condom is not broken yet. After attaching the condom onto the scale, water with a few drops of dye can be added from the funnel at the top of the scale (not shown in figures), which is the same procedure as pouring beads in the original model. After the demonstration, which should be at the moment when the condom breaks, the performer can remove the water tank and open the water drain to release the water inside the tank.

5.3 Summary

Table 3 shows a list of the requirements and expectations from our client (left column), and how we solve each problem and concern within the final design (right column). To provide a more dramatic and effective demonstration to the audience, we choose to replace the beads with water dye, which has been evaluated through the first matrix. To maintain a higher transportability, the model will be carried by a hand trolley. The water tank will be removable for several purposes. The model is expected to be a one-piece design to reduce the time of installation (Figure 7). Moreover, since it will be a one-piece model, meaning that the poles will be fixed inside the water tank, making the water tank removable also increases its adaptability to different environments (Figure 8). In case of different breaking points of different condoms, the adjustable telescoping poles provide a chance to first adjust the height to the corresponding breaking point depending on what brand of condom is used. The team will provide a reference sheet of different condom brands and their information including their breaking point after several tests are done. The team will also mark on the poles at different heights with different condom brands to indicate the corresponding breaking points for the users. Lastly, if the water source is not available, the original method of pouring metal beads is still welcome to be used since the new model is adapting a similar design to the original.

Table 3. Summary of requirements and expectations with corresponding solutions in the final design. The left column is the list of requirements, expectations, or concerns arising throughout the design process. The right column provides the corresponding solutions to each requirement.

Requirements/Expectations	Solutions
More dramatic demonstration	Water
Higher transportability	Hand trolley + removable tank
Time-consuming installation	One-piece design
Releasing water problem	Small drain
Adaptability to teaching environment	Standing + Table model
Different breaking points	Telescoping Poles + Marking on the pole at corresponding length
If water source is not available	Similar design as original

6.0 Future Work

After making the decision of the final design, the first major task to accomplish is the model material selections. The main properties of each component within the final design model will be the weight, the dimensions, and the maximum weight that can be supported since the ultimate goal of this improved device is to be as light as possible, but large enough to be seen for effective demonstration purpose. To be more specific, the scale and the clamp for attaching the condom will remain the same as the original. The hand trolley should be evaluated by its weight and the maximum weight that it can carry. There are several possible materials for the see-through tank, such as plastic, glass, or acrylic. The major evaluation for the water tank will be the dimensions, or the volume, and its weight. To decide how big the tank should be, the team would conduct several experiments to investigate the area that the splashing water can spread out. For the telescoping poles, the team should research as well as seek help from our client and advisor to acquire such material. If two or more options are available, the major evaluation for picking the fitted telescoping poles will be the extendable length and its weight.

After selecting the materials of different components, the team should start to build the model. The prototype is expected to be finished early because several tests need to be done using the new model. Having the prototype finished early can also allow the team to make further corrections if any problems arise throughout the construction or testing process. As mentioned earlier, the team should prepare a reference sheet for the client or any users who are performing the demonstration at any setting. To sort out a reference sheet, several condom tests should be conducted using the new model. The team will acquire different brands of condoms and perform the normal demonstration procedure to collect the data of elongation, maximum weight, and the different stretching shape of different condom brands. The team will also mark on the poles to indicate the different breaking points for different brands.

Finally, the team would hope to use the new model to do actual demonstrations in the client's class. By doing so, the team can evaluate the effectiveness of the new model from the impression of the students and client's satisfaction when using the new model.

7.0 References

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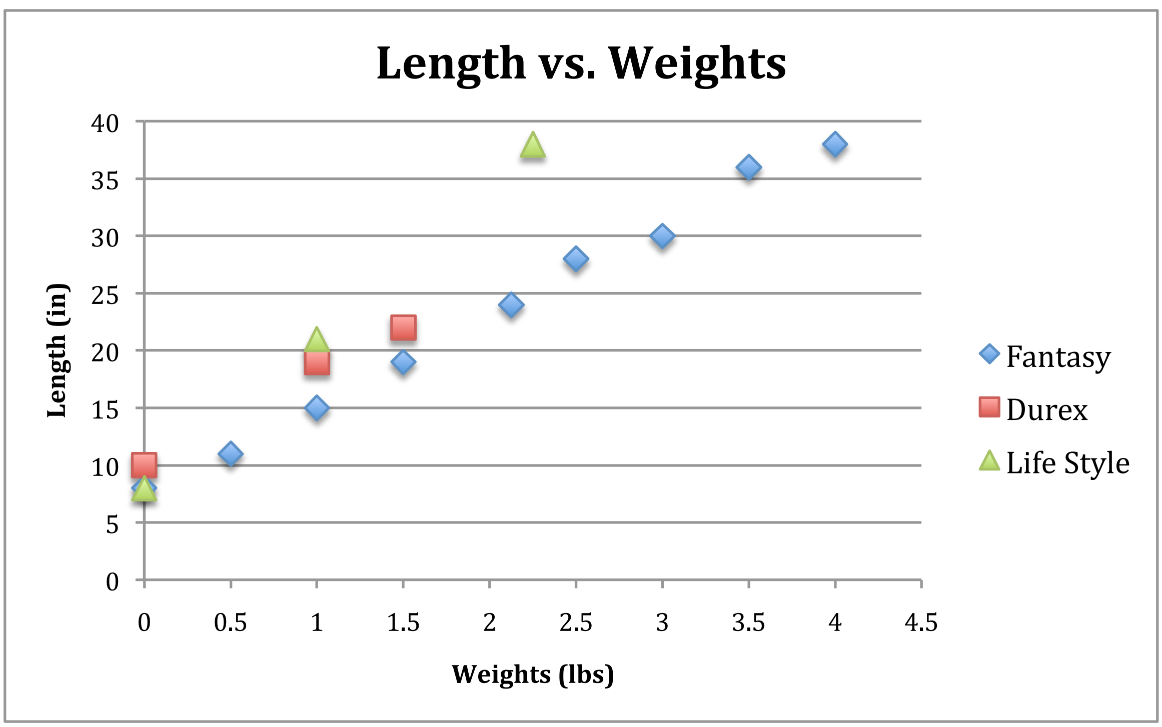
8.0 Appendix

8.1 Preliminary Testing Data

Brand	Weight (lbs)	Length (in)	Elongation (in)	
LifeStyle	0	8	0	
	1	21	13	
	2 ¼	38	17	break
Durex	0	10	0	
	1	19	9	
	1 ½	22	3	break
Fantasy (strawberry)	0	8	0	
	½	11	3	
	1	15	4	
	1 ½	19	4	
	2 1/8	24	5	
	2 ½	28	4	
	3	30	2	
	3 ½	36	6	
	4	38	2	break



8.2 PDS

HIV Barrier Model – Product Design Specifications

Leader: Jessica Kou
Communicator: Bret Olson
BSAC: Albert Wang
BWIG: Lisle Blackbourn

Problem Statement

To demonstrate the strength and durability of latex and polyurethane barriers against HIV infection and other sexually transmitted infections. Currently the original version developed by former BME students has been received extremely well by client's classes in the medical genetics course "Contemporary Issues on HIV/AIDS", however, the model is fragile and not easily transportable. The client is requesting an improved more sturdy and mobile product.

Client Requirements

- Client would like the device to be more mobile.
- A more user friendly version of the current model
  - Lightweight
  - Less parts
  - Easy to install
  - Less bulky
  - Make parts more easily replaceable
  - Sturdy
- Inexpensive (<$100)
- The product must demonstrate the strength and effectiveness of condoms.
- Make a product that is easily reproducible.
- Possibly make a device that can test both male and female condoms.

Design Requirements

1. **Physical and Operational Characteristics**
   a. *Performance requirements*:
   The design would be used as a class demonstration. This means that it would be used less than five times a semester. Our design would need to be capable of functioning properly on each of these occasions.
   b. *Safety*:
   Our design needs to protect the operator from any harm while demonstrating its function. Furthermore, we may need to consider the possibility of small parts falling from the device and causing problems.
   c. *Accuracy and Reliability*:
   Ideally our product would be 100% reliable, meaning it would perform its function on every occasion. The accuracy of the scale involved in our design is very important because this measurement is what shows the strength of the condom.

d. *Life in Service*:
   This device must be reusable. Although this device may only be used 4 or 5 times every 6 months it should be able to perform at any time that is necessary.
e. *Shelf Life*:
   The shelf life would depend on a number of things including, the calibration of the scale, the wear of parts or the misplacement of any parts. We would expect that our product would last upwards of 20 years.
f. *Operating Environment*:
   Our device would be used in classrooms, or other presentation venues.
g. *Ergonomics*:
   The device must be extremely user friendly. Anyone over the age ten should be able to operate the device with ease. It is also important that the audience understands the mechanism, so that the durability of the condom can be portrayed.
h. *Size*:
   The device must be large enough so that someone sitting 100 feet away could see the results of the experiment. It must also be able to fold up in some fashion so that it would be easily transportable or stored.
i. *Weight*:
   The device would need to be light enough so that anyone capable of using it would be able to transport it.
j. *Materials*:
   The materials used would need to be somewhat aesthetically pleasing considering our device would be used as a presentation device. The materials must also be durable because the device would need to stay intact for many years.
k. *Aesthetics*, *Appearance, and Finish*:
   The device's appearance is actually quite important because it is being used as a presentation device.

2. Production Characteristics

a. *Quantity*: 1 deliverable.
b. *Target Product Cost*: Under $100

3. Miscellaneous

a. *Standards and Specifications*: N/A
b. *Customer/Patient related concerns*: N/A
c. *Competition*: As far as we know there are not any devices like this besides the previous BME design group product.