## ***Alternative Design Solutions*** *(Please note that more sketches and tables, as well as more detail, will be included in final report.)*

Both of our two proposed design solutions use existing technology combined with new technology ("The Device") to accurately measure out a bolus size. Each design attaches to a normal baby bottle between the bottle and the nipple (See Fig 4). Aside from use with existing ("normal") baby bottles and nipples, this arrangement would be easily adapted for use with a cup. We feel that this cost and material saving measure is one of the most important aspects of our designs.

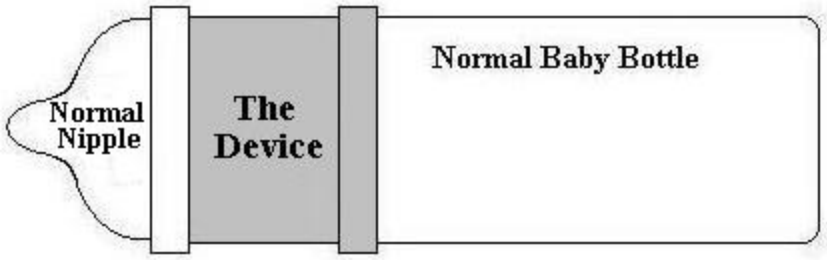


**Fig 4:** The location of the device in both proposed solutions. Both were designed for use when the nipple end is facing down (normal feeding position).

**Design 1: The Ball.** Within the device there is a round hollow ball attached to an arm (see Fig 5 below). This ball and arm is suspended by a "platform" that allows the ball to spin around the axis of the arm while maintaining a watertight seal around the ball. The ball has an opening that allows liquid into the hollow portion of the ball, which has a volume ranging from 1 cc to 5 cc. Since the platform is solid and wider than the opening of the ball, no liquid can flow through. To dispense liquid into the nipple area, the ball is rotated by knob about the axis of the arm. A mechanism would "click" to signal the operator when the ball has made a complete revolution. The number of times the ball is revolved to get a desired bolus size depends on the volume of the ball (if a 3 cc bolus size is needed from a 1cc ball, three revolutions would be needed, etc.). Advantages and disadvantages of this design are discussed in the following sections.

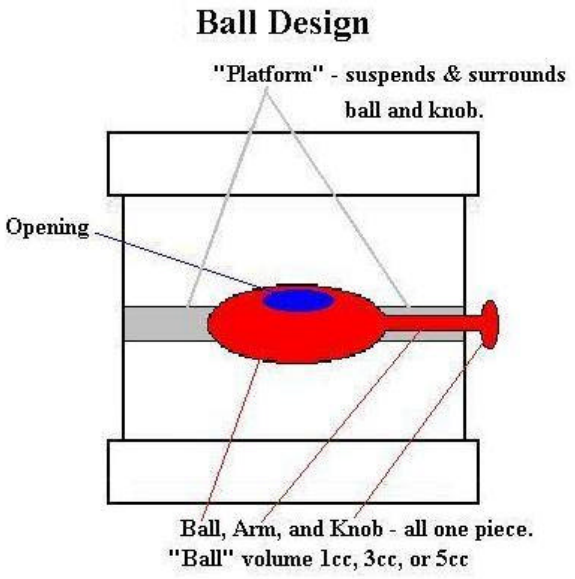


**Fig 5:** *Note*: The nipple attached to the bottom of the device in this picture.

**Design 2: The Cylinder.** Within device two there will be a cylinder with valves marking off volumes from 1cc to 5 cc, each with a valve in between them and between the device and the nipple (see Fig 6 below). The amount of liquid dispensed will depend on which valve is closed. The valves can be closed by pushing down on the arm attached to the cover of each valve. Springs on each arm will open each valve when parents let go (since small children must be fed by parents anyway, this should not present a problem). That will close off the opening in the barrier allowing the liquid to flow through. The attachment will use the force of gravity to get the liquid into the cavity that will measure out he liquid. The main advantage of the design is that it uses gravity to accurately measure out a precise amount of liquid every time. Though it could be somewhat expensive initially, the cylinder design allows use throughout a patient's growing period since it can measure out all volumes in the range specified by our client. This device would also only need the use of one hand to measure out the liquid. A major disadvantage of the design is that there are many small moving parts that can easily break or wear out in the arm or seal. Another disadvantage is that is would be very hard to clean. Durable and effective watertight seals might also be hard to create around all six valves.

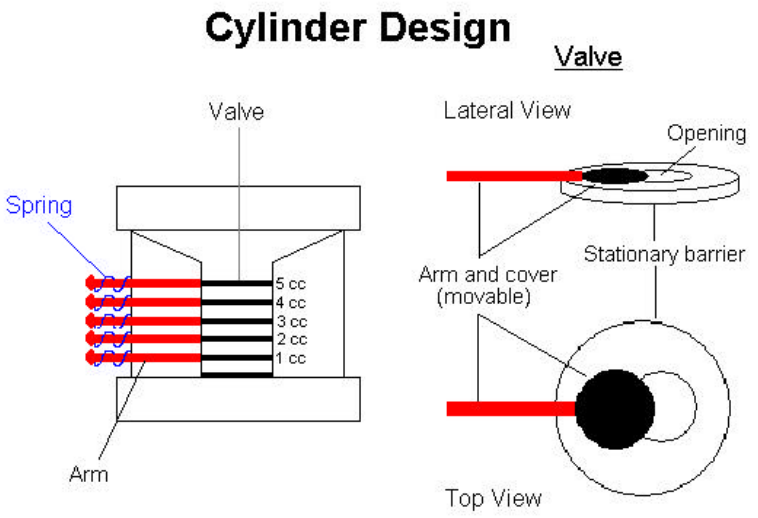


**Fig 6:** *Note*: The nipple attached to the bottom of the device in this picture.

## ***Proposed Solution***

Our proposed solution is design 1, the Ball Design. The criteria used to determine which design is best suited to our project included the six main concerns our client needed the device to address:

| **Requirement** | **Does Ball design meet requirement?** |
|---|---|
| Accuracy in measurement (within 1cc), | *Yes* |
| Ability to vary bolus size by 1 cc increments (between 1-5 cc) | *No, but smaller ball size can simply dispense amount multiple times* |
| Can be used with ages ranging from preemies to 8 years old | *Yes; uses current products* |
| Can be used in therapy and home | *Yes; uses current products* |
| Easy to use | *Yes* |
| Easy to clean | *Not sure; small pieces may make cleaning difficult* |

The other criteria used to choose between the ball and cylinder designs included cost and whether or not our group would be able to build a prototype (the main concerns with the cylinder design). Since the ball design has few moving parts (simple) and would not be complicated to build, the ball design was the obvious choice. (Disadvantages in the following section.)

## ***Potential Problems***

*Potential Problems with proposed "Ball" design*: There are three main problems with the ball design:

- Difficult to clean
- Cannot vary size of bolus without dispensing multiple measured amounts manually
- Watertight seal around ball and platform may be difficult (simply not sure about this because we have not consulted a machine shop or experts on the subject)

*General Potential Problems:* The main problem is due to the size of the measurements involved. Since the largest measurement would be only 5 cc, and the average feeding volume is about 8 oz (~240 cc), with 3 to 5 feedings each day, the device would have to withstand a lot of repetition (up to 200,000 times during a year life-span - see *Performance Requirements* and *Life in Service* on page 2 of Appendix A). These small measurement sizes mean small parts, which means they are more difficult to manufacture, easier to break, and harder to clean.