### 2.6 CONCEPT OF ANET

The idea of Automated Neonatal Exchange Transfusion started in 2020. The idea was conceived to make exchange transfusion as a treatment method of hyperbilirubinemia an automated process. The first project was hence named ANET 1.0. The name ANET was coined as an abbreviation of Automated Neonatal Exchange Transfusion.

Up until now, there have been three editions of ANET. Yiddi et al who are pioneers of this project, implemented the idea in 2020 and named it ANET 1.0. Okrah and Kisser picked up from where Yiddi et al left off and built ANET 2.0 using the same concept in 2021. The latest version of ANET, which is ANET 3.0 is an improvement of the ANET 2.0 model. It was worked on by Agbedor et al in 2022.

Our edition, which is ANET 4.0 seeks to make ANET a workable device in healthcare centers nationwide, and globally, by addressing all challenges faced by the previous editions of ANET

Calculating the pressure needed by the syringe for plunging, as well as the flow rate is important when considering the design of the pusher block. Also, considerations should be made for amount of pressure exerted on the threaded rod component of the pusher block, as well as the torque.

Calculating the pressure of the syringe, the formula used is described as:

Where F is the linear force

d is the diameter of the syringe.

**Linear Force Fundamentals**

Syringe pumps use stepper motor-linear actuators that convert rotary-to-linear motion, which means that the force of the motor will be transferred from torque to linear force. To calculate the linear force in a given device, we have to consider four contributions: force from friction, acceleration force, the force due to gravity and the applied force. Then, a linear force is defined as follow:

Total Linear Force = F (friction) + F (acceleration) + F (gravity) + F (applied).

The applied force is that provided by the stepper motor, however, the net force decrease due to the friction (at higher speed lower force). In practical terms, the friction force is taken as a factor correcting the maximum force of the motor reflected in terms of efficiency. The efficiency is also affected by the lead screw used in the actuator (length and pitch), which modify the velocity of the nut that moves the syringe plunger. Considering these characteristics, we can calculate the linear force with the following formula.

Linear Force = (Maximum force of the motor × 2π × efficiency)/pitch

For example, the linear force of a linear actuator with a motor of 0.5 Nm and a lead screw with a 1 mm pitch, and a 0.8 efficiency at a 1 mm/s speed is:

Linear force= (0.5 Nm × 2(3.14) ×0.8)/0.001 m = 2512 N = 564.69 lbf

The formula for describing the flow rate of the syringe is given as,

The table below describes some standard syringe sizes, their respective inner diameters, and flow rates

|  |  |  |  |
| --- | --- | --- | --- |
| Syringe Size | Inner Diameter(mm)) | Minimum Flow Rate | Maximum Flow Rate |
| 1mL | 5 |  |  |
| 3mL | 9 |  |  |
| 5mL | 10-12.07 |  |  |
| 10mL | 14.5-15 |  |  |
| 20mL | 19.13 |  |  |
| 30mL | 21.69 |  |  |
| 50mL | 25 |  |  |
| 60mL | 26.72 |  |  |