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DESIGN OF A SLIDING INTRAVENOUS STAND

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Abstract
More than 80 percentages of hospitalized patients in Ghana and other parts of the world receive intravenous therapy of one form or the other with the hope of getting better. However, most of these patients end up in worse situations due to intravenous infiltration.The purpose of this work is to identify the reasons why infiltration is very common among various settings and how the situation can be reduced if not totally eradicated.Following an engineering design process together with other engineering knowledge obtained, the issue of movements during intravenous infusion was identified and a sliding intravenous stand was developed to help in curbing the situation. The design makes provision for height adjustment, sliding through bed frame and it is relatively cheaper to existing designs.

Keywords: Intravenous infusions (IV) stand intravenous therapy and infiltration

1. Introduction

Intravenous (IV) infusion is the administration of fluids directly into the veins of patients. The process is used for maintaining and restoring fluid and electrolyte balance, administering drugs, transfusing blood and delivering parenteral nutrition. [1]

During IV therapy, an IV fluid is kept in position at a particular height and connected to the patient through an IV line. The IV line has a cannula at its tip that allows fluid to flow into the veins of the patient. Furthermore, health workers take precautions to ensure the safety of the patient. Some of which include proper procedure for IV placement and insertion as well as ensuring proper flow of IV fluid which is mainly dependent on the height of the fluid above the heart basically three [2] feet and above.

However, fluid that escape the vein can be trapped in various compartments of the body in a situation known as infiltration. ***Infiltration*** is the inadvertent administration of fluids into the subcutaneous tissue. [3] One of the leading factors of infiltration includes mechanical forces that displace the vascular access such as the catheter tip which erodes the vein walls leading to infiltration. A typical complication of infiltration is ***compartmental syndrome*** which requires immediate surgery and also complex regional plain syndrome (CRPS).The purpose of this design is to solve the problem of infiltration by reducing the mechanical forces applied during IV therapy. To carry out the design, a typical iterative engineering design process comprising problem statement, design objectives, customer needs assessment, benchmarking, functional analysis, specification, concept generation and selection of material, evaluation and testing of the product was employed. [4, 5]

The objective of the project was to design a Sliding IV stand that can be easily attached to the frame of patient bed, easy to assemble, support IV-bag, height-adjustable, efficient, durable, safe (enough stability to prevent falling) and cost effective.

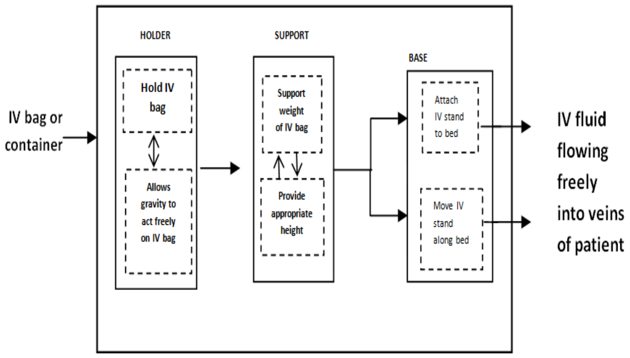
Figure 1: objective tree

2. The Design

Following the engineering design process, bench marking was done from which the functional structure of the product was developed. The functional structure gives a detailed description of the process or channels of operation of the IV stand. This is shown in figure 2.

From the functional structure, a specification table was developed from which the exact dimensions, forces and detailed requirements are determined and provided. In doing this, the various attributes of the product are translated into engineering characteristics. This is to give quantifiable and measurable values to these attributes. [6]
Concept representing different solutions to the problem had to be developed. This is a working principle based on the physical effect needed to be achieved by a given function. Each function may be achieved in a number of ways represented as options. The concepts generated are based pure on the functional structure as well as the specifications.

Figure 2: functional structure



Taking note of the fact that various standards need to be met for the main function of an IVstand to be performed.
By the use of various design tools such as morphological tables and decision matrix, the best concepts for the base, support and holding units were developed. These were then developed by improving on them. The various components were drawn in three dimensions (3-D) using the Mechanical Desktop software. The parts drawn in elevation is shown in Figures (2.3) and the final drawing obtained is shown in Figure (2.4).

2.1 The choice of a holding unit was the hooks

This is because, aside holding the fluid and keeping it in position, it also allows gravity to act freely on it. The hooks were then welded onto the support unit. This is because welding is a type of permanent joint that is tight and strong and can withstand repetitive loading. A square plate is chosen as a means of attaching the hooks because the poles are hollow.

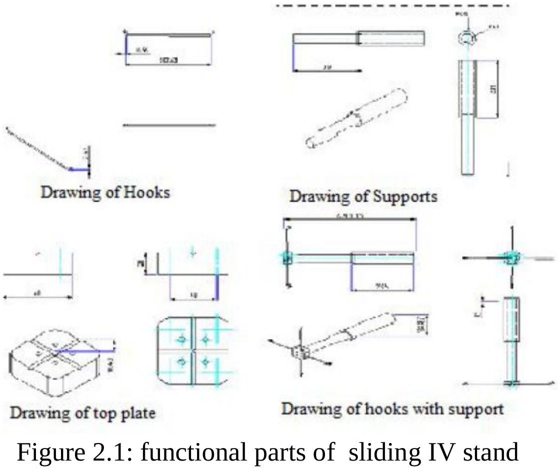


Figure 2.1: functional parts of sliding IV stand

2.2 The supporting unit selected is poles.

These are basically made of two poles with different diameters such that one fits into the other. They are held together by adjuster screws. This enables the poles to be adjusted to any height when necessary.

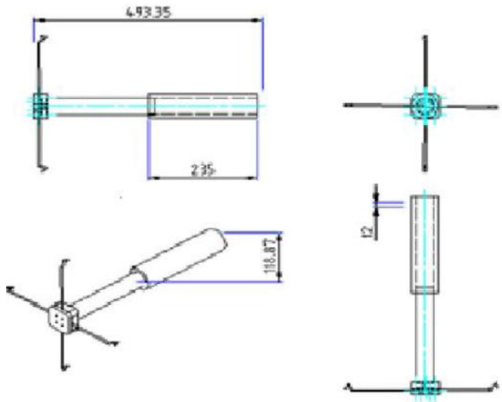


Figure 2.2:Drawing of sliding IV stand

2.3 The base

The base is made of a circular plate. One side of the attaching unit is firmly attached to this base by welding and the other part having a spring joint. The entire base is attached to the pole by screwing because they have threads. The base is lined with a polymer which makes sliding possible.

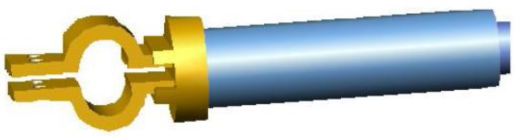


Figure 2.3: base of sliding IV stand

Figure 2.3 and 2.4 is a three dimensional (3-D) drawings of the design which give a detailed description of the sliding IV stand. The dimension of the drawing are in centimeters and the scale for the drawing is 1cm to 12 cm. All dimensions were derived from anthropomorphic data.

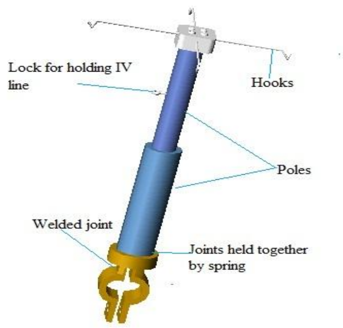


Figure 2.4: functional parts of sliding IV stand

2.5 Bill of materials for the sliding IV stand

Table 1:bill of materials to build sliding IV stand

ITEM	NAME	PART NUMBER	QUANTITY	MATERIALS	COST(GH¢)
1	Pole	SIV 1	1	Aluminum alloy	20
2	Hook	SIV 2	4	Aluminum alloy	10
3	Base	SIV 3	1	Aluminum alloy	10
4	Base liner	SIV 4	1	Polyethylene	10
5	Screws	-	4	Steel	2
6	Springs	-	1	Steel	3
7	Adjusters	-	1	Steel	5
8	Locker	-	1	Steel	10
TOTAL					70

2.6 How the design works

The base is then attached to the bar of the bed and lock to ensure that it has firm grip on the bed. An IV bag which is connected to an IV line is hanged on the hooks of the stand and then connected to the patient. During positional discomfort, slide the IV stand along the bar from one side of the bed to the other until the patient becomes comfortable.

3.0 Discussion

This device is however specific for circular bars but can further be developed to make it applicable to square prism bars. Additional accessories can also be added to make it multi-purpose.

4.0 Conclusion

In conclusion, a mock-up of the sliding IV stand was produced which satisfy all the customers' requirement. This device if used will reduce mechanical force that interfere with the infusion process and consequently reduce the number of IV infiltration cases.

Acknowledgment

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