DESIGN OF " A SYSTEM OF HOSPITAL TROLLEYS. "

DIPLOMA PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE POSTGRADUATE DIPLOMA IN INDUSTRIAL DESIGN

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APPROVAL SHEET

DIPLOMA PROJECT ENTITLED ' DESIGN OF A SYSTEM OF HOSPITAL TROLLEYS ' BY PRERANA PENDSE IS APPROVED FOR THE POSTGRADUATE DIPLOMA IN INDUSTRIAL DESIGN

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C O N T E N T S

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1. Introduction

There have been many new developments and changes in operation theatre methods and surgical techniques over the years. With these changes it is necessary to develop and redesign hospital furniture and equipment.

Hospital furniture design is an area in which there is lot of scope for development.

The functional and user requirements in hospital are unique. There is a need to create a particular designed environment in various hospital areas. e.g. An operation theatre requires a sterile environment. These special needs make design more complex.

A survey of the large hospitals in Bombay was taken followed by discussions with Surgeons and Nurses. This threw light on their problems. The list of hospital equipment and furniture where need for redesign is felt is endless.

It was found that hospital trolleys form quite an important part of hospital furniture. The existing designs of trolleys leave a lot to be desired. It was decided to study hospital trolleys in general and take up the development and design of instruments trolleys used within the operation theatre.

2. Information and Analysis

2.1 Procedure of Enquiry :

Source of information were as follows :

1. Literature survey
2. Survey of catalogues and other published materials at home and abroad.
3. Visits and consultations with hospitals, manufacturers & suppliers and other specialists sources.

Literature survey produced information about operation theatre techniques and user requirements.

The catalogue survey produced extensive information about the market at home and abroad and helped to tabulate the specifications and facilities of the trolleys in the market. The programme of visits to hospitals which consisted of seeing surgical operations, interviewing surgeons, nurses, and assistants culminated in a photographic record of the planning and layout of trolleys and the surgeon-nurse-instruments' relationships.

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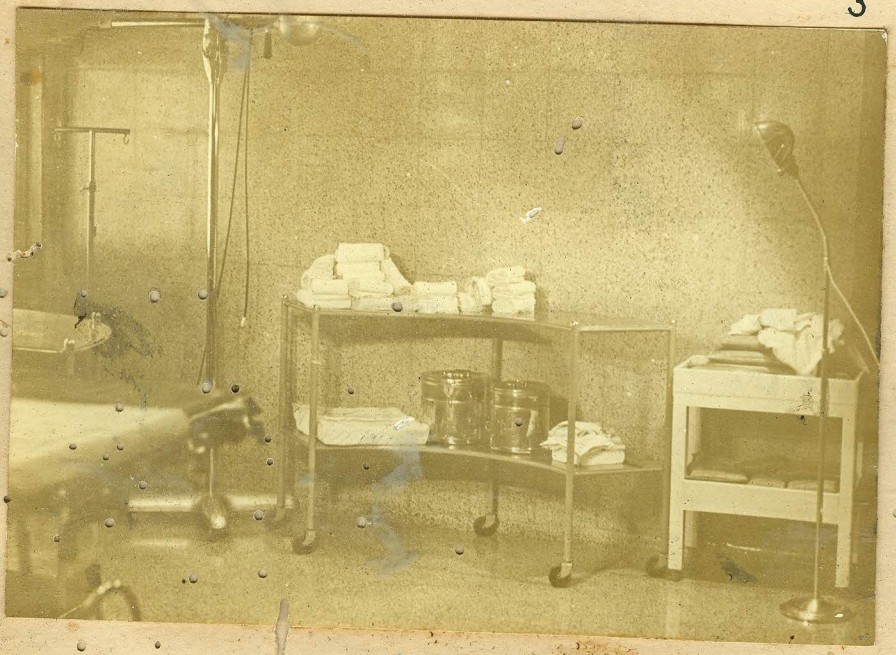


2.2 Instrument trolleys and their preparation :

Types of instrument trolleys presently used in hospitals are the following :

a) Side trolley with height adjustment, commonly called Mayos' fidetrolley (Ref. Photo. 1).

b) Rectangular stand by trolley with aluminium and glass top.

c) Curved instruments trolley with glass or aluminium top.

d) Wash bowl trolley.

A) Mayos' side trolley (Refer Photograph 1).

It has a framework of welded steel tubes with four rubber tyred casters of 2" diameter. It is fitted with one 16" x 20" enamelled iron tray which is detachable. It has a telescopic screw type height adjustment. It has a white finish.

It costs Rs. 190/- if fitted with enamelled iron tray 8% taxes + freight charges. If it is fitted with aluminium tray it costs Rs. 235/- + 8% tax + freight charges.

B) Rectangular standby trolley(Ref. Photograph 3

It has a framework of welded steel tubes with two heavy plate glass shelves freely supported mounted on 2" and rubber tyred casters. The same trolley is also fitted with aluminium shelves.

Size : 27" x 18" x 32" height
16" x 24" x 32" height.

C) Curved instruments trolley with glass or aluminium top (Ref. photographs 3 & 4)

Size : 44" corner to corner 14" width and 38" height. Cost Rs. 375/-

D) Wash bowl trolley (Refer photograph 2)

Framework of welded steel tubes on four rubber tyred casters two inch diameter.

Preparation of instrument trolleys

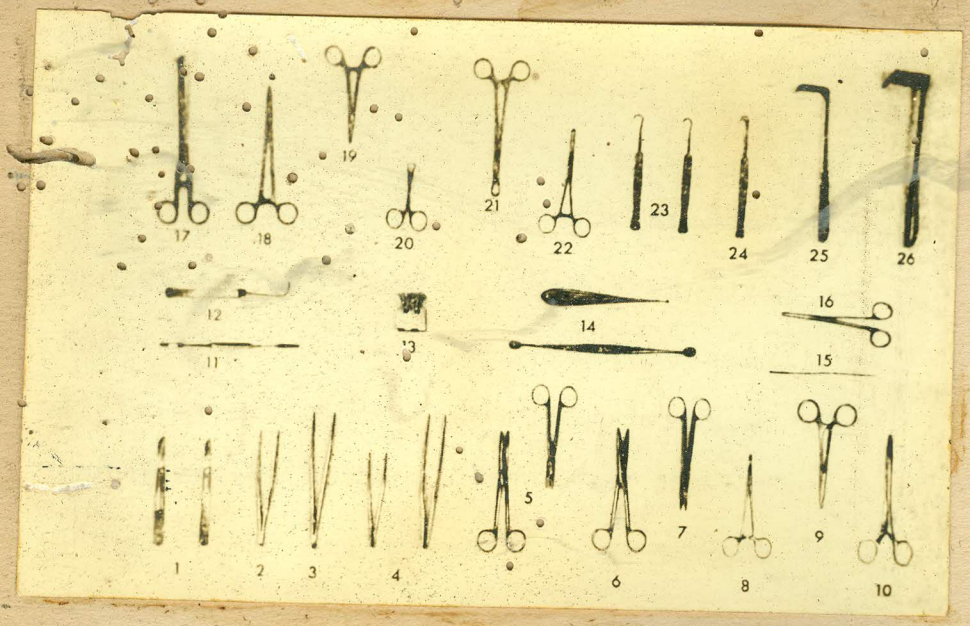
Instrument trolleys are prepared immediately before an operation. It is bad practice to prepare all trolleys required for a list before the commencement of the first case.

All surfaces of trolleys and tables which are to be used for setting out sterile

instruments and apparatus are first covered with a sterile impervious material before the application of sterile towels.

If forceps are used, care is taken to prevent contamination of trolleys occuring when placing requisites in position. The forceps are held so that the hands do not pan over the trolley, except when absolutely necessary.

After the instrument trays have been placed on the trolleys aseptically the instruments are laid out by a nurse wearing sterile gowns and gloves. It is thoroughly bad practice for an 'unsterile' person to complete this arrangement using Cheatle transfer forceps, because of the great risk of contamination occuring when ungloved hands are moved to and fro over the sterile trolley. Alternatively a packet system is used. In this comprehensive sterile packets containing all the necessary equipment and incorporating trolley drapes which fall into position as the packet is opened are used. This method shortens the time taken for preparation and minimises bacterial contamination before operation.



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4 GENERAL SET OF INSTRUMENTS

2.3 Assisting the surgeon

The instrument or Mayo trolley is prepared by laying out only those instruments which will be required in the early stages of the operation. These instruments are replaced with others when necessary and as the operation progresses. The instrument trolley should always be laid out in a specific order not only for tidiness but because many valuable seconds are lost searching for a vital instrument. The instrument trolley therefore should not be crowded.

The suggested order of instruments would be: At the front of the trolley from right to left scalpels, dissecting forcept, scissors, artery forceps; at the back of the trolley retracters, tissue forceps. If the trolley has a raised edge, the handles of the instruments should project slightly over this edge.

Instruments having sharp points such as scissors and scalpels must be placed with their cutting edges or points away from the surgeon. Soiled instruments should be

cleansed before replacing them on the instrument trolley.

When passing instruments, they are placed firmly into the surgeons hand and it should not be necessary for him to reach them. Most instruments such as artery forceps, tissue scissors etc. are handed in a closed position on the first ratchet when that is applicable. An instrument should always enter the surgeons hand so that it may be used without further adjustment.

Naturally the method of passing the instrument will depend upon the way in which the surgeon is accustomed to taking them i.e. if the surgeon extends his hand for a scalpe with the palm uppermost the scalpel is placed with the blade horizontal, pointing towards the instrument nurse and with its cutting edge facing in the same direction as the extended finger tips. As he closes his fingers on the handle the cutting edge will be in the correct position for use.

2.4 Sterilisation

Methods of sterilisation :

Heat sterilisation

1. Autoclaving (steam and pressure)
2. Dry heat.

Heat disinfection

3. Steam and/or formaldehyde at sub-atmospheric pressure
4. Pasteurisation
5. Boiling

Cold sterilisation

6. Radiation
7. Ethylene oxide
8. Ultraviolet light radiation

Cold disinfection

9. Various chemical solutions.

2.4.1 Autoclaving is by far the most efficient methods of sterilisation for materials which will stand upto heat and moisture. The physical process of heating the fabrics to the sterilising temperature can be described as follows. In a sterilising chamber (autoclave) which has been

well exhausted of air, the steam entering promptly fills the air spaces. The steam condenses on the layer of fabrics. In the process, latent heat is given up which is absorbed by the fabric. The air in the interstices of the fabric being cooler and denser is displaced downwards by gravity. This process goes on till the whole load is heated through and no further condensation occurs, the temperature within the packet remaining the same as that of the surrounding steam.

2.4.2 Cold disinfection :

It is a method which is used only when sterilisation by heat is impracticable and is ineffective unless the chemicals can reach all parts of the articles which must be free from debris blood and pus.

Fairly short periods (10 minutes) with certain chemicals will ensure the destruction of bacteria. These short periods refer only to articles which have smooth surfaces. It takes longer for the chemical to penetrate intricate joints.

Some of the widely used chemicals and their dilutions for disinfection of metal parts are as follows :

Chemicals	Dilution
1. Phenol(Carbolic acid aqueous)	2.5%
2. Cresol (Lysol aqueous)	2.5%
3. Chloroxylenol (Pure dettol aqueous)	5.0%
4. Chlorehexidine(Gluconate hibitane)	0.5%
5. Cetavlon	1.0%

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OPERATION ON THE CHEST

2.5 Position of instrument nurse in relation to the surgeon :

The position of the instrument nurse depends on the wishes of the surgeon and also on the area and type of operation.

For operation on the face, neck, chest, abdomen or thighs :

With the surgeon standing on the right hand side of the operation table the nurse is opposite his right hand and with the instrument trolley at her left. A surgeon standing at the left hand side of the table will require the nurse opposite his left hand and her trolley at the right.

For operations on the lower limbs :

The nurse may adopt a similar position as above or stand at the foot of the operation table facing the surgeon and with the instrument trolley in front of her.

When the surgeon is at the operation table head i.e. during craniotomy, the best position for the nurse is opposite his right hand with the instrument trolley over the patient.

For operation performed on the same table :

This is best served by the nurse standing behind her instrument trolley, facing the patient and the surgeon to her right or left with his assistant opposite.

Occasionally the nurse will be compelled to stand behind and a little to the side of the surgeon owing to the nature of the operation.

Whichever position is adopted the nurse should always be able to observe the surgeon's movement and be capable of handling him his instruments with the minimum of inconvenience.

2.6 Preparing operation areas :

In most cases the presurgical skin preparation is performed in the ward. In the theatre, the sterile towels are removed and the operation area is painted with anti-bacterial agent, alcoholic hibitane 0.5%, alcoholic iodine 2% or surgical dettol. Application of this antiseptic should commence first at the site of incision in ever widening squares or circles.

A second application, using fresh swabs is made when the first has dried.

Special care has to be taken for contaminated wounds. Contaminated wounds need a surgical toilet under anaesthesia.

2.7 Draping operation areas :

The operation areas must be draped to allow free access to the surgeon but the towels are so arranged that manipulations do not expose any unprepared skin areas. Wherever possible a sterile water repellent sheet, is placed in position first, to prevent contamination, should the sterile drapes become damp or soiled.

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6 INSTRUMENTS SUTURES AND SALINE PLACED ON THE SAME TROLLEY

2.8 Analysis :

Functional analysis:

Analysing the presently used instrument trolleys functionally, the following observations were made :

1. The different instrument trolleys used together and at the same time have no relationship with each other i.e. their sizes and shapes are not related.
2. Areas for different instruments are not defined, which leads to confusion and disorder.
3. Waste of usable space, as the size of the trolley surface is not derived from the size of the instrument.
4. Lack of flexibility i.e. there is no facility for interchangability of trays from one trolley to another.
5. It is inconvenient for the instrument nurse to reach out for some of the instruments due to faulty layout.
6. The draping procedure is cumbersome e.g. the big standby instruments trolley is

covered with one huge drape and the whole drape has to be removed even if one instrument is required.

7. As the tray surface is flat, dropping of instruments results which then have to be discarded.

8. There is no place to put away the discarded instruments.

9. There is no designed place to keep spillable things on the trolley surface.

10. The trolleys after use do not stack, this takes up a large storage area.

2.9 Formal analysis :

1. The form is crude, and does not suggests efficiency and cleanliness. (Refer photograph 1).

2. The form suggests absolute rigidity because of the welded joints.

3. There is no compatibility between the different trolleys i.e. they do not look like part of one system.

4. The form looks more like something immobile where as the trolley has to be moved all the time.

5. Finish is not durable, and pealed off paint looks unhygenic.
6. Poor detailing.
7. Shape of knob for height adjustment is crude.

2.9.1 Structural analysis :

1. The frame is not designed to be structurally balanced. It is unstable and likely to topple in some positions.
2. As the frame is of mild steel it rusts and creates an uneven surface. This adds to the danger of contamination.
3. The height adjustment is poor. The screw used to adjust the height leaves marks all along the surface of the tube.
4. As the frame is not collapsible packaging problems are created. The package is big in size resulting in heavy freight charges.
5. Only batch production is possible due to problems of rusting and storage.

2.9.2 **Ergonomic Analysis:**

1. Seven to eight trolleys have to be set out at the same time, during major surgery.
2. In the above case it is difficult for the nurse to reach out for the instruments.
3. As the shapes and sizes of the trolleys are not compatible, there is a lot of waste of space around the operation table.
4. As there is no clear demarkation of spaces, on the trolley surface, there is confusion and difficulty in finding the right instrument.
5. The height adjustment, of the Mayo's side trolley is difficult.
6. Due to the required variations in trolley top level, certain problems arise e.g. the nurse has to stand on a stool and give the instruments.