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RESEARCH ARTICLE

STUDY OF HOW EFFICIENT THE PNEUMATIC TRANPORT SYSTEM IS COMPARED TO MANUAL METHODS – INNOVATIVE METHODS TO IMPROVE HOSPITAL EFFICIENCY.

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Abstract

Introduction: Increasing financial burden on us, on quality of patient care and ever increasing competition has forced hospital administrators across world to focus on innovation in the Management of Hospitals. Internal logistics of materials like Laboratory samples, reports, blood products, drugs from pharmacy is of primary importance and has direct bearing on the provision of good quality care to patient and improving patient satisfaction. The present study was done to find the efficiency of one such method of logistics management, i.e. pneumatic transport system (PTS).
Methods: The study was conducted in a tertiary care hospital in India. Data was collected by direct observation and comparing with existing conventional human based transportation.
Observation: There was no difference in time taken for drawing of samples, labelling and handling of samples between two methods. But there was a significant reduction in time for arranging manpower and transportation of samples in case of pneumatic chute system. Total time taken for sample transportation by pneumatic system was 15.8 min while by manual method was 39.7 min, by pneumatic system was 15.25 min while by manual method was 44.4 min, and by pneumatic system was 15.36 min while by manual method was 45.2 min from OT, Cardiac, Semi PVT / PVT to Laboratory respectively.
Conclusion: PTS is a valuable alternative to conventional human dependant transport. The study shows there is a definite saving in manpower and time for transport.

Introduction:-

Introducing efficiency into an existing system is the key functions of all managers and its applicability to administrators in a healthcare scenario is no different. Current practice of evidence based management seeks to adopt known methods while inculcating innovative technologies as well.(1) India is one of the few locations in the world with the latest in healthcare technologies including automation, surgical robotics, modular operating theatres, minimal access surgery systems, telemedicine and radiology. Although Indian hospitals and healthcare providers excel in the fields mentioned, intra-facility logistics and material-management remains untouched by latest innovations like automation of healthcare logistics, materials transportation and supply chain.(1) 95 per cent of the

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total transport system within the hospital is spontaneous in nature viz. Blood Samples, blood bags, and transport of Drugs, Organ & Tissue Samples, imaging documents, discharge summary documents, billing documents, prescription documents, standard errands, analysis reports, surgical materials and other samples. In-efficient and inadequate intra-facility logistics may increase costs on human resources, healthcare delivery and energy costs apart from other factors. This in turn causes several problems, increases risks and difficulties and consequently reduces the quality of patient care in the facility.(1) Current methods used by the hospital for such Spontaneous transports are Human Based Transport (HBT) viz. using Ward Boys / Orderlies, Patient's Attendants / Relatives.(1) With Budgetary constraints and Fledgling competitive situation hospitals are now facing new challenges: reduction of time patients spend in the hospital without loss in quality of care, reduction in staff costs and at the same time increasing results and efficiency. For these reasons the optimization of hospital logistics becomes more and more important.(2) Pneumatic tube systems for hospitals are highly complex systems which perform a great variety of tasks. All of these are urgent since the health of people is at stake. The means of transport which combines speed and reliability is the hospital pneumatic tube system.(3) While doctors and nursing staff dedicate themselves to the patients, the pneumatic tube system transports a multitude of small and medium-sized items. This system saves not only time, but also space: laboratories can be centralized and stocks in the decentralized medicine storage depots can be reduced. Furthermore, the pneumatic tube system helps increase efficiency since the staff is no longer busy running errands, allowing the wards to stay occupied all the time.(3)

The area of application: Pneumatic tube systems don´t necessarily have to be installed at the outset of construction. Even in an already operating hospital, a pneumatic tube system can be easily integrated. Depending on the various structural conditions, the system can be layed inside or outside the walls. Other factors, for instance system capacity, load size or weight, are taken into consideration as well.(3)

The system:
Pneumatic tubes (or) capsule pipelines (or) Lamson tubes, also known as Pneumatic Tube Transport (PTT) are systems in which cylindrical containers are propelled through a network of tubes by compressed air or by partial vacuum.(1)

Components of PTS:
Blower: Large fans that move carriers through the tubes via vacuum and pressure.(4)Three-Way Diverter.
Carriers
PVC tubes
Delivery stations: Automatic Carrier Unloading Station, fully automatic high capacity sending and receiving station(5) & provides automatic carrier unloading process.
Computer control centre: Computer control centre monitors all carrier traffic and calculates the fastest path for each transaction.(4, 6)

Advantages of PTS in Healthcare setting: No expensive errands, staff can spend more time to patients, quick transport of emergency samples & Fast, safe and reliable transport3,centralized laboratory and pharmacy, installation in new and existing buildings(5), PTS can provide a safe efficient and rapid means of sending certain types of pathological specimens between hospital departments, from operation theatre and out-patients to the pathology laboratories(7), the pneumatic tube system decreased the median turnaround time.(6)

Pneumatic chute system v/s Human Based Transport (HBT):
There are several risks and problems that entail Human Based Transport logistics:-
Delays:
Hospital's staff carrying the materials may get diverted to a corner for a quick cigarette or choose to have a quick cup of tea with his or her friends - not realizing the critical life saving time being wasted; non-availability of the staff at the time of need, the carrier staff may suddenly trip-over and the samples/materials fall off and break, which means the entire exercise needs to be repeated.

Theft:
A universal problem, invariably theft is very common during transportation of drugs, instruments and other materials, etc.

Exposure:
There are many confidential and classified materials transported during a day in a hospital, which, are exposed to other unwanted personnel or people during human-transportation from one department to another.

Bio-Hazard:
Carrying of sample (blood/tissue etc...) personally involves high risk of exposure to the carrier of the materials of other persons in the facility to infections and subsequent cross-infection, many more risks and problems.

Personnel:
The Hospital needs to dedicate several staff members for just transporting and carrying samples and materials in the hospital - whereas they specifically hired for patient transportation, patient care etc… re-deputation of staff; over-hiring of staff, etc

Energy:
Use of dumb waiters and elevators for running such errands cause high consumption of energy; adding to already high energy bills of the facility; apart from causing delays due to long waits at the elevator doors.

Aim:
To compare the time by installing pneumatic transport system in tertiary care hospital and to determine its benefit from manual method of transport of investigational samples.

Objectives:
1. To install pneumatic transport system in tertiary care hospital.
2. To calculate the time taken to transport blood samples from respected department to laboratory by pneumatic transport system.
3. To compare both method of transportation of blood sample in hospital.
4. To determine effectiveness of pneumatic transport system on turn around time.

Material &Methodology:-

The present study was an observational study. 2727 samples were observed in this study. Data of 2 months (6th January 2018 to 5th March 2018) was collected from tertiary care hospital, India. All the samples (EDTA, Plain, and Citrate) for Haematology, Biochemistry and Immunology investigation received at Laboratory. Clinical findings, collection time and collected by with all the patient details and other relevant findings were collected by laboratory receptionist in case of manual method. Also, all the relevant information was sent by the responsible person in case of using the pneumatic chute system. Any further queries were resolved by discussing regarding the sample with the respected sister. Mama/Mausi was handled over these samples and transported from OT (3rd floor), Cardiac (5th floor) and Semiprivate/ Private (7th floor) to Laboratory (2nd basement) by using lift or stair case in case of manual method. Respected sister was gathering all the samples and programming the pneumatic chute system's monitor in case of transportation by pneumatic chute system. Once all the data were collected, the data analysis was done. Further analysis was done manually as well as using Microsoft Office Excel 2007 to obtain time difference by both the method.

Inclusion criteria:-
All the IPD samples (EDTA, Plain, Citrate, Heparin) from the OT, Cardiac and Semi private/ Private floor were collected from the patients of all age groups for investigation of Haematology, Biochemistry and Immunology were sent to the Laboratory.

Exclusion criteria:-
Samples from the OPD collection room, Emergency department and rest of the floors and received from outside hospital were excluded in this study. Samples of urine, body fluids for cytology and biopsies for histopathology were excluded. Samples for Microbiology department like culture bottles, urine, body fluids were excluded.

Observation:

Table 1: Overall samples transported to Laboratory with average time taken according to transportation method

Most samples were transported from Semi PVT/ PVT, 1733 samples, out of which 405 samples by pneumatic chute system and 1328 by manual method, followed by from Cardiac and OT.

Total no of samples transported	From	To	By pneumatic chute system	Transportation time by pneumatic system	By manual method	Transportation by manual method
147	OT	Laboratory	82	18.5 Sec	65	14.7 Min
847	Cardiac	Laboratory	181	25 Sec	666	19.4 Min
1733	Semi PVT/ PVT	Laboratory	405	36.8 Sec	1328	20.2 Min
2727	OT, Cardiac, Semi PVT/ PVT	Laboratory	668	-	2059	-

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Table 2: Average time taken for transporting samples from OT to Laboratory

Method	Number of samples	Drawing of samples	Labelling time	Arranging manpower	Handling	Transportation time	Total time
Pneumatic chute system	668	5.0 Min	5.0 Min	Nil	5.0 Min	18.5 Sec	15.18 Min
Manual method	2059	5.0 Min	5.0 Min	10 Min	5.0 Min	14.7 Min	39.7 Min

There was no difference in time taken for drawing of samples, labelling and handling of samples between two methods. But there was a significant reduction in time for arranging manpower and transportation of samples in case of pneumatic chute system which ultimately reduced total time for transportation of samples from OT to Laboratory.

Table 3: Average time taken for transporting samples from Cardiac to Laboratory

Method	Number of samples	Drawing of samples	Labelling time	Arranging manpower	Handling	Transportation time	Total time
Pneumatic chute system	181	5.0 Min	5.0 Min	Nil	5.0 Min	25 Sec	15.25 Min
Manual method	666	5.0 Min	5.0 Min	10 Min	5.0 Min	19.4 Min	44.4 Min

There was no difference in time taken for drawing of samples, labelling and handling of samples between two methods. But there was a significant reduction in time for arranging manpower and transportation of samples in case of pneumatic chute system which ultimately reduced total time for transportation of samples from Cardiac to Laboratory.

Table 4: Average time taken for transporting samples from Semi Private/ Private to Laboratory

Method	Number of samples	Drawing of samples	Labelling time	Arranging manpower	Handling	Transportation time	Total time
Pneumatic chute system	405	5.0 Min	5.0 Min	Nil	5.0 Min	36.8 Sec	15.36 Min
Manual method	1328	5.0 Min	5.0 Min	10 Min	5.0 Min	20.2 Min	45.2 Min

There was no difference in time taken for drawing of samples, labelling and handling of samples between two methods. But there was a significant reduction in time for arranging manpower and transportation of samples in case of pneumatic chute system which ultimately reduced total time for transportation of samples from Semi Private/ Private to Laboratory.

Discussion:

There was no difference in time taken for drawing of samples, labelling and handling of samples between two methods. But there was a significant reduction in time for arranging manpower and transportation of samples in case of pneumatic chute system which ultimately reduced total time for transportation of samples from OT, Cardiac and Semi Private/ Private to Laboratory. Total time taken by pneumatic system for sample transportation was 15.8 min while by manual method was 39.7 min from OT to Laboratory. Total time taken by pneumatic system for sample transportation was 15.25 min while by manual method was 44.4 min Cardiac to Laboratory. Total time taken by pneumatic system for sample transportation was 15.36 min while by manual method was 45.2 min from Semi PVT/ PVT to Laboratory.

Weaver DK et al reported that, sending specimens through a computerized pneumatic air transport system. The specimens traversed a maximum of 829 feet (253 meters) involving 16 bends and eight transfer units at 25 feet/second (7.6 meters/second).5 In one of the studies conducted at a 600 bedded hospital facility it is noted that Dumb Waiters & Elevators - High Energy Consumption and cause delays compare to pneumatic air transport system of sample.1 Keshgegian AA, noted that the pneumatic tube system decreased the median turnaround time for potassium and haemoglobin result on specimens from the emergency department by 25%. The system evaluated is a rapid, efficient mechanism for sending specimens to the clinical laboratory that produces no significant effects on analytical results and has the ability to decrease turnaround time.

Conclusion:-

Pneumatic transport system (PTS) is a valuable alternative to conventional human dependant transport. The study shows there is definite saving in manpower and also the time for transport. With increasing emphasis on effective utilization of resources available in order to cut operational cost in hospitals, it is ideal for modern hospitals and healthcare settings to switch over to using these systems. The study also brings to light the cost escalation incurred in installing PTS into existing buildings. Hence it is better to consider for these facilities at the hospital planning stages itself. Finally although PTS systems can be a boon to any type of hospital buildings it is ideal for vertical structures.

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