Internship training

At

Aakash Healthcare Pvt. Ltd.

Dwarka

on

To project operational cost savings for a period of five years and hence analyze the cost and manpower benefit by effective utilization of Pneumatic Tube Transport (PTS) and Automated Waste & Laundry System (AWLS) when compared to Human Based Transport (HBT)

By

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PG/15/023

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ACKNOWLEDGMENT

On the very outset of this report, I would like to extend my sincere and heartfelt obligation towards all the personages who have helped me in this endeavour. The internship opportunity I had with Aakash Healthcare Pvt Ltd was a great chance for learning and development.

I am also grateful for having a chance to meet so many wonderful people and professionals who led me through this internship period.

First and foremost, I would like to express my sincere gratitude to Dr. Aashish Chaudhry, Managing Director, Aakash Healthcare Pvt Ltd.

At this juncture I feel deeply honoured in expressing my sincere thanks to Mr. Kanishak Gautam (DM) who in spite of being extra ordinarily busy with his duties, took time out to hear, guide and keep me on correct path and providing valuable insights leading to the successful completion of my project.

I would also like to thank all my teammates for their critical advice and guidance without which this project would not have been possible.

I express my gratitude to my college International Institute of Health Management and Research, New Delhi for arranging summer training in good schedule. I also extend my gratitude to my project guide Dr. Sumesh, IIHMR Delhi for his co operation, help and encouragement.

I perceive this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in best possible way and I will continue to work on their improvement in order to attain desired career objectives.

Hope to continue co operation with all of you in the future.

Sincerely

Damini

17/05/2017

DECLARATION

I, Ms Damini, student of International Institute of Health Management Research, New Delhi, hereby declare that I have completed my project titled To project operational cost savings for a period of five years and hence analyze the cost and manpower benefit by effective utilization of PTS and AWLS from February to April 2017. The information submitted herein is entirely true and original work.

The projects were undertaken and carried out by me, under the guidance of Dr. Sumesh, IIHMR Delhi, and it has not been submitted to any other university or institute or published earlier.

Place- New Delhi

Date- 17/05/2017

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LIST OF ACRONYMS/ABBREVIATIONS

1) AHPL – Aakash Healthcare Pvt. Ltd.
2) AWLS: Automated Waste and Laundry System
3) PTS: Pneumatic Transport System
4) HBT: Human Based Transport
5) PTT: Pneumatic Tube Transport
6) LED: Light Emitting Diode
7) RFID: Radio Frequency
8) SS: Stainless Steel
9) CMC: Comprehensive Maintenance Contract
10) AMC: Annual Maintenance Contract
11) MRI – Magnetic Resonance Imaging
12) CT – Computed Tomography
13) OPD – Out Patient Department
14) IPD – In Patient Department
15) MOT – Modular Operation Theatre
16) GDA – General Duty Attendant
17) HIS – Hospital Information System
18) BLS – Basic Life Support
19) CCU- Cardiac Care Unit
20) CICU – Cardiac Intensive Care Unit
21) DMT – Department of Medical Technology
22) CSSD – Central Sterile Supply Department

Section 1

Organisational Profile

Aakash Healthcare Pvt Ltd

1.1 ORGANIZATION PROFILE

About Aakash Group:

Mr. J.C. Chaudhry, the Chairman of Aakash Institute started teaching with one institute in 1988 with 12 students. Today after 28 years of perseverance and excellence, Aakash is a household brand, with more than 150 centers across the country, training more than 125,000 students every year, turning them into accomplished medical and engineering professionals.

Aakash Healthcare is a subsidiary of the Aakash Group, and is a state of the art healthcare facility and the first smart hospital in this part of the city. Their patient-centric policy, erudite doctors and compassionate staff offers the best in class healthcare for everyone. Healthcare was a palpable choice for the parent organization, since this sector shall benefit the institute's enormous alumni network spread across continents.

About Aakash Healthcare:

Aakash Healthcare is a Private Limited Company (AHPL). It was incorporated on **19th November, 2013,** and is a subsidiary of the prestigious **Aakash Group (AESPL)**. It is a state of the art healthcare facility and the first smart hospital in South – West Delhi.

Dr. Aashish Chaudhry the founder and Managing Director of Aakash Healthcare is a celebrated orthopaedic surgeon, having performed innumerable successful orthopaedic surgeries, giving agility and the ease of movement to the incapacitated. Dr. Chaudhry aims to make Aakash Healthcare ‘the healthcare destination’ for all your health concerns.

Aakash Healthcare is furnished with 230 beds in 1st phase, 8 State of the art Operating Rooms, 70 bedded Medical and Surgical Critical Care unit, specialized dialysis unit, 24 hours Cardiac Emergency & Trauma Service.

The board of directors are Mr. J C Chaudhry, Mrs. Kamla Chaudhry and Dr. Aashish Chaudhry.

VISION

To become the most desired healthcare brand by providing compassionate, caring and world class services with the help of talented team of doctors, professionals and latest technology

MISSION

To achieve highest patient satisfaction index by delivering patient-centric, best healthcare services amongst the local and the extended community

VALUES

In the month of November 2011, Dr. Aashish Chaudhry envisioned a smart orthopaedic clinic for the people of Dwarka, New Delhi, which is Asia's biggest residential colony. The clinic thrived as a result of his ethical and transparent healthcare practices, and in present-day Dr. Chaudhry is a celebrated orthopaedic surgeon, having performed innumerable successful orthopaedic surgeries, giving agility and the ease of movement to the incapacitated.

Aakash Healthcare is a super specialty hospital, with state of the art infrastructure, path breaking technology, offering unrivalled healthcare services. Dr. Aashish Chaudhry, the founder and Director of Aakash Healthcare, aims to make Aakash Healthcare the most preferred healthcare brand by providing compassionate, inexpensive, and world class healthcare services, with a talented team of doctors, and ultra modern technology, ensuring speedy recovery.

Infrastructure Highlights

- 230 Beds in Phase 1.
- 70 Bedded Medical and Surgical Critical Care Unit.
- 24x7 Cardiac Emergency & Trauma Services.
- 15 Bedded Dialysis Unit.
- Advanced Neonatal ICU.
- Ward Bed Options - Suite, Deluxe, Twin Sharing and Economy.
- 8 Modular OTs.
- Flat Panel Cath Lab.
- State-of-the-art diagnostic equipments that include - 3.0 Tesla MRI, 128 slice CT scan, Flat panel C-Arm, and 4-D Ultrasound to name a few.
- Automated Waste & Laundry Management System for efficient waste management.
- Pneumatic Chute System.

Section 2

Dissertation Report

2.1 INTRODUCTION

To efficiently manage the hospital and healthcare system is the key function of all hospital managers. 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. Although logistics comprises of almost 90 per cent of a healthcare facility's operations, it is considered least important in the ‘list of procurements’ and end up procuring out-dated, obsolete and redundant options.

Traditional method used by the hospital for such spontaneous transports is Human Based Transport (HBT) viz. using Ward Boys / Orderlies, Patient's Attendants / Relatives.

There are several risks and problems that entail Human Based Transport logistics:

a) 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
b) During the physical carrying of tube samples, the carrier staff may suddenly trip-over and the samples/materials fall off and break - which means the entire exercise needs to be repeated right from drawing the sample at the origin again, again loosing critical life saving time; mixing up of samples and materials is also common in such conventional mechanism, that may cause grave consequences and confusion in the course of procedure for the treatment of the patient.
c) Theft: A universal problem, invariably theft is very common during transportation of drugs, instruments and other materials, etc.
d) 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.
e) 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-infections.

f) 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 that results in re-deputation of staff; over-hiring of staff, etc

g) 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. However small these problems and risks may seem - they form a critical part of factors adversely affecting a hospital's operations and basic important goal- Good Patient Care.

2.1.1 Pneumatic Transport System

Pneumatic Transport System (PTS): 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.

Pneumatic Chute

a) Pneumatic tubes (or capsule pipelines; also known as Pneumatic Tube Transport or PTT) are systems that propel cylindrical containers through networks of tubes by compressed air or by partial vacuum. They are used for transporting solid objects, as opposed to conventional pipelines, which transport fluids. Pneumatic tube networks gained acceptance in the late 19th and early 20th centuries for offices that needed to transport small, urgent packages (such as mail, paperwork, or money) over relatively short distances (within a building, or, at most within a city).

b) Pneumatic capsule transportation was invented by William Murdoch. It was considered little more than a novelty until the invention of the capsule in 1836. The Victorians were the first to use capsule pipelines to transmit telegrams, to nearby buildings from telegraph stations.

c) In 1854, Josiah Latimer Clark was issued a patent "for conveying letters or parcels between places by the pressure of air and vacuum." In 1853, he installed a 220-yard (200 m) pneumatic system between the London Stock Exchange in Threadneedle Street, London, and the offices of the Electric Telegraph Company in Lothbury. The system is known as 'Pneumatic Dispatch'.

Components of PTS

A. Blower: Large fans that move carriers through the tubes via vacuum and pressure. One or more three-phase blowers propel the carrier by means of compression or a vacuum created via a centrally controlled air switch. Self-adjusting Teflon gaskets in all system components guarantee airtight seals.

Figure 1: Blower

B. Three-Way Diverter: Three –way diverters are switching devices used at branching points within a tube network, allows carriers to travel between any two delivery stations. With a standardized offset, it transfers the carriers to the desired tube. The construction allows airtight, silent connection of the tubes.

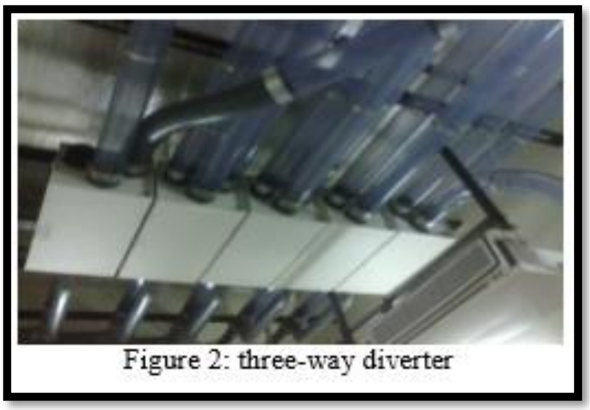

Figure 2: three-way diverter

C. Carriers: Carriers are reusable plastic containers that hold and protect items sent through a pneumatic tube system. Foam inserts can be placed inside a carrier for additional cushioning.

Figure 3: carrier PVC tubes

PVC tubes are available in 4” (inches) and 6” (inches) diameter and mounted inside ceilings and mechanical rooms. They form a network through which carriers travel at speeds up to 17 miles per hour.

E. Delivery stations: Delivery stations are positioned throughout the facility allowing personnel to send and receive carriers with the touch of a button.

F. Computer control centre: Computer control centre monitors all carrier traffic and calculates the fastest path for each transaction. To help manage traffic flow, systems are often divided into zones consisting of a few to a dozen stations each. Diverters and inter-zone tubes allow carriers to travel between zones.

2.1.2 Automated Waste and Laundry System

Hygiene, infection free and odour free spaces, for the safe, secure and healthy healing environment is necessary for hospitals and healthcare facilities. It is imperative for these facilities to ensure reduction and control of potential infection transmission & while ensuring this, the facilities must continue to operate efficiently. Automated Waste & Soiled Linen Tube Systems ensure to fulfil these requirements in hospital and healthcare spaces. AWLS Systems are PLC controlled dedicated, smart, efficient, clean and effective solution for transport of Waste and Soiled Linen bags automatically through steel tube networking a facility, to strategically located collection points.

Hospital waste and soiled linen streams increases the risk of infection, increases operational costs and make system inefficient. Improving infection control and cleanliness through sustainable operations and integrated waste management have moved to the forefront of issues facing hospitals as they seek to reduce adverse risk, improve patient safety and promote satisfaction.

Features & Advantages of AWLS:

- Effective
- Efficient
- Quick
- Safe & Secure
- Hygienic
- Full Automated & PLC Controlled
- Reduces Infection and Cross Contamination Risk
- Fully Automated Loading Stations with Double Door Mechanism
- Fully Automated Transports of the Bags to collection points

COMPONENTS OF AWLS SYSTEM

A. AWLS Loading Stations
   - Sliding Automated Pneumatic Controlled Front Door
   - Sliding Automated Pneumatic Controlled Rear Safety Door
   - LED Light indicators [for Busy, Free]
   - Contactless Access via RFID
   - Selector Switch
   - Integrated service access panel
   - Safety Mechanism built-in to prevent accidents or harm to users and Emergency Button

Figure 5: AWLS Loading Stations

B. Compressor Unit

Air compressor unit 2.2 Kw, 2001pm, 4 bar, 8ATM pressure; with nylon tubing and piping for compressed air circuit for operations of pneumatic elements viz Loading Stations, Air-valves, Diverters, Discharging Hoppers etc. with electric control panel, pressure gauge.

Figure 6: Compressor Unit

C. Diverters

For diversion of bags being transported in the tube network to pre- selected discharge hopper or collection points

Figure 7: Diverter

D. Discharge Hopper

Collection and Discharge Hopper with automatic pneumatic gates; Galvanised Steel construction with external square reinforcement, with collecting volume up to 60 Kg and optional acoustic and visual indicators when in operation for unloading the bags; with switch for manual opening, for access.

Figure 8: Discharge hopper

E. AWLS PLC Control Panel

Fully automated control panel, PLC Controlled software with easy and convenient touch screen functions with graphic visuals of the network, direct access to each device in the network for servicing and inspections, with maintenance, programming and alarms with direct cleaning function and many more features.

Figure 9: AWLS PLC Control Panel

F. Tube Network

Available in Galvanised Steel [GI] or Stainless Steel [SS]

Figure 10: Tube Network

G. Blower Units

Heavy duty high efficient fan blowers with silencer units, air-intake units, blower control electric panel, exhaust pipe, air filters, vibration dampers, High pressure and high flow blowers.

Figure 11: Blower Units

2.2 RATIONALE OF THE STUDY

Most of the total transport system within the hospital is spontaneous in nature. 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 infection risks and difficulties and consequently reduces the quality of patient care in the facility.

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.

Therefore, in order to know the cost and manpower benefit by installing PTS & AWLS in hospital over human based transport, this study was a must.

2.3 REVIEW OF LITERATURE

2.3.1 PNEUMATIC TRANSPORT SYSTEM

A. Current methods used by the hospital for such Spontaneous transports are Human Based Transport (HBT) viz. using Ward Boys / Orderlies, Patient's Attendants / Relatives. In one of the studies conducted at a 600 bedded hospital facility it is estimated that over 300 such runs are made every day; of which 75 per cent are to and fro laboratories/blood bank; 10 per cent to and fro pharmacy / stores and 15 per cent to and from administration / billing. Dumb Waiters & Elevators consumes high Energy and cause delays[1]

B. In a healthcare setting, a pneumatic tube delivery system allows for the fast, safe and reliable transport of pharmaceuticals, lab specimens, blood products and supplies throughout hospital clinical laboratories, pharmacies, emergency rooms, operating rooms, patient care areas and other locations much more quickly and safely than using a courier[3].

C. 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. The use of these systems is increasing because they can improve specimen turnaround time so patients and hospital staff can receive test results quicker. They also allow for more effective time management of messenger staff by reducing the need to physically take specimens from one department to another[4]

D. The pneumatic tube system decreased the median turnaround time 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[5]

E. Using the principle of parallel processing for sample analysis, coupled with installation of a computerized pneumatic tube specimen delivery system, improved turnaround time, a larger test menu, and 24-hour-a-day service from the central laboratory was provided.

F. The study was conducted in a large tertiary care hospital for a period of 3 months in implementing the Pneumatic transport systems (PTS), its utilization and effectiveness over the conventional method of transport systems[2]. Data was collected by direct observation and comparing with existing conventional human based transportation. Study on the existing System of Transportation and time taken for the Transports was started from Dec 2009. A 3-

month period Sample Transportation; Manpower Utilization and Time Taken were studied to put up the Proposal for Installation of the PTS in the hospital[6]

Pneumatic transport system (PTS) is a valuable alternative to conventional human dependant 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[6]

2.4.1 AUTOMATED WASTE AND LAUNDRY SYSTEM

A. The cycle of waste, recycling and soiled linen collection and transport in hospitals is a huge, never-ending operation. According to a 2010 survey from Practice Green health, U.S. hospitals reported generating nearly 34 pounds of waste per day, per staffed bed. When factored against the number of staffed hospital beds, that’s 5.9 million tons of waste per year. Soiled linen generated per patient bed per day accounts for another 2.6 million tons per year[7]
B. Today, most hospitals have insufficient resources to move dirty material off of the patient floors and out of the facility in a timely manner. Dirty material piles up in soiled rooms, hallways, at the bottom of gravity chutes and at the loading dock. Service elevators are used to carry dirty material down and clean material up. More troubling, staff, visitors and often patients use these same elevators continuously[7]
C. In addition to the cleanliness issues associated with the mixing of these functions, productivity and efficiency are compromised with longer elevator wait times for hospital staff. Finally, regulatory compliance may be impacted daily, resulting in life safety risks and possible fines[7]
D. Infection control issues: Beyond these operational challenges, there appears to be a potential infection control issue associated with the collection of soiled linen. A recent literature review performed by a bio-aerosol expert, concluded that “bed linens can harbour microbes, including potential pathogens” and that “microbes can be transported through the air and by touch during the routine handling and transport of soiled line[7]
E. Emerging infection control data taken from soiled rooms and at the bottom of chutes shows much higher exposure risk to potential airborne pathogens compared to other

hospital areas. When soiled linen is agitated as it is pushed onto and off of shared service elevators, the risk rises of cross-contamination with clean supplies, dietary and a vulnerable patient population. As demand climbs for improved infection control, cleanliness, efficiency and aesthetics in hospitals, the tightening of EVS staff resources is creating an unsustainable gap between expectations and reality[7]

F. An attractive solution for many healthcare facilities in design or under construction is the incorporation of pneumatic waste, recycling and soiled linen collection and transport systems as part of infrastructure. These facilities are moving beyond traditional manual methods of collecting and transporting waste and soiled linen. Challenges with manual methods include the need for a large number of carts, which consumes space on patient floors, in the halls and at the dock, as well as a heavy reliance upon elevators for vertical transport. Additionally, substantial square footage is dedicated to staging rooms on patient floors and unplanned intermediate holding areas hospital wide. All of these manual methods require substantially more labour and far greater collection and transport steps than necessary[9]

G. The automated solution features dedicated trash/recycling and soiled linen loading stations on patient floors and other areas of the hospital that generate waste. This simplifies and expedites the removal of waste and soiled linen from patient floors and to the dock[9]

H. The AWLS system is installed both vertically and horizontally with material diverted automatically toward waste or recycling collectors, or to linen collectors typically located near the loading dock area. Because the system is completely sealed, human exposure time to potentially infectious materials is typically reduced by more than 80 percent compared with manual methods that rely on chutes and elevators[9]

I. Implementing an automated waste removal system reduced the number of staff required to transport, stage, unload and manage waste and soiled linen. Facility design is more efficient, as gravity chute collection rooms are eliminated and the size of soiled holding rooms is reduced. Space is freed up by not having to handle and store numerous carts at the dock and/or in halls leading up to the dock[9]

J. Establishing separate dirty (waste, soiled linen) and clean (food, clean linens, patients) pathways supported infection control goals and reduced the risk of direct and indirect exposure of potential pathogens. Productivity improved as housekeeping staff spent less time transporting dirty material and more time on activities that improve the patient experience. Medical staff, patients and visitors spent less time waiting for elevators. The potential cost of noncompliance with regulatory bodies was eliminated by avoiding the mixing of soiled and clean items in shared space[9]

K. Aesthetic benefits include reduced odours from soiled holding rooms, gravity chute collection rooms and loading docks. These improvements are driven by cart moves and reduced exposure on patient floors and public areas. Beyond aesthetics, hospitals are finding there's an attractive payback with these systems, commonly in the 3-6 year range. Factors impacting the return on investment include:
    - Operational cost savings
    - Infection control/cleanliness
    - Increased productivity
    - Worker safety
    - Regulatory implications

Automated systems have all the characteristics of a best practice. Not only do they improve operational efficiency, but the systems help create a less congested, healthier healing environment for patients. Automated waste removal systems provide another opportunity for hospitals to ensure sustainability, improve efficiency and reduce costs[7]

2.5 METHODOLGY-

2.5.1 **Study Design** - Descriptive Study

2.5.2 **Study Area** - Aakash Healthcare Pvt. Ltd.

2.5.3 **Study Time Period** - 1st Feb - 30th April 2017 (3 months)

2.5.4 **Mode of Data Collection** – Secondary Data

- A self administered informal interview was conducted with the key informants of Aakash healthcare to gauge the reasons for gaps recognized in various different phases of the project. Key informants who were the source of information included-
  - Mr. Jaideep Narula- Vendor - PTS
  - Mr. Rajender Sharma- Sr. Manager – Engg. & Maintenance
  - Ms Anita Ryder- Head of department – Housekeeping
  - Ms. Sabita Subramanian – Head of department - Nursing
- The respondents gave a verbal consent.

2.6 GENERAL OBJECTIVE

To project the operational cost savings for a period of five years and hence analyze the cost and manpower benefit by effective utilization of PTS and AWLS when compared to Human Based Transport.

2.7 SPECIFIC OBJECTIVES

2.7.1 To calculate the capital cost involved in installation and commissioning of PTS and AWLS.

2.7.2 To calculate the operational cost involved in operating and maintenance of PTS and AWLS.

2.7.3 To calculate the operational cost involved in recruitment of manpower, their training and operating without PTS and AWLS.

2.7.4 To compare the cost and time involved in operating via PTS and AWLS v/s operating via manpower.

2.8 RESULTS

1. AUTOMATED TRANSPORT

1.1 Capital Expenditure (Capex)

Supply of PTS material				
S. No.	**Description**	**Qty**	**Unit Rate**	**Amount**
1	Central Control Unit	1	300,000	300,000
	Control Software	11		
	Supervision Software for graphic visualisation, log records	3	51,000	153,000
	Power pack	1	78,000	78,000
2	Stations NW			
	Top load station station, pass through type	15	165,000	2,475,000
3	Stations NW 160 mm			
	Bottom Load Compact Station	3	150,000	450,000
4	Stations NW			
	Front load station with touchscreen pad	3	275,000	825,000
5	Stations NW			
	Horizontal Lab receiving station	2	150,000	300,000
6	Diverter			
	3 way, air tight with touch free position and tube switches	4	125,000	500,000
7	Blower Unit	2	175,000	350,000
8	Air diverter	2	55,000	110,000
9	rubber dampers	2	900	1,800
10	Throttle flap	2	3,800	7,600
11	Flex tube blower silencer	4	2,000	8,000
12	PVC air filter	2	1,100	2,200
13	PVC sleeve	2	225	450
14	Hose clamp	20	225	4,500
15	Reducer	2	2,700	5,400
16	PVC elbow	4	1,000	4,000
17	Carrier damper	2	14,000	28,000
18	Zone transfer unit	1	199,864	199,864
	Tubing material			
19	160 mm	470	780	366,600
20	160 mm (for control room)	20	6,500	130,000
21	160 mm (for public areas)	40	16,000	640,000
22	160 mm	100	8,100	810,000
23	160 mm	8	16,000	128,000
24	160 mm	4	51,000	204,000
25	PVC glue	15	9,000	135,000
26	Cleaner for PVC tube	6	9,000	54,000
27	Control cable	700	500	350,000
28	tie strips	700	15	10,500
29	PVC connecting sleeves	350	500	175,000
30	Carrier damper	42	17,100	718,200
31	Tube clamps	100	300	30,000
32	Tube clips	250	200	50,000
33	Installation accessories	700	150	105,000
34	Carrier rack	21	600	12,600
35	Carrier receiving basket	18	2,000	36,000
36	Lab sample vaccutainer	10	1,000	10,000
37	Foam insert	10	3,000	30,000
	TOTAL			**9,797,714**
	Installation, fixing, testing, commissioning and training Charges			**399,000**
	GRAND TOTAL			**10,196,714**

Supply of AWLS material				
S. No.	**Description**	**Qty**	**Unit Rate**	**Amount**
1	AL NW400 Automatic DDS station			
	Double door double access station- one for laundry bag and one for waste bag	5	950,000	4,750,000
2	AL NW400 Automatic DDS station			
	Double door Single Access Station- for waste bag	3	500,000	1,500,000
3	Galvanised tube	80	8,000	640,000
4	galvanised Telescopic tube	70	69,000	4,830,000
5	Galvanised steel bend	25	60,000	1,500,000
6	Galvanised steel inspection hatch	2	42,000	84,000
7	Galvanised steel air intake tube	2	42,000	84,000
8	galvanised Steel Discharge hopper	2	1,400,000	2,800,000
9	Compressed air pressure set	2	1,200,000	2,400,000
10	blower set high pressure, high flow	2	1,800,000	3,600,000
11	control unit microprocessor with tuch screen and protection board with control software	1	7,812,000	7,812,000
	TOTAL			**30,000,000**
	Installation, fixing, testing, commissioning and training Charges			**300,000**
	GRAND TOTAL			**30,300,000**

Materials	**Year 1**		
Equipment	**Nos.**	**Unit Cost**	**Amount(Rs.)**
L - Trolley (S)	3	7,000	21,000
L - Trolley (L)	3	40,000	120,000
W - Trolley (S)	7	5,000	35,000
W - Trolley (M)	5	30,000	150,000
W - Trolley (L)	7	40,000	280,000
Hamper Bag	7	2,500	17,500
Year 2			
Equipment	**Nos.**	**Unit Cost**	**Amount(Rs.)**
L - Trolley (S)	0	7,000	0
L - Trolley (L)	0	40,000	0
W - Trolley (S)	0	5,000	0
W - Trolley (M)	0	30,000	0
W - Trolley (L)	0	40,000	0
Hamper Bag	10	2,500	25,000
Year 3			
Equipment	**Nos.**	**Unit Cost**	**Amount(Rs.)**
L - Trolley (S)	1	7,000	7,000
L - Trolley (L)	1	40,000	40,000
W - Trolley (S)	2	5,000	10,000
W - Trolley (M)	1	30,000	30,000
W - Trolley (L)	0	40,000	0
Hamper Bag	10	2,500	25,000

Year 4			
Equipment	**Nos.**	**Unit Cost**	**Amount**
L - Trolley (S)	0	7,000	0
L - Trolley (L)	0	40,000	0
W - Trolley (S)	0	5,000	0
W - Trolley (M)	0	30,000	0
W - Trolley (L)	0	40,000	0
Hamper Bag	10	2,500	25,000
Year 5			
Equipment	**Nos.**	**Unit Cost**	**Amount**
L - Trolley (S)	0	7,000	0
L - Trolley (L)	1	40,000	40,000
W - Trolley (S)	1	5,000	5,000
W - Trolley (M)	1	30,000	30,000
W - Trolley (L)	0	40,000	0
Hamper Bag	10	2,500	25,000

Table 1: Total capital expenditure in transport through PTS & AWLS

1.2 Operational Expenditure (Opex)

PTS	Years	Y1	Y2	Y3	Y4	Y5
	Annual Transaction load	7508	15083	17112	19140	21169
	Consumption/ Transaction	0.30	0.30	0.30	0.30	0.30
	Cost of Electricity	15	15	15	15	15
	Electricity	33,786	67,872	77,002	86,131	95,261
	CMC @ 3.5%	0	0	342920	342920	342920
	Annual Cost	41,310	82,970	437,049	448,207	459,365
	Depreciation (Life 15 yrs)	679,781	679,781	679,781	679,781	679,781

Table 2: Operational expenditure in transport via PTS

AWS	Years	Y1	Y2	Y3	Y4	Y5
	Annual Transaction load	4320	4320	5760	5760	5760
	Consumption/ Transaction	0.30	0.30	0.3	0.3	0.3
	Cost of Electricity	15	15	15	15	15
	Electricity	19,440	19,440	25,920	25,920	25,920
	CMC @ 3.5%	0	0	1060500	1060500	1060500
	Annual Cost	23,775	23,775	1,092,195	1,092,195	1,092,195
	Depreciation (Life 15 yrs)	2,020,000	2,020,000	2,020,000	2,020,000	2,020,000

Table 3: Operational expenditure in transport via AWS (Automated Waste Sytem)

ALS	Years	Y1	Y2	Y3	Y4	Y5
	Annual Transaction load	2160	2160	3600	3600	3600
	Electricity Consumed/ Transaction	0.30	0.3	0.3	0.3	0.3
	Cost of Electricity	15	15	15	15	15
	Annual Cost	9,720	9,720	16,200	16,200	16,200

Table 4: Operational expenditure in transport via ALS (Automated Laundry System)

Automation Opex	Years	Y1	Y2	Y3	Y4	Y5
	Annual Cost	74,805	116,466	1,545,444	1,556,602	1,567,761
	Manpower Cost	5,928,000	6,224,400	6,535,620	6,862,401	7,205,521
	Depreciation	2,699,781	2,699,781	2,699,781	2,699,781	2,699,781
	Consolidated Opex Cost	8,702,586	9,040,647	10,780,845	11,118,784	11,473,063
	Grand Total	51,116,000				

Table 5: Total Operational expenditure in transport via PTS & AWLS

2. MANUAL TRANSPORT

2.1 Capital Expenditure (Capex)

Year 1			
Equipment	Nos.	Unit Cost (Rs.)	Amount (Rs.)
L - Trolley (S)	25	7,000	175,000
L - Trolley (L)	15	40,000	600,000
W - Trolley (S)	80	5,000	400,000
W - Trolley (M)	30	30,000	900,000
W - Trolley (L)	50	40,000	2,000,000
Hamper Bag	40	2,500	100,000
Year 2			
Equipment	Nos.	Unit Cost (Rs.)	Amount (Rs.)
L - Trolley (S)	10	7,000	70,000
L - Trolley (L)	10	40,000	400,000
W - Trolley (S)	10	5,000	50,000
W - Trolley (M)	10	30,000	300,000
W - Trolley (L)	10	40,000	400,000
Hamper Bag	30	2,500	75,000

Year 3			
Equipment	**Nos.**	**Unit Cost (Rs.)**	**Amount (Rs.)**
L - Trolley (S)	10	7,000	70,000
L - Trolley (L)	5	40,000	200,000
W - Trolley (S)	10	5,000	50,000
W - Trolley (M)	5	30,000	150,000
W - Trolley (L)	5	40,000	200,000
Hamper Bag	50	2,500	125,000
Year 4			
Equipment	**Nos.**	**Unit Cost**	**Amount (Rs.)**
L - Trolley (S)	5	7,000	35,000
L - Trolley (L)	5	40,000	200,000
W - Trolley (S)	5	5,000	25,000
W - Trolley (M)	5	30,000	150,000
W - Trolley (L)	5	40,000	200,000
Hamper Bag	70	2,500	175,000
Year 5			
Equipment	**Nos.**	**Unit Cost**	**Amount (Rs.)**
L - Trolley (S)	10	7,000	70,000
L - Trolley (L)	10	40,000	400,000
W - Trolley (S)	10	5,000	50,000
W - Trolley (M)	10	30,000	300,000
W - Trolley (L)	10	40,000	400,000
Hamper Bag	70	2,500	175,000

Table 6: Total capital expenditure in transport through AWLS

2.2 Operational Expenditure (Opex)

Opex	Years	Y1	Y2	Y3	Y4	Y5
	Annual Transaction load	13988	21563	26472	28500	30529
	Electricity consumed between II Floors	1.5	1.5	1.5	1.5	1.5
	Cost of Per Unit Electricity	15	15	15	15	15
	Annual Cost	314,732	485,162	595,609	641,257	686,904
	Cost of Service lift	700,000	700,000	700,000	700,000	700,000
	Depreciation (Life 15 Yrs)	46,667	46,667	46,667	46,667	46,667
	Manpower Cost	11,544,000	12,121,200	12,727,260	13,363,623	14,031,804
	Consolidated Opex Cost	12,605,399	13,353,028	14,069,536	14,751,546	15,465,375
	Grand Total	70,244,884				
	Grand Total	70,245,000				

Table 7: Total Operational expenditure in transport via PTS & AWLS

Results		
S. No.	Description	Total Cost Rs. (Over next five years)
	Automated Transport	
	PTS	
	Capex	
1	Equipment and installation	10,196,714
	Opex	
2	Electricity	360,053
3	Depreciation	3,398,905
4	Maintenance	1,028,760
	AWLS	
	Capex	
5	Equipment and installation	30,300,000
6	Manpower	5,928,000
	Opex	
7	Electricity	184,680
8	Depreciation	10,100,000
9	Maintenance	3,181,500
10	Trolleys and bags	885,500
	Total	**65,564,111**
	Manual Transport	
	Capex	
11	Trolleys and bags	8,445,000
	Opex	
12	Manpower	11,544,000
13	Depreciaton of service lift	233,333
14	Electricity	2,723,664
	Total	**22,945,997**
	Cost benefit	**42,618,114**
	Percentage of cost saved over 5 years	**65.00%**

Table 8: Summary table

2.9 CONCLUSION

Pneumatic transport system (PTS) and Automated Waste and Laundry System (AWLS) is a valuable alternative to conventional human dependant transport. The study shows there is cost benefit of 65% i.e. 42,618,114 Rupees over next five years after installation. With increasing emphasis on effective utilization of resources available in order to cut operational cost in hospitals, it was important to carry out this study to analyze the cost benefit of Pneumatic transport over human based transport.

The capital expenditure includes equipment cost, installation cost and machinery cost whereas the operational expenditure includes electricity cost, manpower cost, equipment cost, maintenance cost and depreciation of equipment.

The operational costs for the automatic-pneumatic systems are less than those for the conventional-manual systems but the initial capital costs of the pneumatic systems is relatively high when compared to conventional systems (nearly 46,424,714 for the pneumatic systems vs. 8,445,000 for manual collection)

A PTS can promote rapid sample and medication delivery to remote parts of the hospital. Education of all users is essential to ensure that the tube system does not suffer downtime due to carelessness or lack of understanding.

2.10 LIMITATIONS

- The patient load and PTS, AWLS transaction load is based on assumptions because no real time data could be obtained.
- PTS and AWLS equipment and installation cost is approximate because the data was confidential.
- Time factor is not taken into consideration.

2.11 RECOMMENDATIONS

- Training: A critical aspect of utilizing a PTS to transport specimens is in-service training. All employees using the system must be knowledgeable about proper packaging procedures and system use. It is recommended that facilities distribute clear procedural information for proper use of their pneumatic tube systems and automated waste and laundry system. Training may be conducted during monthly nursing in-services, new employee orientations and other similar situations.
- In addition to training, simple procedure guidelines and relevant contact information should be located in each department describing effective system use and

recommended maintenance to ensure compliance with best practices for infection control.

- PTS to be made live on day zero and the end user must be well acquainted with the system. There should be zero manual transport of items intended to be transported via PTS.

2.11 REFERENCES

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2.12 Annexure

2.12.1 <u>PTS utilization report in FMRI, Gurgaon</u>

4th April, 2017

Hospital: FMRI, Gurgaon

Attendees: Dr. Charu Arora, Mr. Kanishak Gautam & Damini

Purpose: To get an overview of utilization of PTS across various departments of a hospital and understand challenges from end user's perspective.

Departments visited: IP Pharmacy, Emergency Triage, Laboratory, Blood Bank& Sample collection.

Observations:

- PTS has been installed and is operational in FMRI from the past 3 years.
- A total of 27 stations have been installed across FMRI and all of them were active.
- Both one way and two way stations are installed in the facility. While one way station sends, or receives the carrier, the two-way station is equipped to carry out both the activities.
- Utilization of PTS for transportation of Laboratory samples is done for Blood samples which are withdrawn in vacutainers. For other samples such as stool and urine, transportation is done manually.
- IP Pharmacy does not transport bulk medications for patient or sub store via PTS.
- PTS for drugs transport is utilized only in case of strips and sachets. To transport vials and other bulky medications, traditional manual transport techniques are utilized.
- Bulk and daily medications are transported manually while stat order and fewer drugs are transported via PTS.
- Vials are transported via PTS after ensuring proper packing in zip pouch or hand bag.
- At the point of generation of blood samples, like Emergency triage, Sample collection etc, PTS is extensively used for transportation.

Take home points:

- Gaps in utilization refer to the gaps while implementation training.
- Training is an ongoing process and interactions with users suggest that reinforcement training show an upward trend in PTS utilization.
- For samples such as Urine and stool, where risk of spillage or damage due to spillage is high, manual mode should be preferred with a set modus operandi.
- Inhibitions from the end users is also a key factor for underutilization of facility, training plays a key role in breaking this barrier.

Some snapshots of the visit are attached herewith:

Figure 12: Transporting Vacutainers via PTS

Figure 13: Operating Instructions

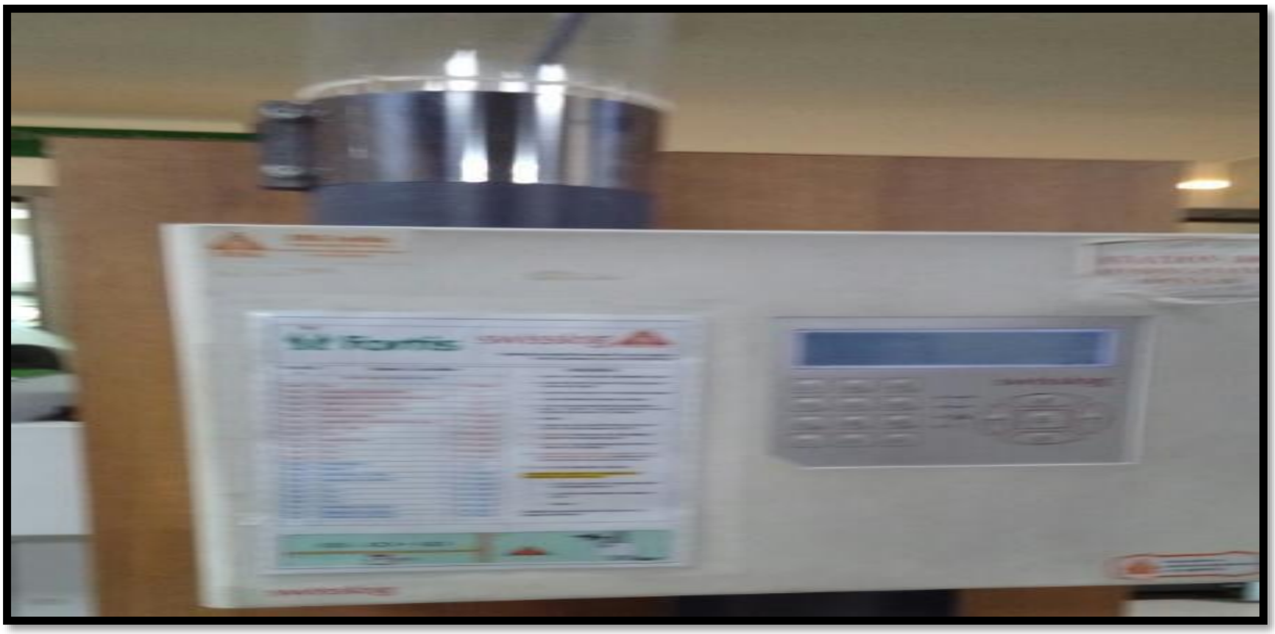

Figure 14: Address of all PTS Stations

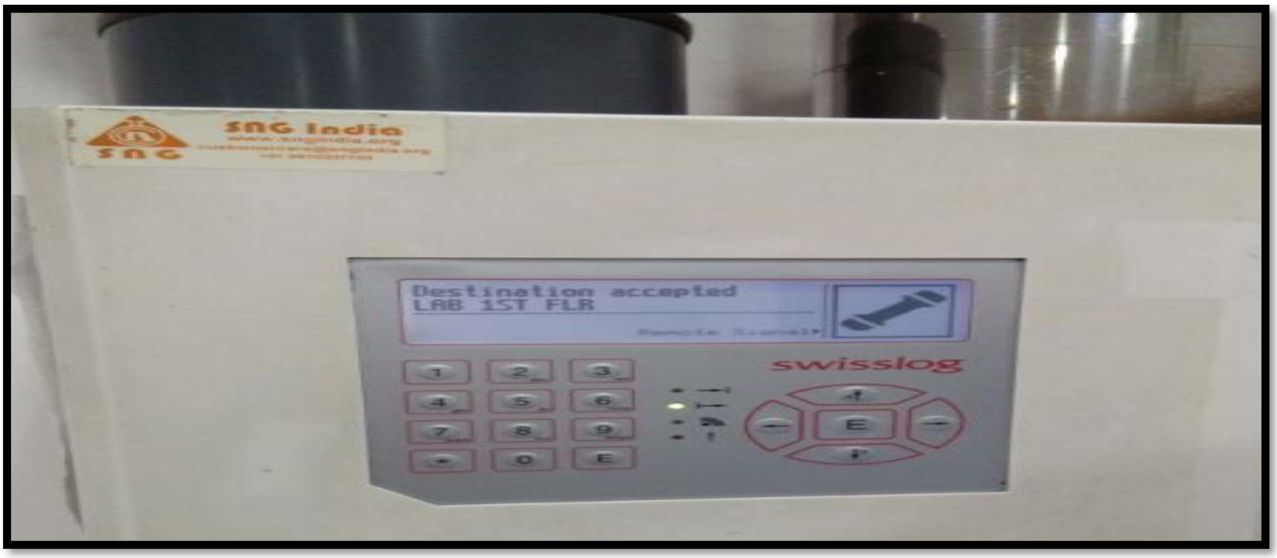

Figure 14: PTS station – Information/ Operation Panel

Recommendations:

- To effectively utilize PTS, training is a vital component both during induction and as an ongoing process.
- Alternate methods of transport have to be devised for items which can cause spillage or are bulky in nature.
- PTS to be made live on day zero and the end user must be well acquainted with the system. There should be zero manual transport of items intended to be transported via PTS.
- Training schedule to ensure adherence and reinforcement of PTS utilization must be drafted and followed without fail.

********************************END**********************************