ASSESSMENT OF MEDICAL GAS SYSTEM AT PARAS HOSPITAL

Internship Training
at
Paras Hospital, Gurgaon

By
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Under the guidance of
Dr. S.D. Gupta

MBA Hospital & Health Management
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Jaipur
2015

INSTITUTE OF HEALTH
MANAGEMENT RESEARCH
(WHO Collaborating Centre for District Health System Based on Primary Health Care)

IIHMR UNIVERSITY

TO WHOMSOEVER MAY CONCERN

This is to certify that Dr.Prashansa dubey student of MBA Hospital and Health Management from IIHMR University, Jaipur has undergone internship training at Paras Hospital.Gurgaon from 23rd February to 20th April 2015.

The Candidate has successfully carried out the study designated to him during internship training and his approach to the study has been sincere, scientific and analytical.
The Internship is in fulfillment of the course requirements.
I wish him all success in all his future endeavors.

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PARAS HOSPITALS
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PHPL/HR – Comm./2015/654 April 20, 2015

WHOMSOEVER IT MAY CONCERN

This is to certify that **Dr. Prashansa Dubey** has successfully completed her dissertation in the department of **Bio-Medical** from **23rd February, 2015** to **20th April, 2015.**

During her dissertation period, she was found to be sincere and dedicated towards her assignment.

We wish her all the best for her future endeavors.

For Paras Hospitals, Gurgaon

Vikas Chawla
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INSTITUTE OF HEALTH MANAGEMENT RESEARCH
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CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **'Asessment of medical gas system in Paras Hospital Gurgaon'** submitted by **Dr.Prashansa dubey** Enrollment No. 1478 under the supervision of Dr S.D.Gupta(President,IIHMR Jaipur) for award of MBA Hospital and Health Management of the university carried out during the period from 23rd February 2015 to 20th April 2015 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

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LIST OF ABBREVIATION

- COPD- Chronic obstructive pulmonary disease
- CMGS -Centralized medical gas system
- RLS-Reporting and learning system
- NSPA-National patient safely agency
- PMGS-Piped medical gas system
- ICC- Interstate Commerce Commission
- ICU-Intensive care unit
- NICU-neurology intensive care unit
- CCU-Cardiac care unit
- OT-Operation theatre
- OPD-Out patient department
- MICU-Medical intensive care unit
- DOT-Department of Transportation
- OD –Outside diameter
- GDA-General duty manager
- GM-General manager
- HOD-Head of department
- PMG-Piped medical gas
- AVSU-Area valve service unit

PROJECT

Assessment of the medical gas system at Paras hospital Gurgaon

ABSTRACT

Medical gases are the basic life support requirement of any modern secondary/ tertiary care hospital. The centralized medical gas system (CMGS) provides a support network that supplies- medical gases (Oxygen, nitrous oxide), vacuum (suction) and compressed air to the patients. It also includes less frequently used gases like nitrogen, helium, carbon dioxide and medical air.

This study includes the process flow; methods to supply the gases in the department, equipments used, number of outlet points, type and number of gas cylinders used, costing and gas consumption annually in Paras hospital and this study is observational and analysis of gas consumption is done through last two months data

The purpose of the study is to understand in detail about medical gas system in Paras hospital, analysis medical gas consumption of last two months and cost incurred in gas cylinders annually and to identify the issues related to it, and propose solutions which would help to increase the efficiency of the medical gas department and would also help in planning and designing of medical gas department in the upcoming hospital of Paras group.

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MEDICAL GASES

INTRODUCTION

Highly sophisticated life support network, which supplies medical air and oxygen for patient breathing, nitrous oxide for anaesthesia, medical air for driving orthopaedic tools and vacuum for suction.

Basic life support requirement of any modern secondary/ tertiary care hospital.

Gases administered to the patients are called medical gases.

Also called: PMGS -Piped Medical Gas system and Manifold room

The centralized medical gas system (CMGS) provides a support network that supplies-medical gases (Oxygen, nitrous oxide), vacuum (suction) and compressed air to the patients.

It also includes less frequently used gases like nitrogen, helium, carbon dioxide and medical air. Medical gas has been used in clinical practice for more than 200 years,these days oxygen is one of the most commonly used medicines in hospital environments, and is used across a range of healthcare specialties. In general, using oxygen is safe. However, there is a potential for serious harm if it is not administered and handled properly. The main safety concerns relate to underuse and overuse of oxygen:

- Underuse of oxygen is extremely dangerous as it exposes critically ill patients to the risk of hypoxic organ damage.
- Overuse of medical gases can also be harmful, especially for vulnerable patients such as premature infants and those patients with chronic obstructive pulmonary disease (COPD)
- Claims relate to equipment issues, relate to prescribing and monitoring problems and claims describe other risks (risks of fire, lack of trained staff, collision).

Medical gas has been used in clinical practice for more than 200 years but sometimes due to interruption or the delay of these gases can cause harm to the patient. Therefore it is very important to assess that the planning and designing of the hospital should be in such a way that the supply of these gases should be smooth and cost of the medical gas supply system to the hospital should be minimum and reduce its incidence.

RESEARCH QUESTION

Q .What is the present state medical gas system in Paras hospital and issues related to it?

Q. What is the approximate annual cost incurred in medical gas cylinders of Paras hospital?

AIM

To study in detail about the medical gas system, estimated cost incurred in gas cylinders yearly and to identify the various issues which causes interruption in the supply of these gases in Paras Hospital

OBJECTIVE

- To assess the medical gas system in Paras hospital
- To estimate the annual consumption of gas cylinders and cost incurred on the basis of data analysis of last two months.
- To identify the various issues which causes the interruption and delay in supply of gases
- To propose solutions which would increase the efficiency of medical gas system in Paras hospital

RATIONALE OF THE STUDY

To understand in detail about medical gas system in Paras hospital, analysis medical gas consumption of last two months and cost incurred in gas cylinders annually and to identify the issues related to it, and propose solutions which would help to increase the efficiency of the medical gas department and would also help in planning and designing of medical gas department in the upcoming hospital of Paras group.

REVIEW OF LITERATURE

- **Incident data from the Reporting and Learning System (RLS)**

The RLS was searched for serious incidents, which contain the words ‘oxygen’ or ‘O2’ in any of the free text fields. It was found that 281 serious incidents, reported to the NPSA between December 2004 and June 2009, relate to the inappropriate administration and management of medical gas. These included 32 serious incidents relating to neonates and children.

- **Data from the NHS Litigation Authority (NHS LA)**

A search of NHS LA reports was undertaken for claims which contain the words ‘oxygen’ or ‘02’ in any of the free text fields. 279 claims were identified and these were reviewed. It was found that 59 claims relate to oxygen related incidents in hospitals.

The claims were categorised using the same themes as above. It was found that most claims relate to administration problems (n=27); eleven claims relate to equipment issues, ten relate to prescribing and monitoring problems and eleven claims describe other risks (risks of fire, lack of trained staff, collision).

The underlying medical gas related incidents were similar to the themes reported to the RLS; however, a further risk identified was that patients were connected to nitrous oxide instead of oxygen.

- **Data from the Medicines and Healthcare products Regulatory Agency (MHRA)**

The MHRA receives approximately 30 to 40 reports a year relating to oxygen therapy in hospitals. The majority of these are user related, for example:

• Empty cylinders – almost always due to lack of pre-use checking and not because of cylinder valve failures;

• Misconnection of oxygen regulators onto air cylinders and air regulators onto oxygen cylinders;

• Damage to cylinders and regulators from being dropped

STUDY DESIGN AND METHODOLOGY

a. Type of study: Observational, quantitative, Study.

b. Area of study: Medical gas department

c. Study subjects: last 2 months data and Equipments

d. Study period :Feb 2015 to April 2015

e. Study variables: Total gas outlets, type and number of gas cylinders, machines, and amount of gas consumed.

f. Source of data
   Primary data: Observational.
   Secondary data: Published studies and research papers, Academics Publications, Journals

Medical gas systems in Paras Hospital Gurgaon:

Types of gases used in Paras hospital:-

- **Oxygen**-indicated for any patient where their injury or illness has caused hypoxemia, high flow oxygen is definitively indicated for use in resuscitation, major trauma, anaphylaxis, major haemorrhage, shock, active convulsions and hypothermia.
- **Nitrous oxide**: - Nitrous Oxide is supplied to various surgical suites for its anaesthetic functions during pre-operative procedures mixed with oxygen to help patients relax during dental procedures; and in cryosurgery (the use of extreme cold to destroy tissue).
- **Nitrogen**: - Nitrogen is typically used to power surgical equipment during various procedures.
- **Vacuum**- Patient Drainage, aspiration & suctioning.
- **Compressed air**- Medical Use includes Laboratory Work, powering of pneumatic drills in orthopaedic surgery, Dental Department.
- **Carbon dioxide** - Typically used to inflate or suspend tissues during surgery. Used to inflate areas of the body for "keyhole" surgery, mixed with air or oxygen to stimulate breathing; and in cryosurgery or testing tooth sensitivity in dentistry.

FUNCTIONS OF MEDICAL GAS DEPARTMENT IN PARAS HOSPITAL

1) Supply of right medical gases at right pressure

2) Supply of compressed air at right pressure

3) Supply of clinical vacuum at right pressure

4) Proper planned maintenance of all equipments, including distribution network

5) Optimum level of cleanliness and pollution free environment

6) Prevention of hazards such as fire, explosion or contamination of gases supplied

LOCATION AND DESIGN OF MEDICAL GAS DEPARTMENT

- Location- Basement
- Near maintenance area
- Separate enclosure for full cylinders, empty cylinders, compressed air, vacuum supply
- No fire hazard
- Liquid oxygen area is cordoned off
- Sufficient space – Vehicles can come into that area.

- Electrical devices located at or above 5ft.
- Oxygen & Nitrous Oxide stored separately from Flammable gases & Liquids.
- The area is free of combustible materials such as paper, plastic material, and cardboard.
- When quantity of gas stored exceeds 2,000 cubic feet, the storage area should ideally be outside the building therefore liquid oxygen tank is placed outside the hospital building.

PHYSICAL LAYOUT OF MEDICAL GAS SYSTEM IN PARAS HOSPITAL

Comprises of:

1. Bulk liquid systems, cylinder manifolds, medical air compressor, medical surgical vacuum producers, and equipment.

2. Pipeline distribution systems comprising of alarms, control boxes, line pressure gauges.

3. Point use delivery connections, panel support boxes, outlet points, pendants

4. Monitoring and control equipment for ensuring safety

KEY PARAMETERS OF MEDICAL GAS SYSTEM IN PARAS HOSPITAL-

- Line pressure alarm for continuous monitoring pipeline pressure.
- Gas specific colour-coding in each pipeline.
- Gas specific colour-coding on cylinder.
- Specific color coding on each outlet. .
- Cut off valves for O2 provided at prominent locations to isolate supply in case of emergency.

COLOR CODING IN PARAS HOSPITAL

Standard Name	**Standard colour**
Air	yellow
Carbon dioxide	Gray
Nitrogen	Black
Nitrous oxide	Blue
Oxygen	Green

COLOR CODING OF GAS CYLINDERS IN PARAS HOSPITAL

GAS	BODY COLOR	VALVE COLOR
Oxygen	Black	white
Nitrous Oxide	Navy blue	Blue
Medical air	Grey	White and black
Carbon dioxide	Grey	Grey
Nitrogen	Black	Black

MEDICAL GAS/VACCUM PIPELINE COLOR BAND IDENTIFICATION IN PARAS HOSPITAL

1. OXYGEN PIPE LINE

Base Colour - Canary Yellow

Band Colour- White

2. NITROUS OXIDE PIPE LINE

Base Colour - Canary Yellow

Band Colour- French Blue

3. MEDICAL AIR PIPELINE

Base Colour - Sky Blue

Band Colour- White & Black

4. MEDICAL VACUUM PIPELINE

Base Colour - Light Blue

Band Colour- Black

GASES SUPPLED TO VAROUS DEPARTMENTS THROUGH:-

- Gas cylinders
- Medical gas pipeline system
- Liquid oxygen tank

GAS CYLINDERS USED IN PARAS HOSPITAL:-

High pressure cylinders used to store and ship compressed or liquid medical gases

Constructed from:

1) Chrome molybdenum steel

2) High strength aluminium alloy

Gas cylinders regulated by:-

Department of Transportation (DOT)

Interstate Commerce Commission (ICC)

Type 3A – made from carbon steel is used Gas cylinders are kept in the manifold room and sent to the departments as per the requirement

FOUR TYPES OF GAS CYLINDERS ARE USED IN PARAS HOSPITAL:-

TYPE OF CYLINDERS	CAPACITY
D TYPE	14 Litres
B TYPE	6 Litres
A TYPE	4 Litres
AA TYPE	3 Litres

TYPE AND NUMBER OF CYLINDERS USED DEPARTMENTWISE IN PARAS HOSPITAL

	D type	B type	A type	AA type
oxygen	9-Manifold room	1-Dialysis 3-emergency 2-surgical ICU 2-MICU 2-NICU 2-CCU 1-CTVS 1-Recovery 5-OT 1-Cath lab 1-Neuro OPD 1-Cardiac OPD 3-Labour room 2-(3^{rd} C counter) 2-(3^{rd} B counter) 2-(4^{th} A counter) 2-(4^{th} B counter) 1-(4^{th} C counter) 9-Manifold room	Total -8 Used in anaesthetic machine mainly in OT, emergency	5-Emergency 2-OT
Nitrous oxide	9-manifold room	7-OT 1-modular OT 3-manifold room	Total-8 used in anaesthetic machine mainly in emergency, OT	
Carbon dioxide		4-OT		
Nitrogen	3-manifold 3-in OT			

CENTRALISED MEDICAL GAS SYSTEM

Advantages:-

For the patients

- No distressing sight of oxygen cylinders at the bedside
- Elimination of irritating noise from movement of cylinders
- Protection of contamination due to movement of cylinders ,Uninterrupted and clean supply at desired location

For Hospital Staff

- Instant availability of gas on taps
- Clean, safe and reliable delivery of gases
- Continuous flow of gases when and where required
- Minimal accident hazards due to mishandling of cylinders

For Hospital Administrator

- Easy purchase of gases in bulk quantities at favourable terms
- Economy on purchase of cylinders
- Fewer breakages
- Rationalization in ordering, storing and transporting a wide variety and size of gas cylinders
- Minimum damage to building due to handling of cylinders.

LIQUID OXYGEN TANK

Company name- BOC

Located outside the hospital building

- Contains 6000 litres of oxygen

Major components

1) Insulated reservoir

-183 Celsius

2) Vaporizer/tubing

- Warms liquid O2

3) Pressure reducing valve

- 50 psi for hospitals

4) Pressure release valve

BOC refill the oxygen tank as per the requirement.

Tank refill done usually in the night time.

- Delivers higher O2 content: 1L liquid O2 delivers 850 L of gaseous oxygen.
- More efficient method of storage of oxygen.
- Economical for >200 bedded Hospital
- Saves on transport of cylinders and associated problems.
- Saves on space occupied by manifold cylinders
- These gases are transferred through medical gas pipeline system
- Colour coding is given as per the standard to identify the gas
- Gases are delivered to the patient at a particular pressure usually 4.5 kg cubic m
- Control panels are attached to the wall and pipelines and with the help of gauges the pressure and also the amount of gas left in the cylinder can be checked
- Alarm System and Emergency valves are given in each departments and manifold room to stop the supply of the gas in case of high and low pressure

ABOUT MANIFOLD ROOM OF PARAS HOSPITAL

- Cylinders are outsourced by company named A synergy and hospital manifold room is managed by their company person

- One technician in day shift (8 am to 8 pm), One technician in night shift (8pm to 8am)

- Reading is taken by them 4 times a day (8am, 2pm, 8pm, and 2am) And consumption is noted down in register.

- This way records are maintained in the department and monthly consumption report is send to the HOD by the company person/technician in excel file.

- Cylinders are sent to the departments as per their requirement

- Refill of the cylinder is done as soon as the cylinder is empty.

- Company person/technician (PMP) calls the company and get the cylinder refilled by them

- Daily rounds are taken by manifold room in charge to see that the gases are transferred smoothly to the patient or to check and note down the complaint if there is any problem and rectify it.

- There are two banks BANK 1 and BANK 2 of oxygen in the manifold room which is used in emergency

FIG 1.1 PROCESS FLOW OF MEDICAL GAS DEPARTMENT IN PARAS HOSPITAL

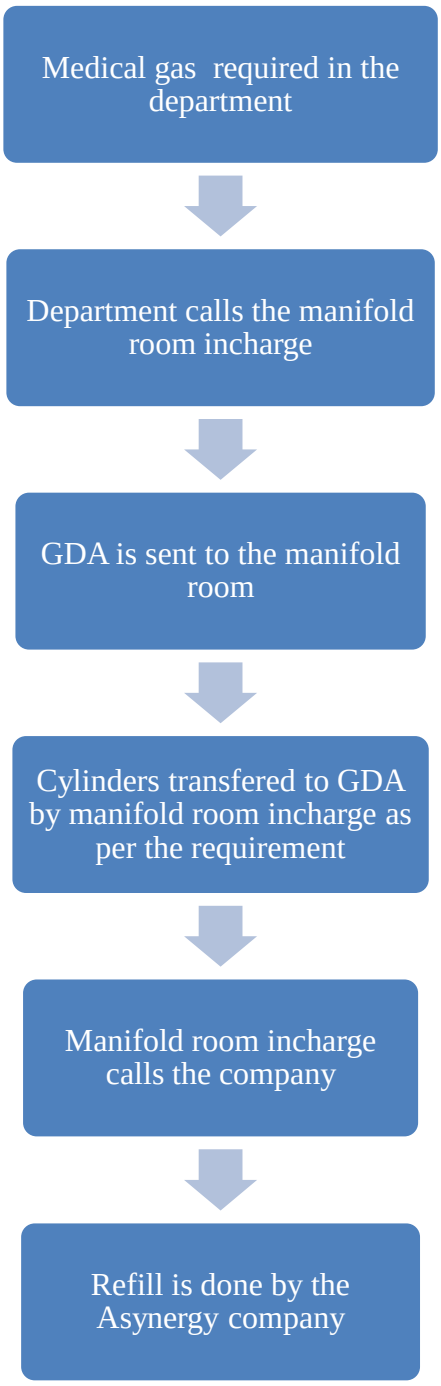
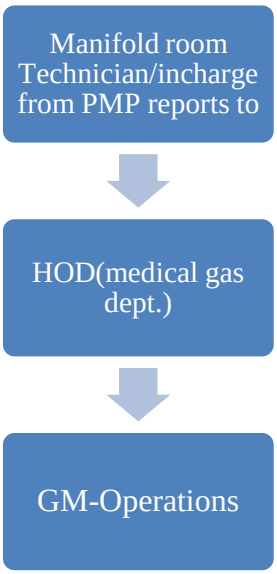


FIG-1.2 ORGANOGRAM OF MEDICAL GAS DEPARTMENT IN PARAS HOSPITAL



EQUIPMENTS AND DISTRIBUTION SYSTEM IN PARAS HOSPITAL

Company name-PMG

- Pipes are made of Copper
- Oxygen pipes -- ½ inch OD (outside diameter)
- Other Gases -- ¾ inch OD
- Name and direction of flow of gas displayed by Board.
- Instrument Air, Nitrogen - @ 160 psi
- Other Gases @ 55 psi
- Kept visible not embedded in walls
- Seamless type, non-ferrous, non arsenic, of high quality copper tubing
- Protected against physical damage and corrosion
- Exposed oxygen pipelines are not installed in areas like kitchen, laundry and rooms where combustible materials are stored
- Colour coded as per the gas content
- All pipes, tubes and fitting cleaned thoroughly and washed with tetrachloride
- Pipes blown clear using oil-free air or nitrogen
- When whole system is in place, it is subjected to a test pressure of 150 psi or 1 ½ times the working pressure for 24 hours to check, if it can withstand the pressure as well as leakages
- This test, called pressure lock is done section by section

COMPRESSORS

There are 3 Oil free compressors in the department

Air Compressors 1 and 2(10HP)-company KIRLOSKAR

Air Compressor 3 (15HP)-company ANEST IVVATA

If one compressor on running mode, others on standby mode

Records are maintained separately on compressor register

Function-An air compressor is a device that converts power (usually from an electric motor, a diesel engine or a gasoline engine) into potential energy by forcing air into a smaller volume and thus increasing its pressure.

Infrastructure consists of:

- A compressor with electric motor
- Shut off valves on tank outlets
- Valves on drains
- Pressure gauges
- Safety valves, Check valves
- Pressure switches
- Inlet filter mufflers
- After cooler
- Air receiver and
- Air dryer-absorbs moisture before delivering in the pipeline
- Automatic electrical controls OIL FREE COMPRESSOR
- Delivered at 4 bar or 7 bar.
- Supplied from cylinders on the anaesthesia machine/ventilators OR from central manifold.
- Piped supply system for patient use
- Compressed air is provided by 2 air compressors in 1+1 backup system.
- Compressors are oil free.
- No moisture, no bacterial contamination.
- Uses: Ventilators (4 bar)

- Surgical Tools (7 bar)
- NOTE: Oil filters, dust filters, moisture separator and the dryer at the equipment level should be there to provide air free of dust and moisture for:
- Medical-surgical purposes
- To prevent damage to equipments and
- To prevent contamination of chemical, foods and drugs.

AIR RECEIVER

2 Air receivers in the department

Company name-GRAVITAS

Capacity - 1000 and 500 litres.

Function-

- The receiver tank acts as a reservoir of compressed air for peak demands.
- The receiver tank will help remove water from the system by allowing the air a chance to cool.

AIR DRYER

2 Air dryer in the department

Company name- 1.Gravitas

2. Trident

Function- is a device for removing water vapour from compressed air, Excessive water in compressed air, in either the liquid or vapour phase, can cause a variety of operational problems for users of compressed air.

These include freezing of outdoor air lines, corrosion in piping and equipment, malfunctioning of pneumatic process control instruments, fouling of processes and products, and more

VACCUM (SUCTION)

2 vacuum pumps-capacity 1000 and 2000 litres

Company name- Ingersoll Rand

- Used in Surgeries, ICU and recovery
- Central vacuum consists two vacuum pumps that operate either simultaneously or alternately

- Each pump is capable of maintaining 75% of calculated demand during peak time
- The pumps alternate automatically
- uses to provide reliable and continuous suction in various departments

- Pumps equipped with a motor starting device and overload protection
- Failure of one vacuum not affect the other

DISTRIBUTION SYSTEM OF MEDICAL GASES

- Consist of pipelines, pipeline fitting and valves.
- Solid drawn, seamless, deoxidized, non arsenical, half hard and degreased copper pipes are used.
- All piping identified by painting and tagging.
- Branch lines are provided with stop valves to enable them to be isolated from main system for repairs.
- Piping not installed in kitchens or electrical switchgear rooms.
- Correct size piping is one of the most important aspects. Undersized pipes may not give adequate pressure while oversized pipes will increase cost.
- Material (Pipe): The piped distribution system use copper pipes manufactured from phosphorous de-oxidised non-arsenical copper, seamless, half hard, and tempered to comply with standards. Pipes are degreased suitable for oxygen use.

INSTALLATION OF MGPS

Company name-PMG

- Short pipeline run which is most economical.
- Half hard Copper pipe.
- All pipes installed either vertically or horizontally
- The pipelines are surface-mounted on walls at a height not less than 2.13 meters (7ft.) Supported suitably at periodic intervals
- As far as possible - open installation
- Isolation of different areas should be possible
- Each pipeline identified by colour coded bands painted at periodic intervals

PRESSURE RELIEF VALVE

- Pressure relief valves are installed downstream of all pressure regulators
- Valves set at no more than 50% above the pressure regulator setting.
- **Function**: Fully relieving the pressure at the set point in case failure of regulator.
- All pressure relief valves have piping connections to allow release of to outside facility.

AREA VALVE SERVICE UNIT

FEATURES

Reliable and easy to operate.

Easy site installation with pre-fitted stub pipes.

Break Glass' access to isolation valve as standard. .

Optional pull out plastic window on AVSU.

MANUAL SHUTOFF VALVES:

Installed in openable windows

Visible – accessible at all times

Open – each valve is labelled with details of the gas flowing.

SERVICE SHUT OFF VALVES:

Closed Under Lock & Key

To Be Opened On Occasions by authorised personnel.

Every Person Related Should Know the Locations of All Types of Valves

LOCATION OF VALVES

MANUAL SHUTOFF VALVES:

Ideal location is outside anaesthetic room – in cases of Fire, personnel can run out of the room, and shutoff the supply – so ideal location is outside the Operation Theatre.

And the other Location is- Main Source Supply to shut off as and when required the complete source.

Each riser line adjacent to the connection to the main supply line.

Those supplying, Operation Theatre, ICCU, ICU.

SERVICE SHUT OFF VALVES: Each branch or lateral line should have Service Shutoff Valve except, ICUS, Cath lab, CTVS, OT.

ALARM SYSTEM

- Introduced at judicious points in different zones of pipeline network.
- Microprocessor based.
- Monitors pressure of gases and generate audio visual alarm in case of abnormal pressures.
- Location should not affect the patients.

MASTER ALARM SYSTEM:

Signal panels located in two places

1) Maintenance personnel

2) Security office

- Telephone switchboard – has connections with other alarm systems
  Monitors entire central supply and distribution system.

AREA ALARM SYSTEM:

- Located in PICU, ICUS, OT -- beeps when the pressure inside the System drops to 20 %.
- In OTs, the location will be upstream of the shutoff valves.
- In other areas placed downstream of the shutoff valve.
- Sometimes alarms are placed to each OT
- Monthly MOCK-DRILL is performed.
- It is connected to main alarm systems.

LOCAL ALARM SYSTEM

TO MONITOR the functions of:

Central Medical gas + Instrument air

Scavenging System

Vacuum System

Sometimes Systems can be separate or Connected to Central System

AUTOMATIC CONTROL PANEL- to check the pressure by which gases are transferred within the pipeline and also to check how much gas is left within the cylinder.

HEAD WALL PANELS

- Provide a pre-wired and pre-piped system.
- Designed to eliminate expensive on-site work for providing gas, electrical & instrument utilities on a single unit.
- Ensures engineering safety by isolating electrical conduits, instrumentation lines and pipe work.

TERMINAL UNITS

- Bed head panels: height- 123 cm
- Provided for dispensing gases in wards and patient care areas.
- Also houses nurse call system, flow meters, infusion pumps.
- Wall outlets
- Running panels along the walls.
- Similar to bed head panels

PENDANTS

- Used in OT
- Type - Retractable ceiling column ,motor driven ceiling column
  Ceiling type outlet, reel type outlet
- Increase efficiency by keeping medical gas hoses and electrical cables clear of the floor area and provide integration with other products.

HOSES

- Colour specific hoses
- Should not touch ground to prevent wear and tear.
- Strong and robust

SECONDARY EQUIPPMENTS

HUMIDIFIER-Humidifiers treat dry air by releasing moisture, making it easier to breathe and soothing your dry throat and nose.

WALL SUCTION UNIT-

ACCESSORIES

Gas regulators -High pressure regulator for use with medical gas cylinders equipped with a medical cylinder valve

Carts: - use for loading and unloading the gas cylinders and to transfer it to various departments as per the requirement.

TOTAL GAS OUTLET POINTS DEPARTMENTWISE IN PARAS HOSPITAL:-

Department	oxygen	Vaccum	Air	Nitrous oxide
Emergency	8	8	8	
Minor OT	1	1	1	
Daycare	4	2	4	
Endoscopy	2	2	2	
Dialysis	5	5	5	
Cardiac OPD	1	1		
Neuro OPD	1	1		
Medical ICU	20	13	13	
Surgical ICU	10	8	8	
Neuro ICU	9	7	7	
Cardiac ICU	23	14	14	
CTVS	10	10	5	
PACU	6	6	6	
CATH LAB	4	2	2	
OT 1	2	1	2	1
OT 2	2	1	2	1
OT 3	2	1	2	1
OT 4	2	1	2	1
OT 5	3	3	2	2
OT 6	3	3	2	2
OT 7	4	4	2	2
PICU	10	10	1	
Neonatal ICU 1	11	8	8	

Neonatal ICU 2	6	4	4	
Recovery room	3	3	3	
Labour OT 1	2	2	2	1
Labour OT 2	2	2	1	1
Room no 301 to 309,348 to 366,370 to 372,,314,135(single bed)	29	29		
Birthing suite 1& 2	2	2		
Room no.310 to 313(4 bedded)	8	8		
Room no.364 to 369	6	6		
Room no.414 to 427,402 to 409,434 to 443,455(single bed)	33	33		
Room no.444 (general ward)	8	8	8	
CTVS	26	26	13	
Room no 431 to 433,445 to 454	13	13		
Room no.410 to 413(4 bedded)	8	8		
Total	263	256	132	12

METHODOLOGY

Type of study-

Quantitative, Analytical study

Study subjects-

Last 2 months data obtained from the record maintained in the medical gas department

Last two months data:-

Occupancy rate in the month of January in Paras hospital =56.08%

Liquid oxygen consumption in the month of January=11450

Total no. of cylinders consumed in the month of January

Cylinder	D type	B type	A type	AAtype
Oxygen	3	124		13
Nitrous oxide	11		1	
Carbon dioxide		4	1	
Nitrogen	11			

Occupancy rate in the month of February =62.1%

Liquid oxygen consumption in the month of February=11450

Total no. of cylinders consumed in the month of February

Cylinder	D type	B type	A type	AA type
Oxygen	8	165	2	29
Nitrous oxide	13		1	
Carbon dioxide		4	1	
Nitrogen	12			

DATA ANALYSIS:-

Fig-1.3 Showing the occupancy rate in the month of January and February

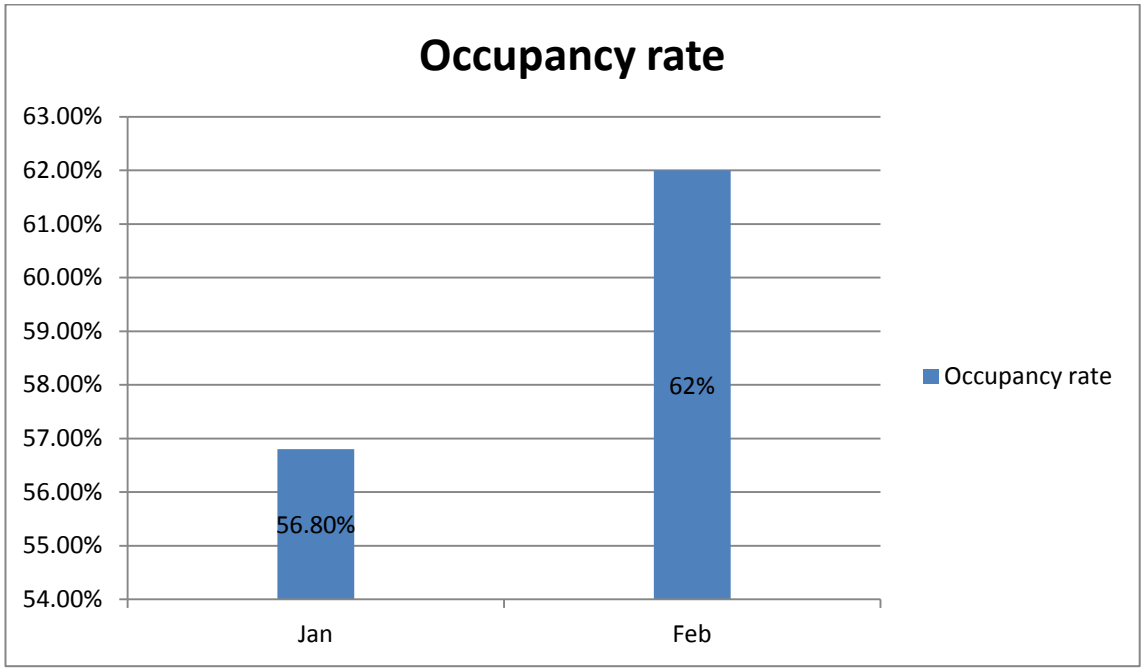
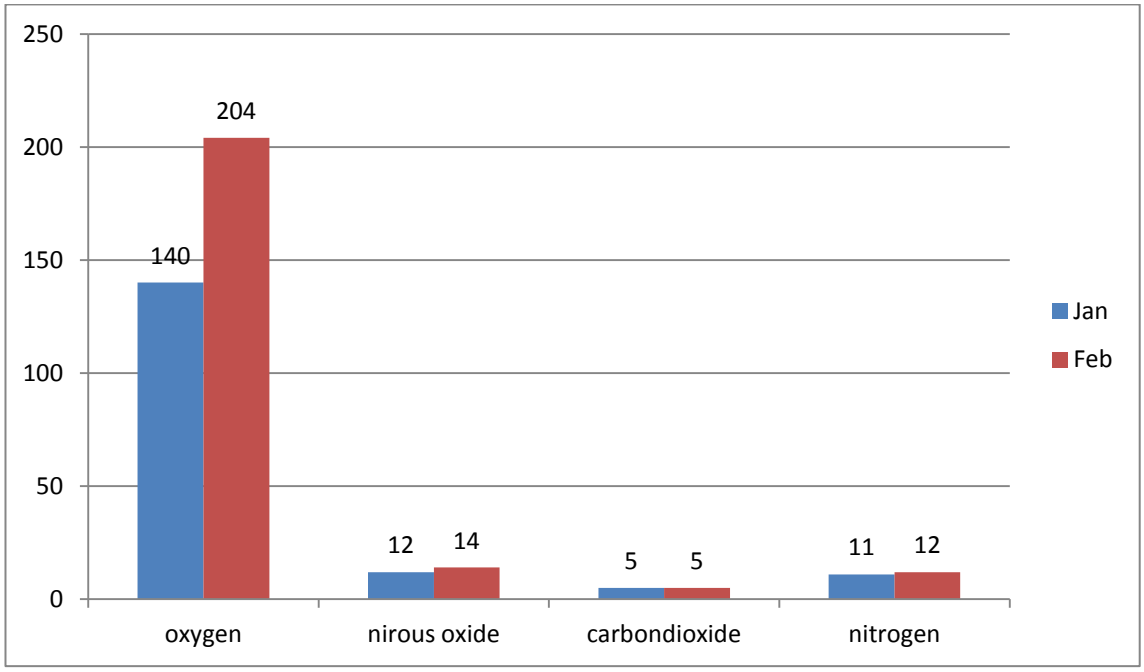


Fig 1.4 shows the total no. of cylinders used in the month of January and February



On the basis of last 2 months data, average consumption of different gas cylinders when occupancy rate on an average is 59% is as below

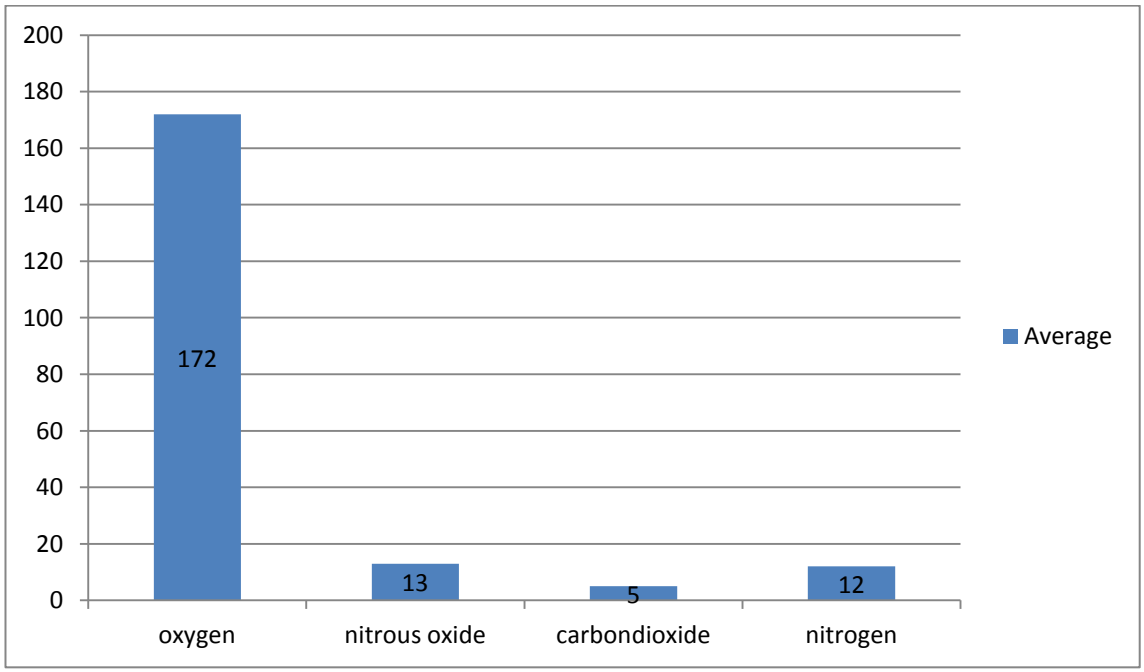


Fig 1.5 shows the average number of gas cylinders used in a month in Paras hospital

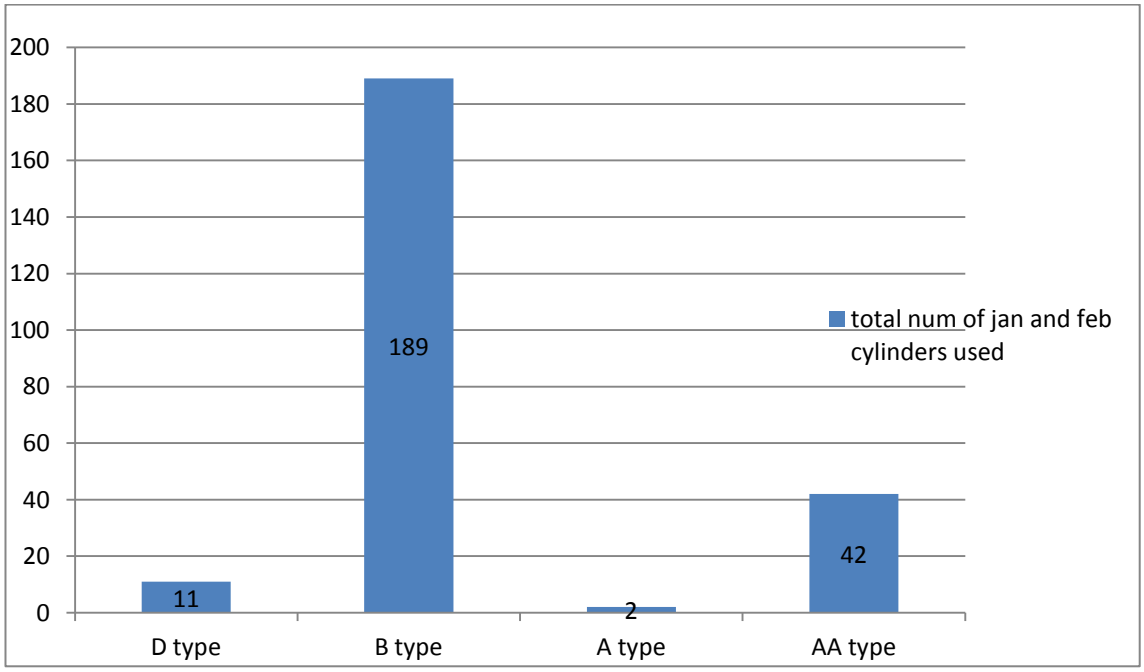


Fig 1.6 shows the number of type of oxygen cylinders used in the month of Jan and Feb (combined)

Fig-1.7shows type of total number of nitrous oxide cylinders used in the month of January and February

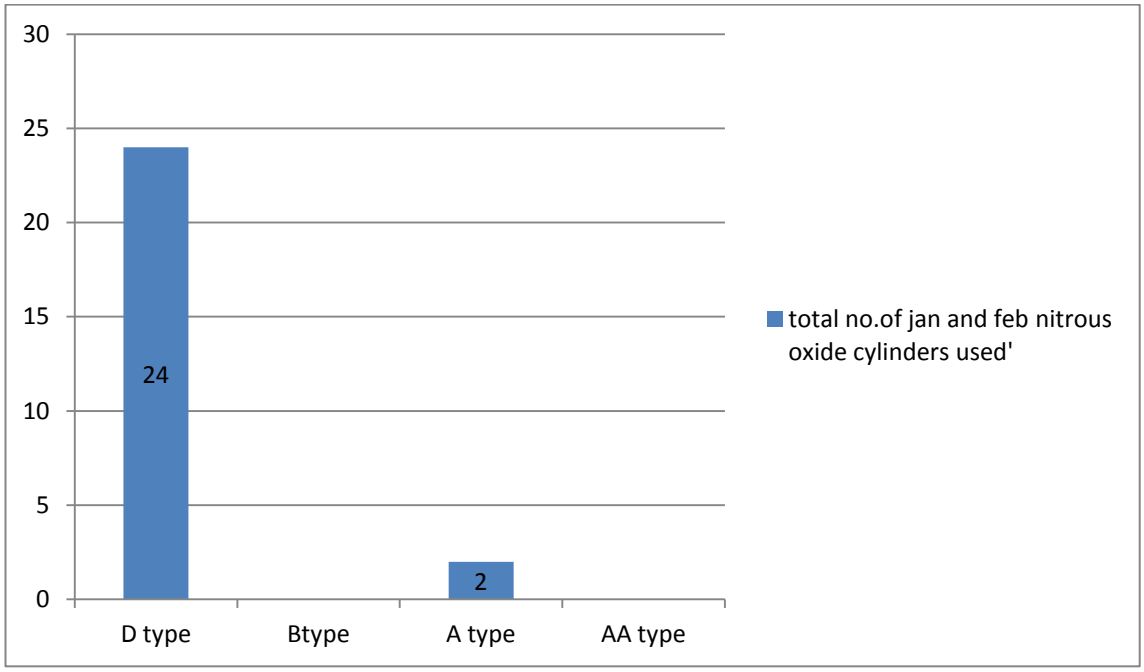


Fig 1.8- shows type of total number of carbon dioxide cylinders used in the month of January and February

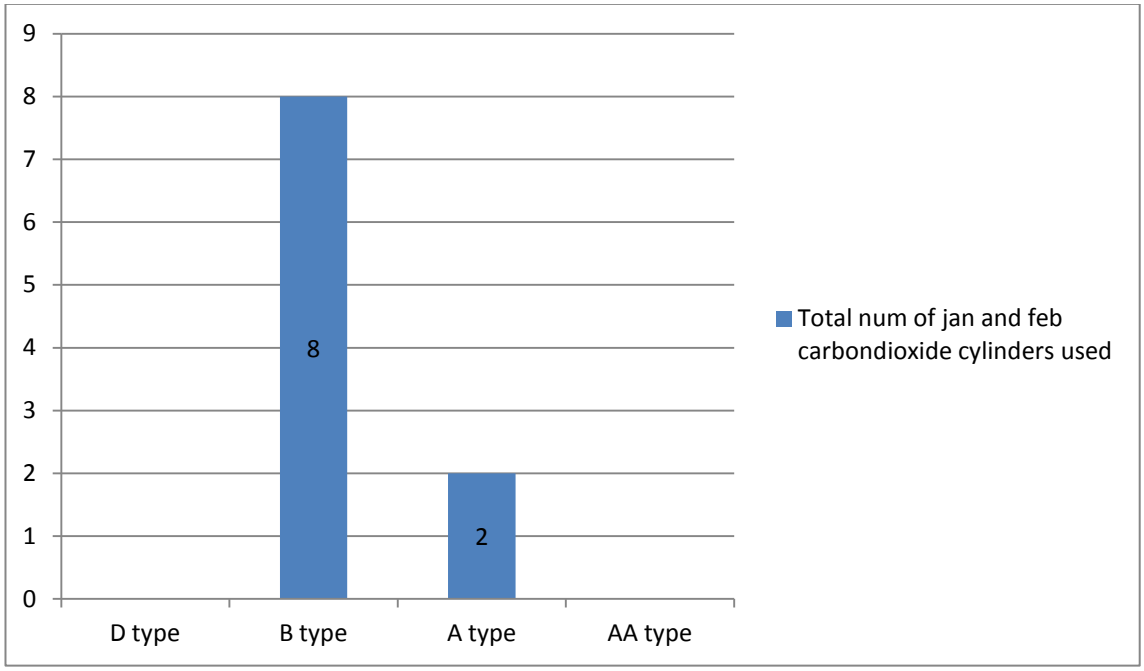
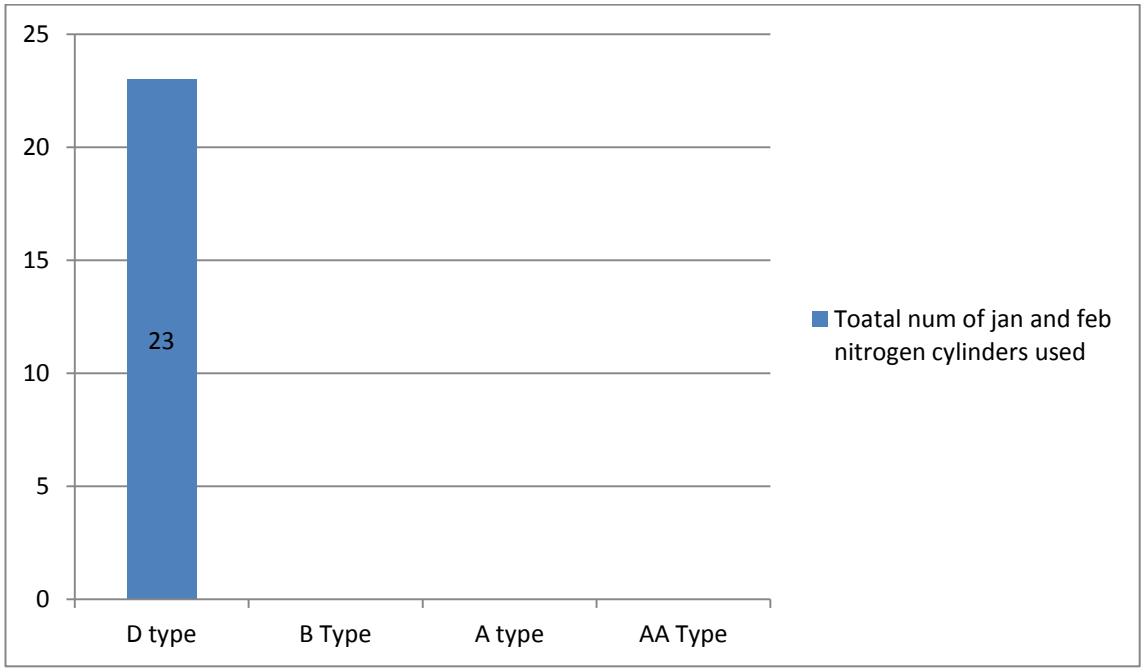


Fig 1.9- shows type of total number of nitrogen cylinders used in the month of Jan and Feb.



The average occupancy rate of Paras Hospitals is 59%, hence approximate numbers of gas cylinders and liquid gas consumed in a year are:

Oxygen cylinders: 172*12=2064 (D=93, B=1599, A=17 and AA=355)

Nitrous oxide cylinders: 13*12=156(D=144 and A=12)

Carbon dioxide cylinders: 5*12=60 (B=48 and A=12)

Nitrogen cylinders: 12*12=144 (D=144)

Liquid oxygen gas: 11450*12=137400

COST OF CYLINDERS (monthly)

CYLINDERS	D TYPE	B TYPE	A TYPE	AA TYPE
OXYGEN	Rs 149	Rs 85	Rs 72	Rs 72
NITTROUS OXIDE	Rs 3025		Rs 385	
CARBONDIOXIDE		Rs468	Rs 275	
NITROGEN	Rs 418			

DATA INTERPRETATION

Cost incurred in different types of gas cylinders annually are:-

Oxygen cylinders-D type 93*149=Rs 13857

B type 1599*85=Rs 135915

A type 17*72= Rs 1224

AA type 355*72=Rs 25560

Nitrous oxide cylinders-D type 144*3025=Rs 435600

A type 12*385=Rs 4678

Carbon dioxide cylinders-B type 48*468=Rs 22464

A type 12*275=Rs 3300

Nitrogen cylinders-D type=D type 144*418=Rs 60192

- In fig 1.3, fig 1.4, fig1.5, fig1.6, fig 1.7, fig 1.8, fig 1.9 we can clearly see as the occupancy rate increases the consumption of these gases also increases.
- Consumption of oxygen gas is highest among all.
- Oxygen B type cylinders demand is more compare to other type of cylinder.

ISSUES

Source of data-Observational, last 2 months data from complaint register maintained

- Suction not working
- cylinder regulator not working
- leakage
- Humidifier bottle cap broken
- Oxygen cylinder gauge not working
- Malfunctioning flow meters
- Damaged valve
- Pressure problems – less or more
- Alarm problems

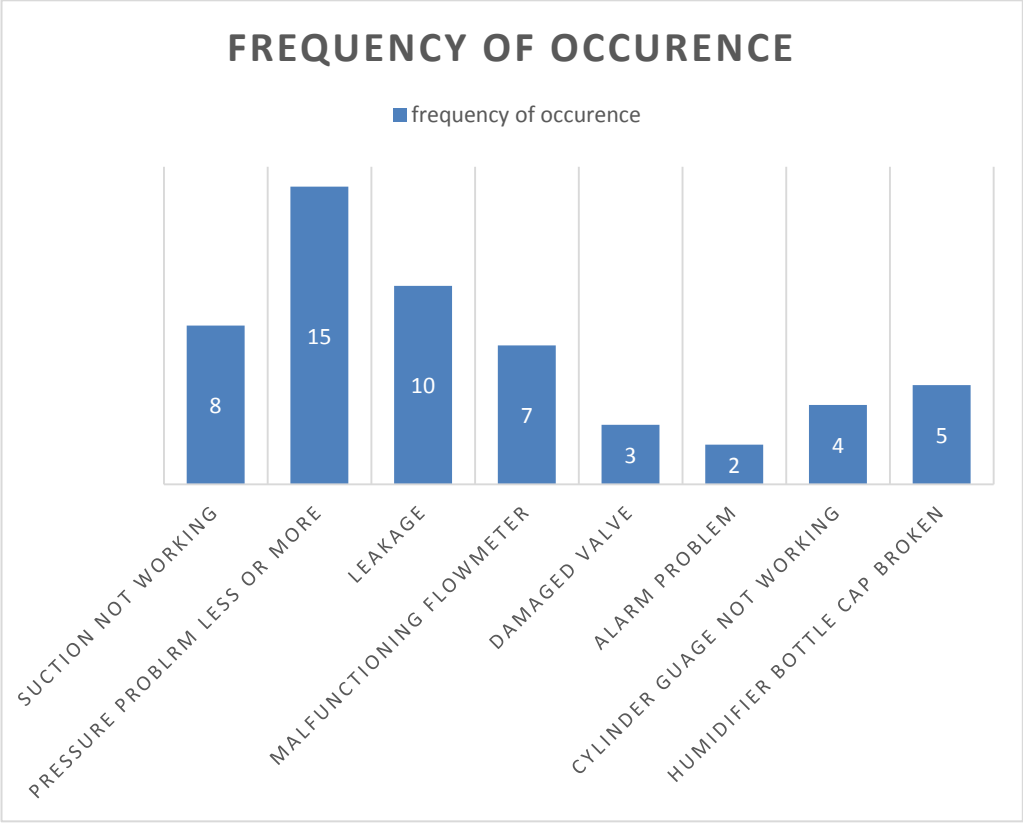


Fig 1.8 shows the common issues of the medical gas department

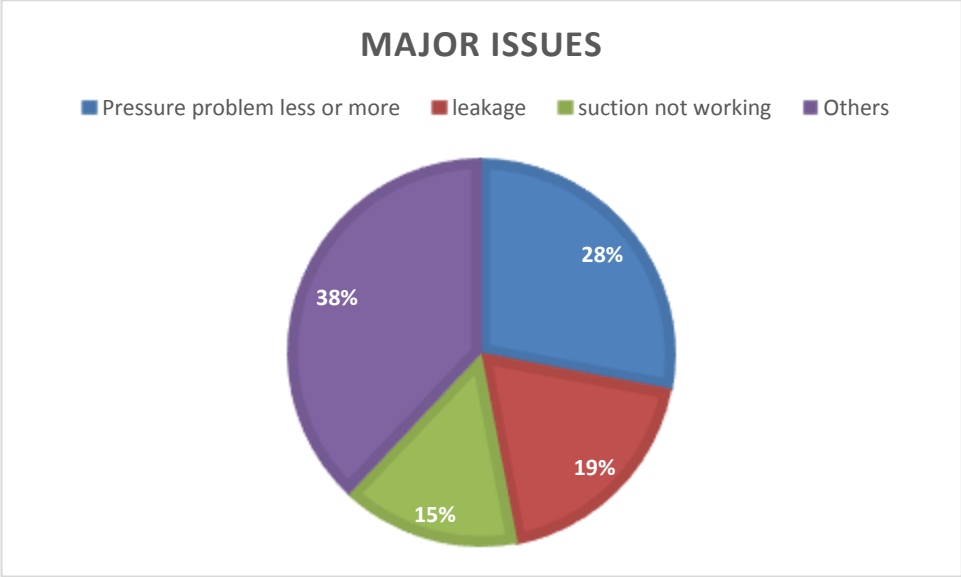


Fig 1.11 shows the major issues of the medical gas department

MAJOR ISSUES

PRESSURE PROBLEMS-LESS OR MORE

- Inadequate pressure is most frequently reported malfunction
- Anaesthesia ventilators require a minimum driving gas pressure to operate properly.
- Excessive pressures can cause damage to equipment and baro trauma to patients. Some ventilators may not function if excessive pressure is built up in system.
- Most common cause of high pressure is regulator failure.

LEAKS

- Leaks in the System are extremely common.
- Common failure is due to 0-rings. If oxygen accumulates in closed space, if can pose fire.
- N2O leak into OT may contaminate and pose problem to OT personnel.

RECOMMEDATIONS:-

- There should be proper training of the persons working in medical gas department so that they can identify medical gas cylinders, connection valves, regulators, and the distribution system within a facility
- Medical gas technician should conduct scheduled shutdowns; establish protocol; maintain written policies and procedures; and remain informed of new standardized recommendations within the medical gas supply industry.
- Disaster Mock Drill should be carried out every 3 month to be ready in real emergency arises in future.
- Hospital should have enough backup system to provide the continuous transfer of gas to the patient at the correct pressure without any interruption.
- Apart from compressed O2 cylinders, portable liquid oxygen containers and oxygen concentrators should be kept ready
- Do not drop a cylinder, strike two cylinders against one another, or strike other surfaces
- Clear disaster plan manual should be made ready.
- Maintenance has to be carried out as per the recommendations of the manufacturer.
- Pressure gauzes, shutoff valves, pipes, hosing have to be inspected regularly.
- Special places like ICUs should be inspected and test results have to be documented.
- Regular checks will prevent sudden shutdowns and prevent great economical burden.

LIMITATION OF THE STUDY

- It is limited to Paras hospital Gurgaon only, so it cannot be generalised
- The study was done during a period when the occupancy rate was 55-65%

CONCLUSION

- The study was done to know the medical gas system in Paras hospital which would be used as a base study in designing and planning of the upcoming hospital of Paras group
- This study gives total consumption of gases of liquid oxygen gases consumed-137400 and number of cylinders used (Oxygen cyliders-2064,nitrous oxide cylinders-156,carbondioxide cylinders-60,Nitogen cylinders-144)when the average occupancy of hospital is 59%.
- Issues in the department are pressure problem less or more, leakage, suction not working, malfunctioning flow meters, damaged valve, alarm problems Major issues are pressure problem less or more and leakage
- Proper training of the persons working in medical gas department so that they can identify medical gas cylinders, connection valves, regulators, and the distribution system within a facility
- Regular checks and Maintenance is required to supply these gases without any interruption which would increase the efficiency of the medical gas department.

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