ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 01 | January - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMMISSIONING OF HEALTHCARE FACILITIES

Healthcare

Dr Sarvadarshi Shukla* Professor, Indian Army *Corresponding Author

Dr Poonam Mishra Senior State Specialist, NFRU, IHAT, UPTSU

Dr Alok Sati Professor, Indian Army

ABSTRACT

Healthcare facilities are extremely complex organisations and as difficult it is to construct them, it is at times even more challenging to appropriately commission them. There are multiple aspects of patient safety which need to be taken into consideration to ensure a safe and healing environment for the patient. The article endeavors to elucidate various important aspects of commissioning of healthcare facilities, including microbiological aspects, stages of commissioning and systems to be considered in commissioning.

KEYWORDS

Healthcare facilities, Patient safety, Stages of commissioning

INTRODUCTION

Healthcare facilities are generally commissioned in consultation with the users and various project management and engineering professionals according to terms of contracts and as per various standards and stipulations laid down by regulatory bodies or as enunciated in various codes/ guidelines. In India, the commissioning process is normally only concerned with the physical functioning of the building services and is aimed at ensuring the installed services are operating according to the engineer's specifications. This article will take a broader view of commissioning within the healthcare sector and explore the range of issues associated with the start up of a new building. It is no longer acceptable just to ensure a clean hospital and consider that as adequate for patient occupation.

The range of issues that should be addressed includes fungal and bacterial contamination, air movement and vectors such as dust. Air flow direction, pressurisation and separations all need to be measured, adjusted or confirmed and documented in a cohesive manner together with biological commissioning prior to patient occupation. High risk areas such as ICU, theatres, isolation rooms, haematology/ oncology and CSSD must undergo a more rigorous level of commissioning that should include involvement from infection control staff. Only then can we have confidence that the commissioning process is creating as safe an environment as is possible in a setting with increasing patient morbidity.

Definition

American Society of Healthcare Engineering (ASHE) has defined commissioning as a "process intended to assure that all building systems in a facility, including sustainable building technologies, are installed and perform in accordance with the design intent, that the design intent is consistent with the owner's project requirements, and that operations and maintenance staff are adequately prepared to operate and maintain the completed facility"

The Commissioning Process is a quality oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.

It is a well acknowledged fact that the physical healthcare environment can impact on patient wellbeing. It is very often seen that healthcare buildings are handed over not functioning according to the design intent. Further, no national standards exist for the systematic and comprehensive commissioning of buildings.

Total building commissioning (TBC) although not in vogue in India, is a mandatory requirement on most US Federal Government contracts. TBC can draw some parallels to the old clerk of works system with its principal function to act as the owner's representative throughout each phase of the project. TBC has a strong role in the overseeing of design, construction and system integration, providing a systematic approach to ensure design intent and owner requirements are met, and also to constantly review quality control systems.

Types of commissioning in Australia (2):-

Building commissioning refers to completion for occupation by the contractor from a physical facility viewpoint. Typically, the activities include the successful running of all plant and equipment.

Operational commissioning refers to activities undertaken leading up to handover of the building to the users. Typical activities include familiarization of staff with safety, security and communications systems. Current commissioning practice consists only of testing, adjusting and balancing, however, this approach does not take a holistic approach.

Phases of Commissioning

Although as mentioned above, the authorities responsible for the commissioning the facility should be incorporated right at the design phase of the construction and as stated by ASHRAE, the phases of commissioning include (3) :-

(a) Pre-Design
(b) Design Phase
(c) Construction Phase
(d) Occupancy/Operations Phase

Systems to Consider for Commissioning

The major categories of systems to be commissioned. For more details, view the more detailed sub-category list on the commissioning checklist (4).

(a) Building envelope –
will require special emphasis on checking the integrity of load bearing structures. However, the quality of construction of building envelope/ structural integrity has to continue during the construction process itself.

(b) HVAC systems –
functioning of AHUs, air velocity, air changes per hour, temperature and humidity in different facilities of the hospital, air pressure and in case of critical areas like Operation Theatres, the particle counts, and efficiency of HEPA filters will also need to monitored.

(d) Plumbing systems –
The structural integrity of plumbing system has to be monitored during the construction phase itself and it should be as per the predefined contractual agreement. However, at the time of handing – taking over of the building/ commissioning, any leakage/ seepage from such pipes needs to be checked.

(e) Medical gas systems –
the integrity of valves, colour coding of pipes, pressure at the outlets, the presence of outlets at the bed heads as given in the contractual agreements will need to be checked.

(f) Electrical systems –
The presence of electrical outlets as asked for by the hospital/ user

including accurate provision of earthing in the electrical terminals needs to be ascertained.

(g) Fire protection system & Fire alarm systems –
The various fire alarm systems, smoke detectors, fire sprinklers, functioning of wet risers, dry risers, jockey pumps, supply of water in fire hose/ reels should be functional.

(h) Miscellaneous -
Other systems which require inspection, verification of functioning and their provision as per the contractual agreement include :-
(I) Information technology,
(ii) Interior lighting
(iii) Exterior lighting
(iv) Refrigeration
(v) Vertical transport
(vi) Material handling

Although, it is ideal to have individuals/ teams responsible for commissioning of a particular facility to be closely involved and associated with the project, from the stage of inception of the project, i.e. pre-design or the design stage itself, at least the commissioning individuals/ authority should be closely involved during the construction phase and be regularly interacting with the constructor/ builder executing the project. In this way, the requirements for operational commissioning of the facility can be explained in detail to the executing agents. Although, these days, most of the facilities or services are sub contracted to agencies which are specialized in them, it is always preferable to have end users as well as the authorities who are well versed with the standards for checking such facilities or mandatorily required as per laws/ regulations, closely interacting with the executing agencies.

Thus, it may be required that agencies for checking that HEPA filters are functional and carry out the relevant tests as per ISO - EN 14644-3/ now 29463-5:2022(en) (which includes test like DOP test, Particle count and measurement of air velocity through the HEPA filter) are hired or taken on board for commissioning of Operation Theatres in the hospital (5).

There are also certain special areas in the hospital, which require specific monitoring and procedures before being commissioned. Thus, Commissioning must occur before an operating theatre is first used and after any substantial modifications that may affect airflow patterns in pre-existing theatres (as part of a re-commissioning process). It is important that the infection control team is involved at all stages from pre-design through to opening and that adequate time for commissioning is built-in to the schedule, including an allowance of time for microbiological assessments. This may need particular consideration for facilities built under private finance initiatives in that there may be need for a contractual condition to allow commissioning before handover of the theatre or for delayed acceptance after handover such that faults can be rectified (6).

Commissioning in Conventionally-ventilated theatres
Must be commissioned before being used, after being built or modified substantially. The Infection Control Team and the project department must co –operate in the commissioning of areas like Operation Theatres. A few important considerations to be looked into before conventionally ventilated OTs can be commissioned are given below (7) :-
(a) The theatre interior should be checked for obvious defects.
(b) The air distribution within the theatre and between rooms in the theatre suite should be checked by smoke tracing.
(c) The air handling unit (AHU) supplying the theatre is properly constructed, finished and functioning.
(d) Where "setback" (reduction of ventilation rates when theatre is not in use) is in place, there are indications in theatre of its function and there are safeguards against setback operating whilst the theatre is in use.
(e) The air change rates in theatre and preparation room are satisfactory.
(f) Airborne microbial contamination in an empty theatre is satisfactory.

Theatre interior
Inspection of the theatre interior before it is handed-over from the building contractors to the hospital is the last convenient occasion to rectify faults. The following observations should be made:
(a) Pressure-release dampers should move freely and be partially or fully open when doors are closed and move to shut when doors are open. The doors must close properly,
(b) Flooring should have no cracks or gaps in it and its coving joins to the wall painted surfaces and finishes are smooth, complete and without cracks that there are minimal fixtures, shelves etc. The windows are sealed the ceiling is solid.

Inspection of ventilation in conventionally ventilated OTs
Team comprising of Infection Control team and Project Management professionals should carry out airflow visualization (smoke testing) to ensure turbulent airflow in the theatre, particularly around the position of the operating table (a puff of smoke should disperse within seconds of creation). It should also be established that supplied air does not "short-circuit" i.e. take a direct route out of the theatre such that it cannot entrain contamination generated in the theatre. Large volume smoke generators are useful for tracing larger airflow patterns. Airflow visualization should also be used to establish that air flows in the desired direction between rooms in the suite (with all doors closed) – from the theatre into - the anaesthetic room - the disposal room - the corridor from the anaesthetic room and scrub area into the corridor air should either flow from the preparation room into the theatre if it is used for lay-up or they should be at equal pressure if used as a sterile pack store (i.e. no direction of flow between them) and should flow into the corridor from the preparation room.

Microbiological sampling
It is one of the most important aspects in the commissioning of Operation theatres including Ultra Clean Ventilated OTs. The level of airborne bacteria introduced by the supply air can be checked by closing all doors and leaving the operating room empty with the ventilation system running for one hour, after which a bacterial sampler mounted on the operating table should be activated remotely. Aerobic cultures on non-selective medium should not exceed 35 bacterial and/or fungal particles per cubic meter of ventilating air. The most appropriate time for microbiological commissioning of an operating theatre should be shortly before it comes into use. Most healthcare institutions use consecutive 3 fumigation protocols followed by Air sampling and its culture. It is only when three such culture come out to be negative, that the OTs are considered to be ready for commissioning. The theatre should have had an "in-depth" clean and be thoroughly clean and dust-free. The air handling unit should have been operating at normal flow rates (i.e. not on setback ventilation) continuously for at least 24 hours before sampling. Given the usual time-frame for sampling, it is usually only the production of satisfactory microbiological sampling that is required to enable a new or refurbished theatre to come into use. It is therefore vital that (8, 9):-
(a) Checks on the engineering aspects listed above should have already occurred and be satisfactory before microbiological sampling is done
(b) False-positive microbiological results (primarily from airborne contamination dispersed by the person doing the test) do not cast doubt on the adequacy of the ventilation.

CONCLUSION
Commissioning of healthcare facilities like hospitals is an extremely deliberate process, as this is not merely a residential/ office accommodation. There are sick and vulnerable patients, maybe on life support systems being treated and accommodated there. Any shortcomings, for example, in the HVAC systems or fire protection systems can have long lasting impact on the functioning of the facilities, and may sometimes lead to very adverse impacts if the systems have not been constructed of built properly. Thus a defect in AHUs, filters can lead to inappropriate Indoor air quality in ICUs/ OTs which can lead to Hospital acquired infections in patients. This can lead not only to adverse effects on the patients and severely impact the image and reputation of the hospital. Problems encountered during commissioning must be tackled vigorously at that very time itself to avoid problems in future. It also needs to be mentioned that any commissioning of healthcare facilities needs to be have a team approach and professionals from various fields need to be part of such exercise including civil engineers, electrical engineers, HVAC engineers, Infection control team members, Hospital administrators, clinicians, nursing staff etc. Only a team approach can ensure the appropriate provision of services and facilities to provide quality patient care is present in the healthcare facility to be commissioned.

REFERENCES

1. American Society of Healthcare Engineers, Health Facility Commissioning Guidelines, Page 1-10, 2010.
2. Australasian Health Facility Guidelines; Part F - Project Implementation 0950 - Operational Commissioning; Revision 5.0 01 March 2016
3. ASHRAE; Updated Commissioning Guideline Harmonizes Terminology, Usage with Commissioning Standard, 2019, https://www.ashrae.org/news/esociety/updated-commissioningguideline#:~:text= ASHRAE%20Guideline%200% 2D2019%2C% 20The,and%20consistent%20approach%20to%20commissioning.
4. EPA building commissioning guidelines, United States Environment Protection Agency, Jan 2009.
5. International Organisation for Standardisation; https://www.iso.org/obp/ui/#iso:std:iso:29463:-5:ed-2:v1:en.
6. Jyoti.S.Kabbin, 1Shwetha, J. V., 1Nagarathnmma, T., 2Sandhya, K. and 3Subhas, G. T; commissioning of operation theatre at a tertiary care centre – microbiological perspective; nternational Journal of Current Research Vol. 6, Issue, 05, pp.6871-6874, May, 2014
7. Holton J, Ridgway GL. Commissioning operating theatres. J Hosp Infect. 1993 Feb;23(2):153-60. doi: 10.1016/0195-6701(93)90019-v. PMID: 8097219.
8. J. Holton, G.L. Ridgway, A.J. Reynoldson, A microbiologist's view of commissioning operating theatres, Journal of Hospital Infection, Volume 16, Issue 1, 1990, Pages 29-34, ISSN 0195-6701
9. Hoffman PN, Williams J, Stacey A, Bennett AM, Ridgway GL, Dobson C, Fraser I, Humphreys H. Microbiological commissioning and monitoring of operating theatre suites. J Hosp Infect. 2002 Sep;52(1):1-28. doi: 10.1053/jhin.2002.1237. PMID: 12372322.