



Exploring the Impact of Operational Lean Management on Patient Satisfaction and Sustainable Healthcare Development

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ABSTRACT:

The COVID-19 pandemic has underscored the importance of quality healthcare services and positive patient experiences. This study examines the application of lean thinking in a multispecialty hospital, with the goal of improving operational efficiency and patient satisfaction. Using a case method approach, a team of healthcare workers, including representatives from hospital management and medical specialists, applied lean principles to various hospital procedures. The study employed value stream mapping, patient feedback, direct observations, and interviews with key employees and hospital documents to gather data. Results indicate that the use of lean thinking in the hospital setting can lead to waste reduction and enhanced patient experiences. Overall, this study highlights the potential benefits of lean management for sustainable healthcare development.

1. Introduction

Covid-19 has come up as a threat to human life's globally causing severe acute respiratory syndrome (SARS). It is an infectious disease caused by newly discovered corona virus.¹ The virus is highly contagious due to high efficiency of infection (with reproduction number being 2.2)². Effective strategies for controlling outbreaks such as COVID-19 include isolating and treating infected patients, quarantining individuals suspected of carrying the virus to prevent further transmission, and providing healthcare workers with appropriate personal protective equipment (PPE) and training. Additionally, regular and transparent communication between healthcare providers, policymakers, and the public is essential for effective outbreak prevention and management.³ In hospital settings its advised use of protective measures like N 95 masks or higher level of protection (PPE kit, face shield), gloves, gowns, eye protection, and importantly hand hygiene. There is a growing need to develop isolation rooms with negative pressure in healthcare facilities wherever possible to prevent the spread of infectious diseases like COVID-19.⁴ Surface cleaning and disinfectant spray at hospitals are recommended as Covid-19 gets transmitted by droplets and contact with infected persons and surfaces.⁵ Proper training of medical professional and staff, they being at higher risk of contacting the infection.⁶ Standard operating procedures (SOP's) are made to improve operational

efficiency of health care organization. Covid-19 pandemic has been a new kind of infection in terms of infectivity and rapidity of serious illness.¹ In the COVID-19 pandemic, it is crucial to prioritize the safety and protection of healthcare workers, including nursing staff and doctors, from infection. They are the front-line workers who play a vital role in treating and managing the disease, and safeguarding their health is essential for effective pandemic response.⁷ The potential cost of treating and managing infections among healthcare workers during a pandemic can have a significant impact on the functioning of healthcare systems. The absence of frontline workers can lead to further strain on resources and a reduction in the quality of care. To effectively respond to new pandemics, a system must be developed that can manage the large number of infected patients while also safeguarding the health and well-being of healthcare providers.

Customer service expectation are of two types – desired and adequate. In emergency situations like in pandemic customers adequate service level rises, which narrows the zone of tolerance. It makes customers more demanding in such emergency situations, to provide the right service the very first time.⁸ So, healthcare goals also change, and primary goal become safety and delivery of high-quality essential health services throughout an emergency.⁹



Hence need is felt of establishing safe and effective patient flow (including screening for COVID-19, triage and targeted referral).⁹

The present study aims to analyze the establishment of lean thinking as a system in hospital operations, which can improve the efficiency of service processes while eliminating those that do not add value for patients. The study is conducted to assess patient satisfaction with the use of Lean tools in promoting sustainable development.

2. Review of Literature

Healthcare services are considered essential, particularly during a pandemic when they become indispensable. It is crucial to review and improve the performance of healthcare services to ensure that they can effectively respond to the needs of the population. This may involve the development of new protocols and guidelines, the allocation of resources to high-priority areas, and the implementation of measures to safeguard the health and well-being of healthcare providers.¹⁰ Healthcare providers and the people working in management of patients with Covid-19 should take care of air borne nature of infection, wear N95 mask, avoid skin contact, follow adequate hand hygiene, wear PPE, and follow proper practice of donning of PPE.¹¹ All non-essential planned surgeries are avoided¹² and aerosol generating procedures should be done in negative pressure isolation room.¹¹

Lean thinking tools focus on “process improvement”. Lean is an operational strategy oriented towards achieving the shortest possible cycle time by eliminating waste. Lean originated from Taiichi Ohno’s production philosophy which was implemented in Toyota during 1950’s.¹³

Historically Lean was first applied in UK health care in 2001 and then USA in 2002. To manage and organise hospitals in a better way, Lean management system tools are used. With Lean thinking, healthcare providers can have a smooth process flow which allow them to focus on providing care. Lean also support and strengthen healthcare organisations reducing costs and risks.^{14 15} This cost reduction in providing care in turn leads to better care for the patients. Lean brings various hospital departments together to work for benefit of patients.¹⁶ Lean helps in managing demand and capacity, cost reduction and improvement of safe and Quality services.¹⁴ Economic burden caused by the first wave of Covid-19 has created a renewed interest in Lean thinking.¹⁷ Lean thinking got attention in pandemic as dependence and expectations of patients increased. Load on hospital operations increased to provide rapid access to quality care in minimum wait time with minimum cost.¹⁷ Lean approach eliminate waste in flow of patients like interruptions, delays which promote faster movement of patients.¹⁵ Lean principles have been successfully applied in the healthcare sector in the past,

resulting in improved operational efficiency, better patient outcomes, and increased satisfaction among healthcare providers and patients.¹⁵

Recent studies¹⁸ have suggested that lean thinking can not only improve the processes and procedures associated with healthcare business but can also aid to reduce the costs associated with this industry. Lean is already a tried and tested methodology to improve the way work gets done.¹⁹ At its core, lean thinking is based on the principle that it promotes elimination of waste. Anything which does not create ‘value’ is ‘waste’^{20 21}. Study by researchers²² on the applicability of lean in private hospitals of India also document the experience of implementing this thinking and propose a framework to implement it in the system. Waste could be anything like any service which is not required by customer, any service which requires more time, any mistake which requires correction repeatedly.¹⁴ The primary benefits of lean implementation in healthcare are in form of improved efficacy in quality and improved processes which also aid in provision of faster services¹⁹. Lean thinking in hospital setting removes duplicate, redundant, unneeded, and unnecessary processes and procedures.²¹

Healthcare Wastes identified at NHS UK (NHSIII 2007)²¹ were related to transportation, inventory, motion, waiting, overproduction, over processing and defects correction. Highest priority waste found in hospital setting is waste due to waiting.²⁰ Another waste being waiting for resources, which may reduce efficacy of system and quality of service provided.²³

Lean methodology improves the quality of care by reducing errors and waiting times for patients. Lean also supports healthcare providers in focussing on quality care, as process flow is smoothened.²⁰

Womack identified four principles in Lean thinking¹⁴- which are mainly value stream, creation of value flow, pull production, strive for perfection. Value stream mapping is a diagnostic tool to find new opportunities in a system by gaining awareness of current situation through mapping.²⁴ VSM aims in reduction of non-value-added things to reduce unnecessary steps and time. Value stream map is made in six phases from drawing current state value stream map, including premeasurement to measuring the outcome.

5S is an operational tool which in a process can possibly improve safety through improved housekeeping practices.²⁵ The aim of which is to reduce workload for workers, reduce number of errors in working process and develop employee experience by communication. The main benefit of this system is that it reduces the search time and provides a smoother operational flow. This leads to increased efficiency in the system. Benefit of 5S is an organised workplace where workers feel safe with reduced defects in process.²⁵ 5S is a tool for organising,



standardizing, and maintaining the workplace. It makes the workplace clean, well ordered, and disciplined.²⁶ 5S improve flow of patient without delay, it helps in shortening the queue in hospital.²⁷ The tool is applicable in hospital to decrease staff movement in hospital and suggest having separate way for patient, staff and maintenance people.^{28, 29}

In Lean system, pull principle represents a process that a desired product is produced when it is demanded by the customer.¹⁴ It is used to mingle various resources for an on-demand activity. It prevents the waiting time for healthcare provider and patients. This approach contrasts with the traditional push system, in which products or services are produced based on forecasts and then pushed through the system. In present study, services were made available at the touch points for example in present study sanitizer and mask requirement kiosk were typically placed in high-traffic areas. Pull principle is often used in conjunction with other tools like Value stream mapping for an effective output. With help of supply chain various requirements in OPD and wards were fulfilled. Lean thinking is applied in Covid-19 pandemic to fulfil patient safety at hospitals. Patient safety according to Institute of Medicine is prevention of harm caused by errors of commission and omission.³⁰ At institution healthcare providers are expected to accept and practice patient safety as their priority.³¹

The application of lean tools in healthcare has the potential to create a significant impact on sustainable development, encompassing all three aspects of sustainability: environmental, social, and economic⁴². By reducing waste, improving efficiency, and optimizing resources, lean principles can help healthcare organizations reduce their environmental footprint and promote sustainability. Moreover, lean principles can also help improve the quality of care, leading to better patient outcomes and increased satisfaction among healthcare providers and patients, thereby contributing to social sustainability. Finally, by reducing costs and increasing efficiency, lean principles can help healthcare organizations improve their financial performance, leading to greater economic sustainability.

Material and Methods

The study proceeds by first describing the methodology used, followed by an explanation of Value Stream Mapping (VSM) and 5S as tools. A model is then created for the study, which focuses on using these tools to improve patient satisfaction and promote sustainable development in hospital operations.

Problem statement and research opportunity- The ongoing pandemic has created a need for increased study and efforts to reduce resource waste, while also ensuring that these efforts are sustainable for the future. Hospitals are facing significant financial and operational challenges during Pandemic. Pressing priority is to adopt

more efficient and effective management practices. Therefore, there is a need for hospitals to implement lean management practices to improve patient care, increase operational efficiency, and reduce costs.

The present study has identified gaps in the existing literature, and a lack of application of Operational Lean management practices in hospitals keeping in mind a sustainable future.

The research design adopted for this study is a Descriptive – Exploratory Research Design.

Objectives-

The objective of this study is to investigate the impact of operational lean management on patient satisfaction in healthcare settings, with a focus on its role in promoting sustainable development. The study will aim to assess the effectiveness of lean management practices in improving patient satisfaction, particularly in areas such as communication with doctors, wait times, and overall experience, and will also explore the potential for sustainable development in healthcare organizations that implement lean management practices. By examining the relationship between operational lean management, patient satisfaction, and sustainable development, this study will provide valuable insights for healthcare organizations seeking to improve their sustainability performance while enhancing the patient experience.

Hypothesis- Implementation of operational lean management practices in healthcare organizations is positively associated with higher levels of patient satisfaction, and this relationship is mediated by improvements in communication, reduced wait times, and overall patient experience. Furthermore, the adoption of operational lean management practices promotes sustainable development in healthcare organizations, which in turn positively affects patient satisfaction.

This study seeks to test the hypothesis that lean management practices can enhance the patient experience and lead to sustainable development in healthcare organizations. Specifically, the study will investigate whether lean management practices such as process improvement, waste reduction, and staff engagement can improve patient satisfaction by reducing wait times, improving communication, and enhancing overall patient experience. It will also explore whether the adoption of lean management practices can lead to sustainable development by reducing waste and increasing efficiency in healthcare organizations.

Sample design – Study conducted at Tertiary Care Private Hospital during Covid Pandemic

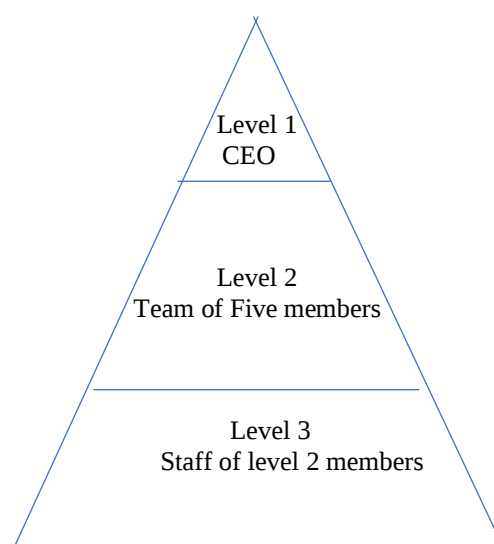
Sampling Method- The convenience sampling (non-probability sampling) method was used during the study, as the Covid pandemic was still there. Keeping in mind



the shortcomings of the method, lack of representativeness of the population, chances of sampling error, and potential for selection bias. In present study while applying Lean thinking, a diagnostic tool, value stream map is used. The value stream map of whole process was made from beginning when patient connects with hospital till

discharge. Patients journey was divided in four parts patient inflow, consultation, pharmacy, and outflow. A team of 5 persons (Level 2) was made which reports to CEO of hospital (level 1) including Medical Superintendent, Medical director (Medical doctor), Nursing Supervisor, Infectious disease specialist doctor, Pharmacy In charge.

Figure-1- Diagrammatic representation of Hierarchy involved.



In their role, the team pointed out various areas of delay and gaps in the process. The team's aim was to provide quality care with smooth and efficient movement of patients, minimizing exposure and contact, in proper hygienic conditions. Statement of purpose were made and distributed to front office staff, nursing staff, security team, doctor team, and pharmacy. Head and supervisors (level 3) were made from the concerned department of level 2, to check for process and advice to higher level regarding any change if required. Regular meetings were organized to discuss about process and need for improvement or changes. To ensure communication in lockdown conditions in Pandemic, what's app groups were formed. Medical director made what's app group including all the doctors including Infectious disease specialist. Nursing supervisor level 2 was admin for group including all the nursing staff. Pharmacy in charge level 2 admin of a group to contact with his departmental persons and his distributors. CEO level 1 was added in all the groups to supervise and be informed. The primary aim was to examine if all the processes are working efficiently by a team which includes a Quality control person, Nursing supervisor, and an Operations person from management was made. The present study was carried out at a private multispecialty hospital. Study was done during the Covid-19 pandemic. The data was analyzed using value stream map.

Sources of data and evidence for answering the research questions were discussions with key employees, direct observations, satisfaction status of patients and hospital documents.

The satisfaction of patients was assessed using a Likert scale with response options ranging from "very satisfied" to "very dissatisfied". Patients were asked to respond to a single question sent via SMS on their phones: "I am satisfied with the quality of care provided at the hospital during the Covid pandemic." Over the course of the study, feedback was received from 410 patients. The satisfaction level among patients was found to be above 90%. Due to the lack of staff and the ongoing pandemic, as well as considering the patients were stressed with the disease, it was not feasible to obtain detailed feedback using a questionnaire. Therefore, to address practicality issues, a single feedback question was used instead.

Wastes that got generated in the process were external transportation of patients to hospital for seeking appointment, motion of patients within hospital for getting appointment, waiting before their appointment, as well as before meeting the physician, and occurrence of over processing and defects on postponing patient appointments.

Based on the data a value stream map was made. VSMs represent the key people, material, and information flows required to deliver a product or service.

**Table 1.** Waste Inflow and outflow in hospital setting

Waste	Patient	Ways to prevent waste
Coming to hospital Travel Hospital crowd	To	Tele consultation
Appointment booking		Screening done at entry point for patients and segregating possible infected or Covid positive Use of plastic screen at counters Use of Mask, Sanitizers Avoid accompanying person or single attendant Online booking
Wait time Filling forms	Hospital In hospital to	Multiple counters Use of Aadhar card for registration Payments promoted with UPI or touch less
Payments with cash	OPD From billing counter to Consultation chamber	sorting patient movement of doctor to opd rooms
Wait time		Adequate chairs with social distancing norms Plastic screen , PPE kits, Masks, Gloves at consultation chambers
Wait time Crowding	To	Prescription made online, sent to pharmacy online through connected computers for faster availability of medicines by the time patient reaches pharmacy Another option of patient getting medicines by home delivery
Wait time Crowding	Pharmacy	
Wait time	If required, before pharmacy patient movement for Investigation	Covid sample collection separate rooms

The purpose of conducting the value stream mapping was to decrease chance of infection by stressing on four measures-

1. Decrease number of patients or people at one place
2. Decrease movement of patients in hospital
3. Use of sanitizer
4. Cleaning of hospital premises

Movement of patient divided into 4 categories-

Table 2. Measures of Patient Inflow consultation pharmacy and patient outflow

Measures	Patient Inflow	Consultation	Pharmacy	Patient Outflow
	1. Providing mask to all the patients (At entry gate) 2. Marking on the ground 3. Marking in the lift 4. Time slots for appointments, online appointment booking 5. Sanitizers at various touch points 6. Separate vaccine area 7. Putting up of signages and information booklets 8. Playing informational videos in OPD areas. 9. Promotion of non-cash payment methods to avoid contact 10. Teleconsultation	1. Fever clinic 2. Video Consultation 3. Plastic curtains at opd counters for opd staff 4. Regular cleaning in opd 5. Regular Spray of Hypochlorite after patients are gone 6. Changes in sitting arrangement in OPD keeping social distancing norms	Medicine delivery at home on online orders Using Intranet the consultation is shared to the pharmacy and medicines are kept ready by pharmacist by the time patient reaches pharmacy counter	Getting lab testing and radiological investigation



	11. Team of 5 specialist doctors at upfront	7. Only one attendant allowed with patient 8. Provision of PPE kits to staff members		
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Performance measure- Decreased waiting time, avoid crowd, decreased transit time in hospital, satisfied staff and doctors.

5S used in Lean management system is as follows

Sort- remove what is not needed at workplace.

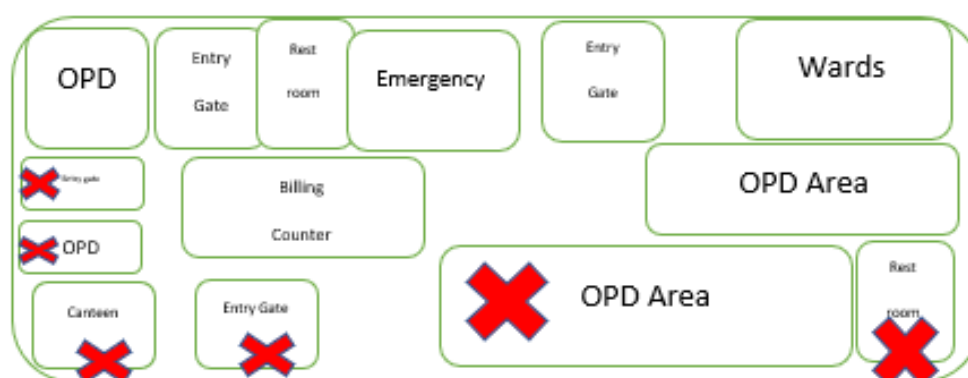
Hospital which has four entry gates at ground floor. All the gates other than one single gate were closed. The entrance point was through a separate OPD point, not the regular OPD counter. The other entrance gates of the hospital were closed.

Figure 2- Diagrammatic representation of changes done at entrance at ground floor of hospital

Before Covid-19 Pandemic



After Covid-19 Pandemic



Decrease number of doctors and staff in OPD. A single-entry gate in the hospital made to restrict entry in hospital. This restriction made to prevent chances of spread of infection. An OPD set made at the single-entry gate called the screening OPD. A team of three Medical Officers (MBBS doctors) are posted, to decide where to send the patient. They direct the patients depending upon the symptoms. Sitting arrangement in the hospital was changed. Only few chairs were left rest removed. Chairs with capacity of three people were painted red on middle chair, so that social distancing norms were followed in

sitting also. In hospital to avoid crowding only one attendant was allowed with one patient.

Straighten—set in order, clear to everyone where to go, signages, sanitizers

Consultations were divided on methods of delivery like video, online booking, walk-in. When a patient comes to hospital, he directly goes to entry gate. After the doctor refers the patient. Patient either goes to fever clinic or to a room where a team of five specialist doctors sit. Fever clinics were set up for patients directly to go to fever



clinic. Fever clinic was set up to segregate suspected and positive Covid-19 cases, from other patients. In other

room where specialist doctors sit, they examine patient and then write prescription, or investigation if required. If required, doctor from other specialty is called and advice is taken. Lean Pull system was used. Lean pull system aims to create a workflow where work is pulled only if there is a demand for it. To avoid overcrowding in OPDs, consultant used to come only when required directly to fever clinic. Limited number of doctors are asked to attend OPD and then they change duties, so that availability is not an issue.

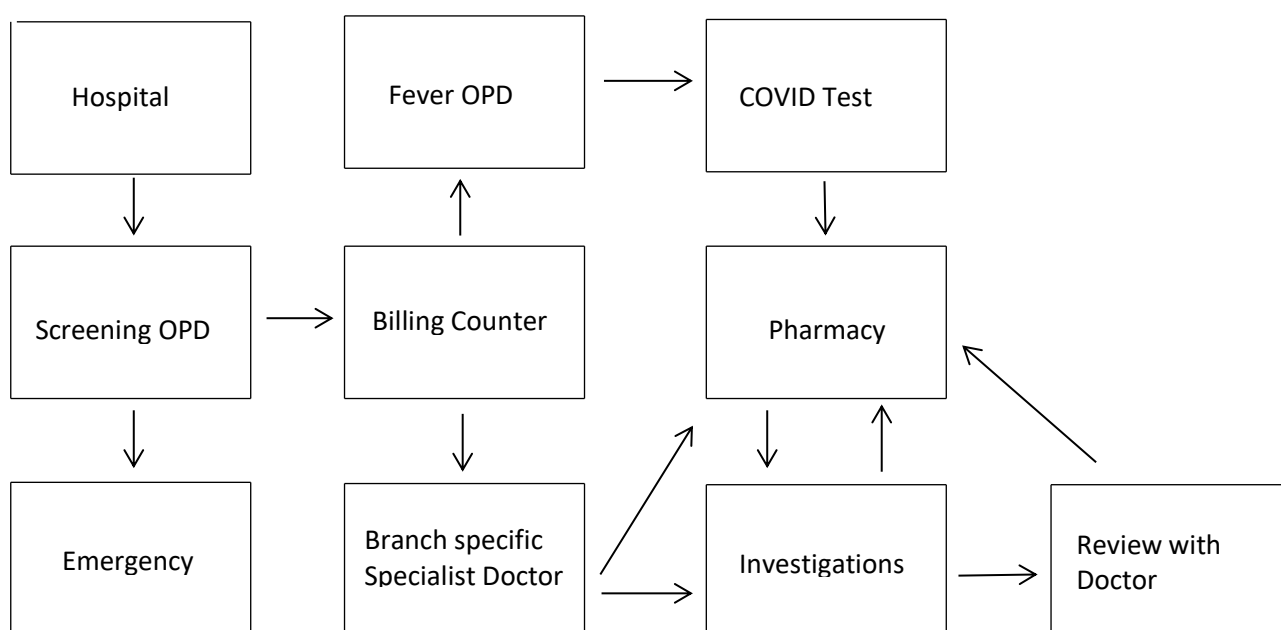
An examination room was made with plastic curtains between doctor and patient where airway examination is required like in ENT OPDs, to prevent spread of virus. By making segregation wait time at the billing counter in the beginning is decreased, as patient is already advised by a doctor to whose OPD to attend. Other benefit being patient is not roaming around in hospital. Patient will directly see the specialist doctor and directed to pharmacy or investigation if required. Another change is that blood sample collection room is made near the OPD itself. Change from previous condition is that the whole hospital which was open was closed and only a part of it is open. OPD rooms are closed other than three

rooms. For the admission patients two wards and one ICU was made open. And were named as 'Isolation wards'. Any admission was made to these isolation wards 'only' and not to any other ward. After the patients gets negative Covid RTPCR, then is shifted to other concerned wards or separate private rooms. If any patient required urgent surgery or emergency procedure then Rapid antigen testing (which gives immediate results) was done in Sample collection room as Covid-RTPCR test took nearly 24 hrs to report. For admitted patients Covid-19 RTPCR test was done at the isolation wards. For OPD patients the sample collection room was made near to the Fever clinic.

Round the clock patients were advised to keep social distancing and to wear masks by regular announcements. Display LEDs were placed on the walls and educational and informational videos regarding Covid-19 infection and its prevention were played round the clock. Doctors, nursing staff in Isolation ward were supplied PPE kit.

Whenever the Covid-19 positive patient was moved from the isolation ward to other place in hospital like radiology department etc, an announcement was made in hospital and 1% Hypochlorite spray was made after his movement. A proper disposal of biomedical waste was done. Donning and doffing rooms for PPE kit were made for medical staff.

Figure 3- Diagrammatic representation of movement of patient from entrance in hospital



Shine - sanitization of area, and putting up sanitizers everywhere, putting up exhaust fans, setting up the air flow outside the hospital building where possible. Morning and evening spray of 1% Hypochlorite was made in the lobby, stair case, OPD rooms and possible

areas of the hospital. This was done other than the regular cleaning and mopping. OPD tables and chairs were cleaned with the sanitizer spray and mopped. In Covid-19 infection which being a droplet and air borne infection, care was taken for the air flow. The



centralized Air conditioners were closed. Separate room Air conditioners were there in hospital, so were used. In places of OPD, air-coolers and table fans were used in a way to push 'room air' outside hospital building. The air circulation is important to prevent virus getting suspended in air and causing infection. Coolers and fans were directed so that air flows outside the room through open windows and doors.

Standardize- adequate supply of sanitizers, posters, signages are made available.

To maintain all the standards a team was made. The team includes a Quality control person, Nursing supervisor, and an Operations person from management. The work of team was to check availability of the material and its proper supply to concerned places. Team directly reports to CEO and Medical superintendent. It is very important to sustain and if required improvise.

Data Interpretation

The results suggest that lean thinking in hospitals is a method which can enhance the efficiency of procedures. The results are like those reported by earlier studies^{32,33} Application of these methods in the hospital setting can be valuable and can significantly improve the measures of service quality and patient experience in these settings. The processes which were found to increase patient experience were getting Tele-consultation at home, decreased time spent at hospital, quicker and smarter movement with less crowding, proper use of smart technology and mobile application, and getting enlightened with informational videos and pamphlets. Similar to our study, application of Lean at work place, performance improvement has been noted.³⁴ In study by Sheehan et al³⁵, methods were used to reduce the staff exposure, patients were screened at entry to hospital. Naik et al³⁶ in their study highlighted the importance of support and commitment of management for successful implementation of Lean principles. Similarly stressed in various studies^{37,38,39,40,41} the need for team work and staff involvement for success of Lean implementation. In the context of sustainable development⁴², Value Stream Mapping can be a useful tool for identifying opportunities to reduce waste and increase efficiency. In a healthcare setting, Value stream mapping can be used to map out the patient journey from admission to discharge. By identifying areas of waste or inefficiency in the value stream, such as unnecessary tests, redundant processes, or overuse of resources, healthcare organizations can reduce costs while also improving the patient experience. Additionally, by incorporating sustainable practices into their operations, such as reducing energy consumption and waste, healthcare organizations can contribute to environmental sustainability.

Hence the use of lean thinking in hospital operations resulted in the increased effectiveness and efficiency of both the tangibles and intangibles in the service delivery process.

Conclusion:

Operational Lean thinking in Covid-19 times has helped in finding new ways of safety without compromising quality for the patients. In fight on front with a new virus our healthcare providers safety is of prime importance. Each of the steps taken above contribute to the increased efficiency and effectiveness in the processes and procedures in the hospital setting. Together with the healers, management can work together and support in providing better infrastructure and functioning to improve quality and patient satisfaction as an output. Hence appropriate measures should be taken as an impediment to spread of virus. Value stream mapping can be a useful tool in promoting sustainable development by identifying opportunities to reduce waste, increase efficiency, and minimize the environmental impact of operations.

Limitations of the study

The study has been conducted in a single hospital setting and may be replicated in larger hospitals for replicating similar results. The study was conducted during the pandemic so overall patient satisfaction could not be assessed, a further detailed analysis is suggested. The Six Sigma principles can be added further for improving quality services in healthcare sector.

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