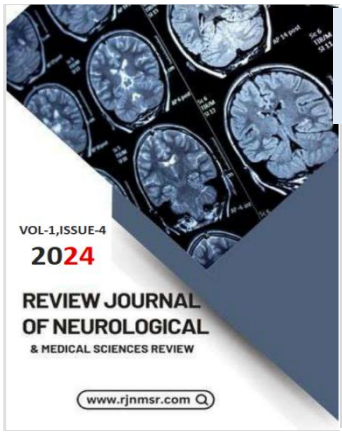

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Built For Crisis! Exploring User Satisfaction With The Emergency Department Environment In a Selected Teaching Hospital

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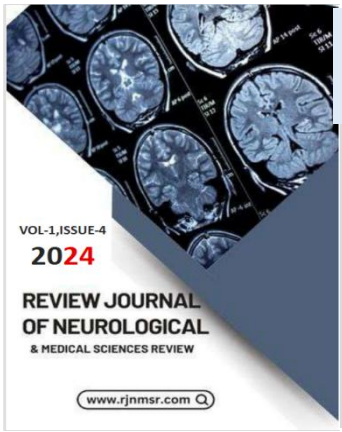
Abstract

The provision of healthcare is essential to the health of society. It affects people's physical, emotional, and social well-being. In developing nations like Pakistan, hospitals are essential parts of the healthcare system. Hospitals are incomplete without the emergency department (ED). It acts as the initial point of contact for patients with accidents, crisis, and acute medical issues, offering vital and timely care that frequently saves lives. Environmental design considerations into design of any ED is crucial towards its functional needs and optimum performance. Lack of environmental design consideration into the recent upgradation of the ED at Bakhtawar Amin Trust Hospital Multan lead to poor user satisfaction. Hence it was need of the hour to observe, document, explore and resolve the current issues faced and how it can be addressed through environmental design interventions. Using purposive sampling with sample size of 120 were baselined. Piloting was done in the initial stage to ensure ample participation. Observational study of the facility was followed by data collection from respondents. With lack of sufficient seating spaces and facilities, people tend to wait standing prior to previous patients to get their turn. Improper designed toilets, stores, dirty and clean linen storage and labs based rooms in the ED facility was below users satisfaction. Non-presence of ramp created critical issue for orthopedic patients. Enhancements in thermal comfort, improving lighting,



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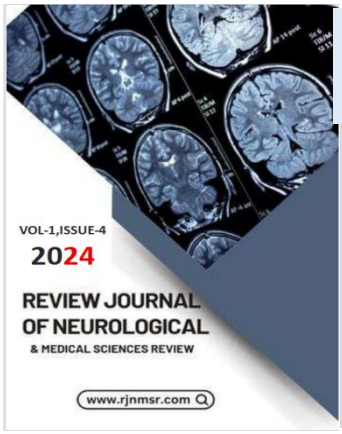
upgrading accessibility and allied spaces for the department have been proposed to help develop interventional improvement.

Keywords: Accident & Emergency, Teaching Hospital, Architectural Design, Healthcare Design, Environmental Design, End user satisfaction.

Introduction

The foundation of any flourishing society is healthcare. It is a holistic approach to preserving and improving the well-being of individuals and communities, not only the treatment of diseases (Kistelegdi et al., 2022). Beyond the confines of hospitals and clinics, healthcare plays a vital role in many aspects of life and greatly advances society as a whole. Preventive treatments, such as immunizations, tests, etc help discover and alleviate health risks before they become serious. By ensuring that acute and chronic illnesses are adequately managed, access to high-quality medical care lowers rates of morbidity and death (Boudreaux et al., 2013). This strong correlation between physical health and productivity in the workplace is essential because healthier people are more likely to make valuable contributions to their communities and the economy (Liu et al., 2020). Healthcare is essential for maintaining mental and emotional well-being in addition to physical health. A wide range of problems are addressed by mental health services, including counseling and psychiatric care, from anxiety and depression to more serious mental diseases (Paul et al., 2018). Thanks to improved access to mental health treatments and growing understanding, the stigma associated with mental illness is progressively fading (Marsh et al., 2020).

Healthcare system as a facility is a necessary ingredient for the survival of any society towards basic human rights and well being of the society itself. Its directly related with public at large through its perception of physical, mental, social, psychological and emotional needs and their fulfillment where health has a role to play (Aroua et al., 2017). It has to be flexible, adaptable and robust to keep up with the challenges of society and allied domains like socio-economic, financial, environmental and peace based conditions at large (Bosch et al., 2023). With respect to Pakistan, healthcare infrastructure becomes one of the most critical social as well as physical infrastructure for the well being of the people at large as they refer to these facilities in times of utmost severity and medical needs (Nafees & Khan, 2020). Hospitals serve as the center to ensure availability of essential medical care which includes but is not limited to surgical procedures and operations, emergency and trauma based treatments, and specialized consultations in OPD and IPD facilities (Ahmed et al., 2020). Furthermore, these also have a strong role to play in public perception development, campaigning, communication and overall public health improvement and facilitation at all scales including urban, rural and sub-urban levels (Noreen et al., 2020). Emergency department or A&E i.e. Accident & Emergency depart is one of the most critical and immediate responsive department at any hospital, acting as the door mat for the overall facility with working and operational side 24 by 7 across the year (Bhatti & Ghufran, 2020). A&E acts as a major facilitator in country like Pakistan where the severe crisis and emergency situations may rise up at any time and any place due to traffic accidents, socio-economic disparities, terrorism, epidemics, etc (Bhatti et al., 2022).



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By easing the load on other hospital departments, the emergency department also plays a crucial role in the broader healthcare system. The ED makes sure that other hospital services may concentrate on non-emergency care and long-term treatments by effectively addressing acute and urgent situations (Dewar, Barr, & Robinson, 2014). The general efficacy and efficiency of the healthcare system are preserved by this division of duties. The ED also plays a key role in emergency preparedness and response. Natural catastrophes including earthquakes, floods, and landslides are common in Pakistan (Bhatti et al., 2023). Environmental design considerations into the design development of any ED is crucial towards its functional needs as well as optimum performance based on the end user satisfaction. In ED departments associated with teaching hospitals, the aspects of learning as well as serving are integrated together and hence have a direct impact not only on the service provider but mainly on the service availing part as well (Asif, Raza, & Khalid, 2020). The patient, attendant, visitor along with medical team including doctors, nurses, paramedic staff, support staff and administration plays a vital role in delivering the most crucial help and support in the time of life and death situation for the people seeking medical attention. Hence the environmental design of these facilities is of pivotal significance towards delivery of these services as well as end user satisfaction to enable best performance (Carenzo et al., 2020).

Recent upgradation and transformation of Emergency department services in the ED block of a teaching hospital in Multan city of Punjab province was done but it was later observed that end user satisfaction with respect to environmental conduciveness was mainly missing. Hence there was a need to explore how these gaps could be documented, explored and later resolved through environmental design interventions. Hence following major research objectives were set forth:

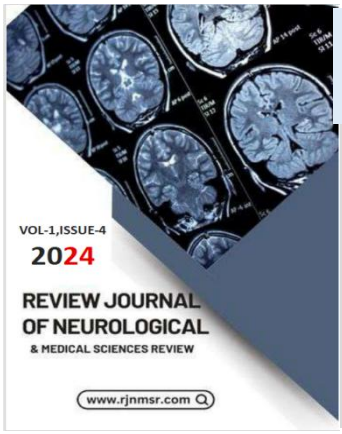
1. To evaluate and document current issues in the Emergency Department based on selected environmental variables of critical importance.
2. To propose recommendations to address the gaps observed using environmental design strategies for end user satisfaction and facility optimization.

The existing study has been able to contribute to identification of environmental variables significance in emergency department of a teaching hospital in a developing country towards optimization of spaces, functions and user satisfaction through environmental design integration. The current faced issues were documented, highlighted, discussed and later design interventions were proposed to address these gaps to help better serve the society while enabling more conducive environment for the medical teams to serve the humanity and public at large.

Literature Review

Understanding the Emergency Department & Allied Functions

An emergency department (ED), sometimes referred to as an emergency room (ER) or accident and emergency department (A&E), is a hospital facility that specializes in emergency medicine, or the acute care of patients who arrive without an appointment and are sent there either on their own or by ambulance (Shujat Bhatti et al., 2022). Usually located in a hospital or other primary care facility is the emergency department. The department must provide initial treatment for a wide



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range of illnesses and injuries, some of which may be life-threatening and require quick attention, due to the unscheduled nature of patient attendance. Emergency rooms have developed into crucial entrance sites for people without other access to healthcare in several nations. The majority of these are open seven days a week, 24 hours a day (Montana et al., 2019).

The emergency room is a fast-paced, high-stress setting created to manage a broad range of life-threatening medical issues. It is manned by a group of medical experts with training in diagnosing and treating a wide range of medical situations, including physicians, nurses, physician assistants, and support personnel. The ED is furnished with cutting-edge medical tools and supplies to guarantee prompt attention and efficient care (Cappelletti et al., 2023).

Some of the key functions of the ED may include but are not limited to the following:

a) **Immediate Medical Care**: This acts as the main responsibility. It mainly includes examination followed by diagnosis, support, stabilization and later referral to OPD or IPD (Lee et al., 2024).

b) **Triage**: It acts as the first point fo reception and segregation toenable better classification and management of the patients higher influx with priority for the most critical one on top (Gettel et al., 2022).

c) **Diagnostic Services**: After reception and initial screening, determination of the source or root cause of a patient's disease or symptoms, A&E are facilitated with diagnostic equipment like MRIs, CT scans, X-rays, and laboratory services. These can be in allied departments as well (Bosch et al., 2023).

d) **Treatment and Stabilization**: Prior to patients being admitted or moved to specialized units, the ED offers patients with the appropriate treatments, including medication administration, minor surgical operations, and stabilization (Bull et al., 2022).

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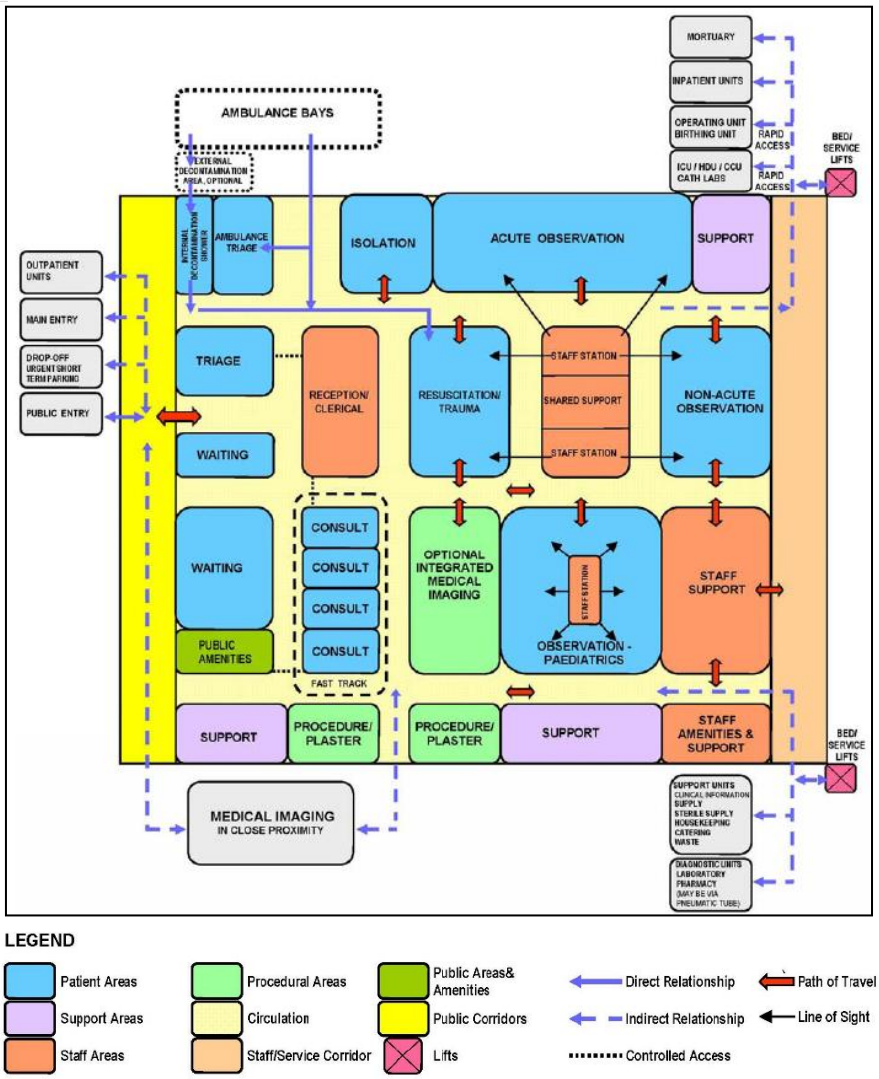
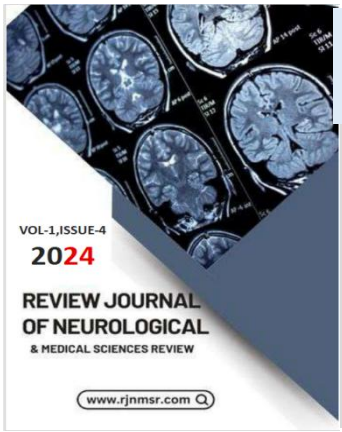


Figure 01 Emergency Department Planning for 11-30 beds (IHFG, 2017)

The emergency department is an essential part of medical education and training in a teaching hospital. It provides a distinctive learning environment where fellows, residents, and medical students can obtain practical experience under the guidance of seasoned & trained medical professionals (Saoud et al., 2018).

a) **Clinical Experience**: To obtain real-world experience managing a wide range of medical emergencies, medical students and residents cycle through the ED. Developing clinical skills and decision-making abilities requires this exposure (Bahari, Bahari, Asadi, & Asadi, 2020).

b) **Mentoring and Supervision**: Medical residents in the emergency department receive mentoring and supervision from seasoned doctors and specialists. Both guaranteeing patient safety and improving the educational process depend on following these guidelines (Santamaria et al., 2019).



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c) **Inter-professional Collaboration**: Healthcare workers are encouraged to collaborate across disciplines in the emergency department of a teaching hospital. Together, nursing students, medical students, and other trainees in the healthcare industry promote a team-based approach to patient care (Vaimann et al., 2015).

d) **Research Opportunities**: The ED offers chances for undertaking research on emergency medicine themes, and teaching hospitals are frequently involved in clinical research. Research like this advances our understanding of medicine (Pow & Skinner, 2023).

In a teaching hospital, the ED is an essential part of patient care as well as medical education. In addition to offering patients urgent and essential care, it offers medical students a vibrant learning environment. Innovations in technology, training, and research are used to address the challenges of a large patient volume, a wide range of medical illnesses, and the requirement to strike a balance between patient care and teaching. The ED in teaching hospitals will be more and more influential in determining the direction emergency medicine and medical education take as the healthcare industry changes (Bhatti et al., 2024).

Impact of COVID19 on Emergency Department Working

The COVID-19 pandemic has had a significant influence on emergency departments (ED) in Pakistani hospitals, exposing the healthcare system's advantages and disadvantages in the nation. Healthcare practitioners and infrastructure faced considerable hurdles due to the highly contagious nature of the virus and the abrupt and extraordinary spike in patient numbers. These difficulties included everything from a lack of resources and safety issues to psychological pressure on medical staff and behavioral shifts in patients (Bhatti & Huma, 2023). Many Pakistani public hospitals were already struggling with underfunded and overcrowded circumstances prior to the outbreak of pandemic. These problems were made worse by the COVID-19 patient surge, which overloaded emergency rooms that were unprepared for the increase of patients. Due to lack of medical support and infrastructure to manage large scale pandemic situation, with focus on need of isolation wards and intensive care units (ICUs), many patients were not able to receive treatment in time and lead to fatalities (Bhatti et al., 2023).

There was a time in which it turned out to be a major lack of necessary medical support, supplies, services and equipment which resulted in an immediate surge in patient influx due to pandemic. Testing kits, ventilators, oxygen supply, and personal protective equipment (PPE) were severely lacking. In addition to making it more difficult to treat patients successfully, this scarcity raised the possibility that healthcare personnel may spread viruses to one another. To fill the gaps, many hospitals had to rely on contributions and last-minute purchases, but supply was frequently insufficient (Bhatti et al., 2024).

During the pandemic, medical personnel in Pakistan's emergency rooms faced tremendous strain and danger. Their workload and stress levels increased due to the high patient load and the requirement to adhere to tight infection control standards. Their worry of getting infected and maybe infecting their family was exacerbated by the inadequate personal protective equipment (PPE). There were reports of a high

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number of infections and deaths among healthcare personnel, which made the staffing crisis worse and put more pressure on the surviving employees (Guo et al., 2015). The psychological effects on medical staff were significant. Burnout, anxiety, and despair were brought on by the high death rate, ongoing exposure to seriously ill patients, and infection dread. Numerous healthcare professionals were left to handle these problems on their own since support networks, such as counseling and mental health services, were frequently insufficient to manage them (Zamani, 2022).

The Pakistani government took a number of actions to strengthen the healthcare system's reaction to COVID-19. These included establishing hospitals specifically for COVID-19 patients, expanding the number of testing centers, and accelerating the acquisition of medical supplies and equipment. Healthcare facilities received funding to improve their infrastructure and capacity. In an effort to stop the virus's spread and safeguard vulnerable groups like healthcare workers, the government also started vaccination initiatives. Emergency rooms and the larger healthcare system in Pakistan have been permanently impacted by the COVID-19 outbreak. The crisis has brought to light the need of having a strong and durable healthcare infrastructure, sufficient medical supplies, and adequately trained healthcare personnel. It has brought attention to how important healthcare spending is and how it can help at multifold level in healthcare system to manage epidemics and public health at large (Hosseini-Shokouh et al., 2022).

Critical variables of Environmental Design in Emergency Department

Environment lies at the heart of any healthcare facility and environmental design aspects and variables play a significant role in managing and enhancing the optimum performance of these facilities at large. With respect to Emergency Departments, following major key aspects are highly critical towards developing better outcomes and success at managing and delivery of services at these departments (Sampson & Johnson, 2023).

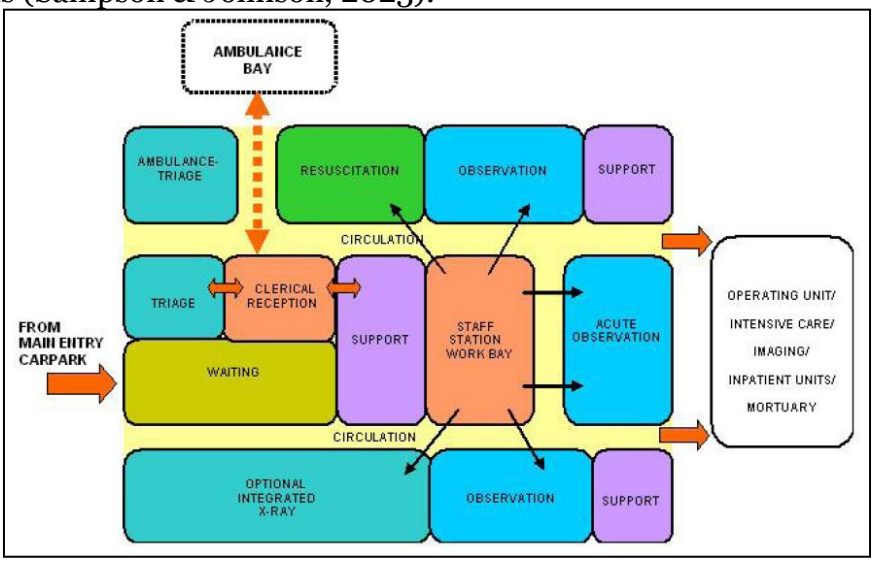

Figure 02: Critical components of Emergency department (IHFG, 2017)

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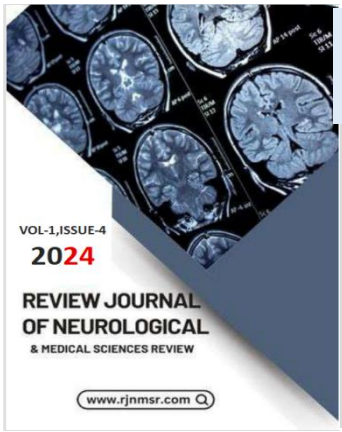
Way-finding and Accessibility When designing an emergency department, accessibility is crucial. Regardless of their level of knowledge with the hospital, patients and their families must be able to find and access the ED with ease. It is essential to have well-marked entrances, easily navigable navigation systems, and clear signage. Confusion can be decreased by using several languages and universal symbols. To guarantee that it can be immediately located in an emergency, the ED entrance should also be easily distinguished from other areas of the hospital (Omer Shujat Bhatti, Wahida, Bhatti, & Zahid, 2024).

Access passage and Area of Triage The first areas of contact in an ED are the entrance and the triage area. The layout needs to allow for the quick influx of patients and guarantee a smooth transition from admission to care. To avoid accidents, there should be a distinct division between pedestrian and vehicular traffic, and the entry should be large enough to accommodate wheelchairs and stretchers. The triage area inside should be set up to quickly examine patients and rank them according to the severity of their conditions. To help with preliminary assessments, this space should be roomy, well-lit, and furnished with the medical equipment that is required (Bhatti et al., 2023).

Flow of Patients and Zoning An essential component of ED design is effective patient flow. Triage, treatment rooms, diagnostic centers, and operation rooms should be as close together as possible in the layout. Reducing bottlenecks, enhancing response times, and regulating patient flow can all be achieved with the use of well-planned zoning and clear paths. One way to reduce crowding and guarantee that patients with urgent needs receive care on time is to divide high-acuity and low-acuity zones. In order to guarantee comfort and secrecy, private and semi-private areas should also be provided for patient examinations (Bhatti et al., 2024).

Areas of Treatment The ED's treatment spaces need to be built to handle a variety of medical crises. These areas ought to be adaptable, enabling prompt reconfiguration in response to changes in patient load and the kinds of situations being handled. It's crucial that there be enough room surrounding treatment beds for medical personnel to walk about and access equipment. Standard features should include oxygen outlets, suction units, and sophisticated monitoring systems, among other essential medical equipment. Incorporating elements like climate control and adjustable lighting can also improve patient comfort and facilitate medical procedures (Khairina et al., 2023).

Control of Infections Hospital design places a high premium on infection control, particularly in the emergency department (ED) where cross-contamination is a major concern. Materials and finishes that are pathogen-resistant and easy to clean should be used in the design. Throughout the department, hand-washing stations should be positioned thoughtfully to promote consistent hand hygiene among employees and guests. Negative pressure ventilation systems used in isolation rooms can aid in containing and halting the spread of infectious diseases. To reduce the



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danger of infection, the layout should also facilitate the easy movement of garbage and contaminated items away from patient care areas. (Castanheira-Pinto et al., 2021)

Comfort and Privacy In the emergency department, patient comfort and privacy are critical to fostering a healing atmosphere. Soundproofed private treatment rooms or bays can lessen stress and safeguard patient privacy. Patients and their family may feel less anxious in waiting rooms with cozy seating, lots of natural light, and soothing color schemes. The patient experience can also be improved by adding facilities like televisions, reading materials, and snack places. In addition, family members' requirements should be taken into account when designing the space, with designated areas for them to rest and get information on the health of their loved ones (Hammoumi & Qesmi, 2020).

Sustainability In healthcare design, sustainability is becoming more and more significant. To lessen its carbon footprint, the ED should use eco-friendly procedures and supplies. This can involve using sustainable construction materials, water-saving fixtures, and HVAC and lighting systems that consume less energy. In order to give patients and staff with a peaceful environment, the design should also take into account the incorporation of green spaces, such as gardens or courtyards. In addition, the hospital's general sustainability objectives may benefit from the usage of renewable energy sources like solar panels (Ayyaz et al., 2020).

Acoustics Maintaining a quiet and productive atmosphere in the ED requires careful management of noise levels. Elevated decibel levels have been shown to exacerbate stress and impede staff communication. To minimize noise, the design should include strategically placed layouts and materials that absorb sound. Soundproof private treatment rooms can reduce the disturbance noise level for patients. To further control the department's overall acoustics, zoning systems that divide loud activity from quieter sections should be put in place (Auerbach et al., 2020).

Lighting In an ED, adequate lighting is essential for both functional and psychological reasons. It has been demonstrated that natural light elevates happiness and lowers stress in both staff and patients. As a result, wherever feasible, the design should make the most of natural light coming from windows and skylights. But artificial illumination is also necessary, and it needs to be arranged wisely. Systems with adjustable lighting can offer softer, ambient light for patient comfort and intense, focused light for medical procedures. In the event of a power outage, emergency backup lighting is also required to guarantee the ED's continued operation (Carenzo et al., 2020).

Flexibility and Future-Proofing An ED's architecture needs to be flexible enough to change with the times in terms of technology and medical procedures. When demands change, spaces can be easily reconfigured thanks to modular design principles. Future technological advancements, such the installation of new medical equipment or improved IT systems, should be supported by the infrastructure. It can be advantageous to plan for future growth as well, since this will guarantee that the ED can expand to accommodate the growing number of patients without causing major problems (Ali & Gatiti, 2020).

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Sensitivity to Culture It's critical that an ED's design be inclusive and culturally sensitive in varied populations. This involves creating areas that can support different cultural customs and viewpoints. Prayer rooms or other quiet areas for introspection, for instance, may be crucial for patients and their families who practice different religions. The design ought to take into account the requirements of patients who do not understand English by integrating multilingual signage and translation services (Atif & Malik, 2020).

Engagement of Patients and Families Participating in the care process with patients and their families can enhance results and satisfaction. The ED's layout should encourage this kind of interaction by including areas where relatives can stay with patients in comfort. Digital screens or information boards can inform families about the care process and wait periods. Involving families and patients in the design phase can also assist guarantee that the ED fulfills their requirements and expectations (Hayat et al., 2020).

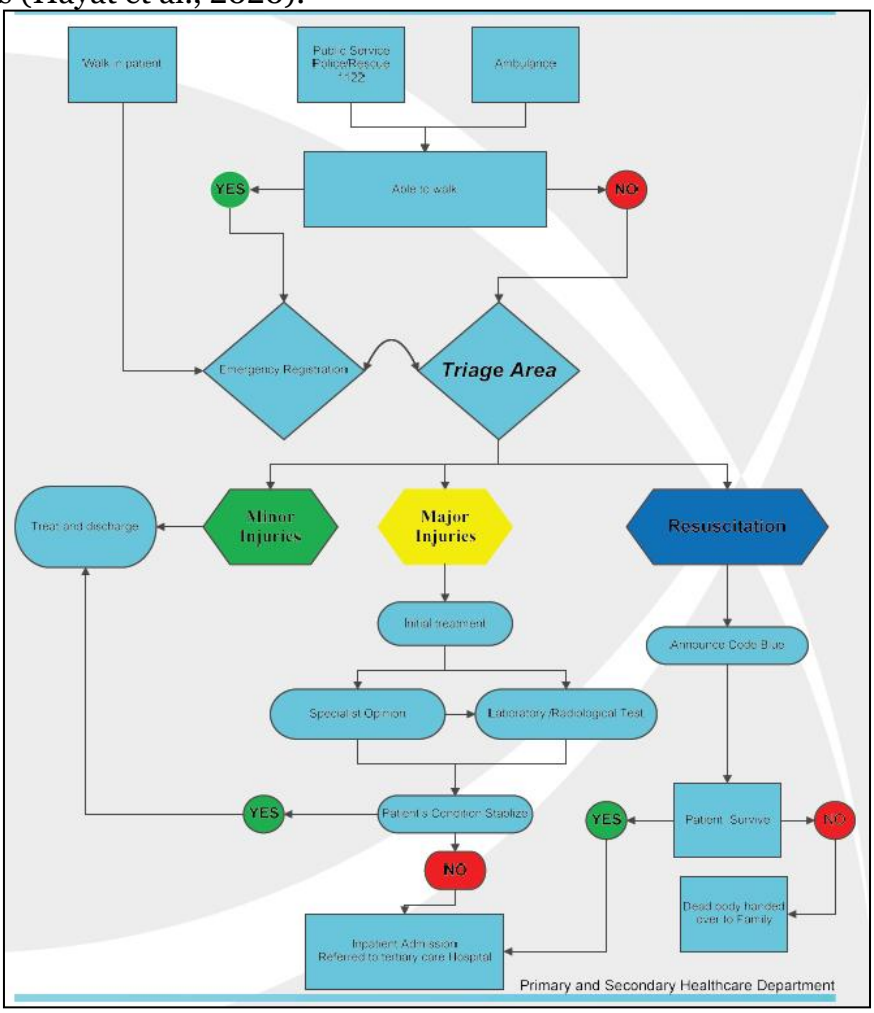
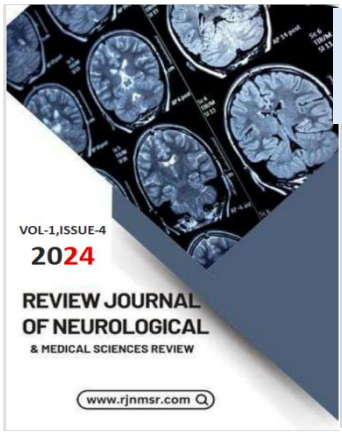


Figure 03: Internal Patient flow (MSDS, 2020)



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To build a more resilient and equitable healthcare system, Pakistan must continue to invest in health infrastructure, ensure adequate funding, and address systemic issues such as corruption and mismanagement. By focusing on these areas, the country can improve healthcare outcomes and ensure that all citizens have access to the care they need.

Research Methodology

In order to carry out the research further ahead and devise the modalities, research work by multiple researchers was explored and baselined, one questionnaires which was adapted with respect to the current exploration was evolved. Observational study along with site documentation was carried out later by data collection through questionnaires form respondents in the explored spaces.

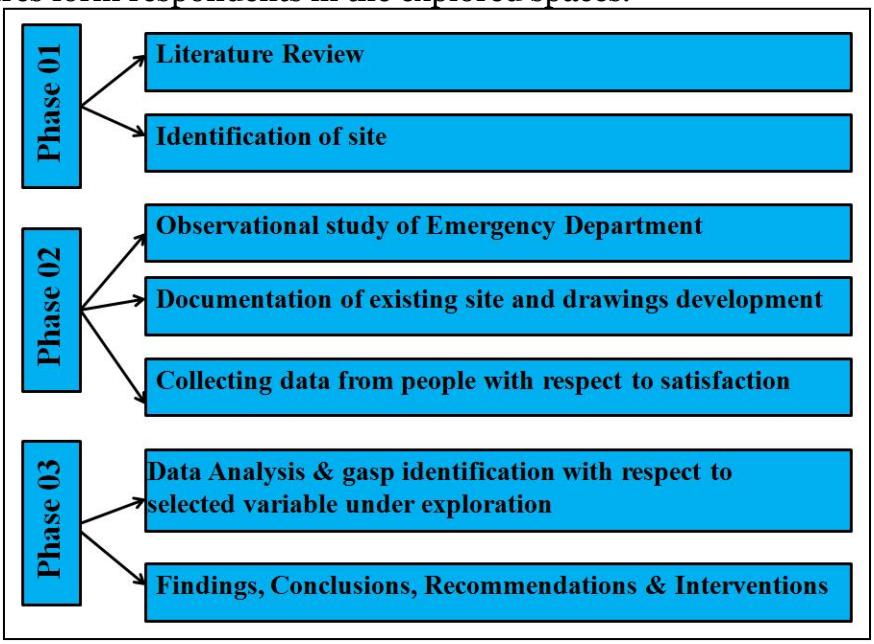
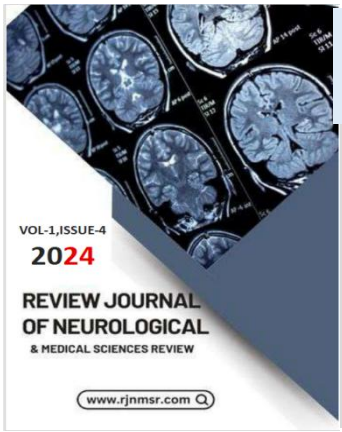


Figure 04 Research steps & sequence of information flow

Population of the research exploration was large as it encompasses patients, attendants, medical staff, support staff, nurses, doctors, physicians, administration people and allied. . Yet to manage the research within the stipulated timeline and resources, sampling was used. Here the sample consisted of patients, attendants and medical staff mainly doctors, nurses and support staff using these explored spaces with respect to patient center areas. The sample size mainly consisted of 100 and above respondents. Sampling technique used mainly was purposive based on the focus respondents using these spaces and their extensive exposure.

Data Collection and Analysis

Based on the review of literature and developed research methodology, data collection and analysis phase started. In order to carry out the data collection, prior permission was taken from the administration of the Accident & Emergency Department (A&E) at selected Bakhtawar Amin Trust hospital Multan city.



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Taking forward the research, data collection was done using multiple tools which incorporated observational study followed by respondents questionnaire based data collection. An initial checklist was evolved through review of literature and later helped in reframing the questionnaire. With respect to the documentation of the selected facility physically, architectural plan was developed using AutoCAD through onsite measurements. Photography was also done on site to ensure observational study had ample proof based evidence. Research timeline is shared below. The timeline of the data collection and observational study is shown below in Table 01.

Table 01 Timeline of Documentation & Data Collection

S.No	Activity	Tools used	Time Duration
01	Observational study as initial stage	Photography, measuring tools, AutoCAD for developing architectural plans.	April, 2024 (14 days)
02	Observational study along with data collection	Checklist	April, 2024 (14 days)
03	Respondents data collection phase only	Questionnaire	April-May, 2024
05	Data Compilation of collected data from previous phases	MS Excel	June, 2024

As evident from the table 01 above, multiple phases and their respective timelines along with details are highlighted. It all started in April-2024 and got completed till June-2024 comprising of almost 90 days time frame. Documentation & observational study took 14 days towards its completion, during the same stage initial checklist data completion got started as well. April-May, 2024 was mainly dedicated for data collection from respondents. Since it was an A&E department, hence very few people agreed to communicate and hence it took more time to collect data. Data compilation and later analysis was followed in June, 2024.

Observational Study & Site Documentation

Researcher initiated the site documentation through photography along with taking measurements of the existing facility and developing its architectural plans. These took almost 14 days to ensure the directions given were followed with ample visits to complete the assigned task. The documentation through photographs and figures are shown below:

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Figure 04 Passage to the A&E Department from main entrance of hospital

As shown above in the figure 04, the A&E access which is comparatively away from the main central gate is evident. This distance makes the patient access to the space more complicated and delayed.

Figure 05 Man entrance and exterior of the A&E Department

As evident from figure 05, entrance of the main hospital A&E department is on the side of the building and was not very welcoming. It also lacked any focused space for the ambulance drop point as well as separate stretcher or wheel chair bay.

Figure 06 Main entrance lobby and attendants waiting

As evident from the figure 06, the main reception area as well as the waiting lounge for the attendants and visitors was very congested and small and overall felt lack of fresh air, cross ventilation, natural lighting, natural views to help cope with mental stress of the emergency situation faced by the people coming to these spaces.

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Figure 07 Main Patients Hall

Figure 08 Main central hall reception area

As evident from Figure 07-08, the overall hall is mainly lead through a formal reception which acts as a nursing station with respect to admin services along with nursing staff related to allied functions like basic demographic, medical history and vital's recording etc.

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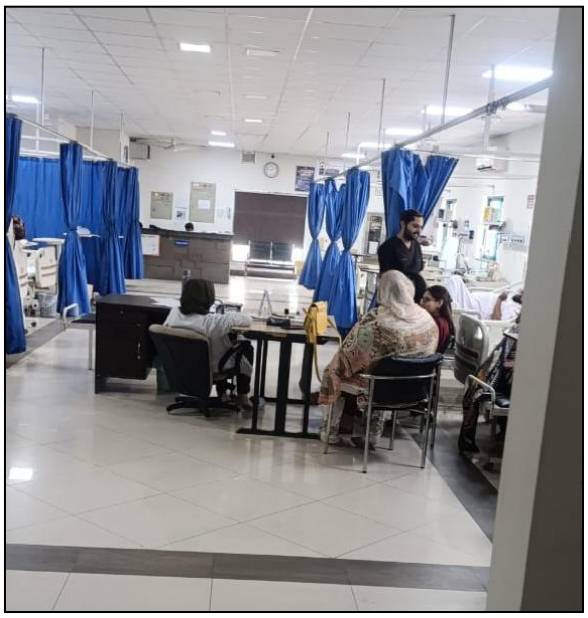

Figure 09 Doctors & Paramedic staff counter

As evident from figure 09, the main medical over looking, observational, examination and support people were teamed up in the center of the hall with one table acting as the central nursing station. This not only was having trouble for movement across the ward but also created visual and physical privacy issues for the patients, visitors, attendants and the medical team itself due to poor location and lack of proper design of the facility.

Figure 10 Waste segregation

As shown above in the figure 10, waste segregation protocol was followed with compliance based on the guidelines and its details mentioned above the multiple waste collection buckets placed within the ward.

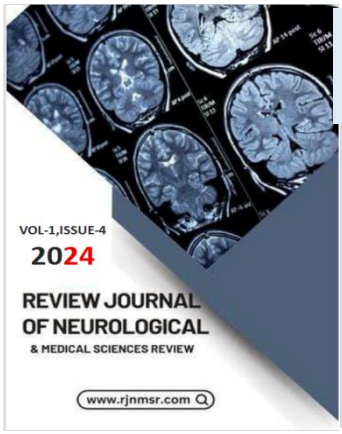

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Figure 11 Medical support systems and medicines staking using crash carts

As evident from the figure 11, medical support systems, medication trolley and support stuff was placed at the end of the corner of A&E ward. This helped managed the space but immediate movement based support and sharing of trolley was not easy to poor location and accessibility.

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Figure 12 Minor OT

Figure 12 shows the overall planning and location of the Minor Operation Theater (OT) in the A&E department. Though it had the major equipment as well as space to perform the allied functional necessities, without a space for a Medical Officer or in house surgeon, a toilet was attached with the OT which compromised its functional protocol for hygiene and sterilization of internal spaces and their optimized working.

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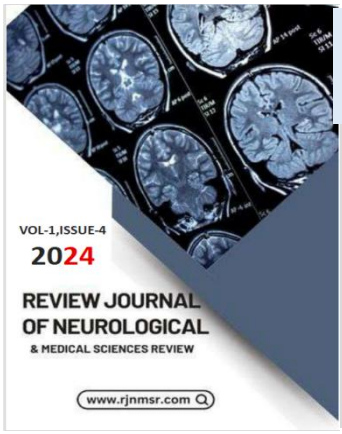

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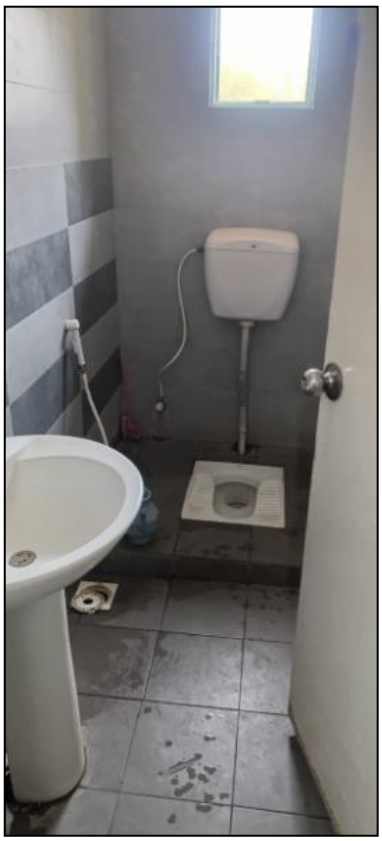

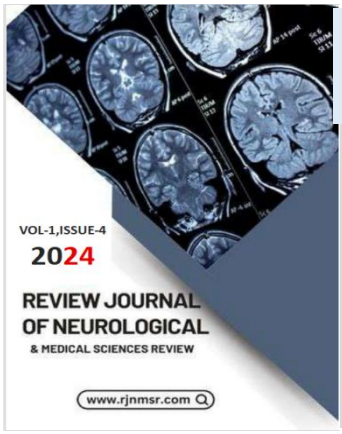

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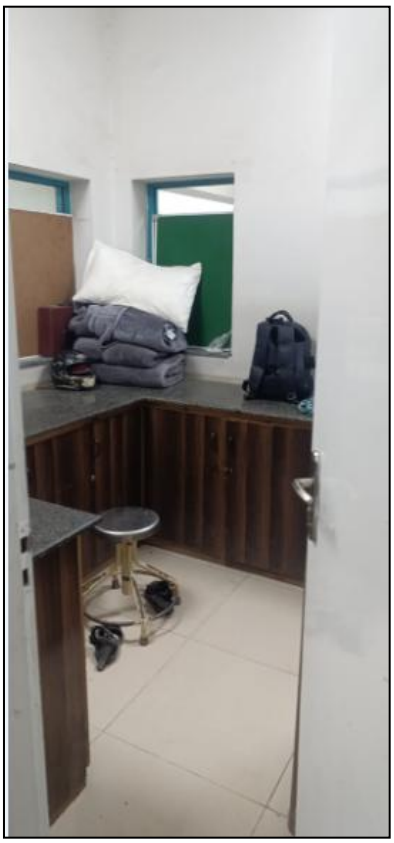

Figure 13 Multiple Indoor Spaces

As evident from the figures shown above in figure 13, there was a complete lack of management, control and administration for the store associated with the A&E department. The toilets provided lacked seating WC as well as hand support rail and the overall size was not conducive to accommodate patient on wheel chair. The phlebotomy or medical lab based facility lacked zoning and internal finishes were not as per standard.

As evident from the observational study done, the facility planned lacked the prioritization of spatial, functional and environmental consideration in the overall building. It seems that with help of medical teams, facility has been kept operational but its functional optimization needs as well as standardization has been completely ignored. It highlighted that these functions along with environmental consideration of noise, views, fresh air & cross ventilation, day lighting, segregation, thermal comfort and allied aspects were also ignored. Hence it was decided to carry on with the data collection after completion of the architectural plan documentation of the facility explored as shown below in the figure 14.

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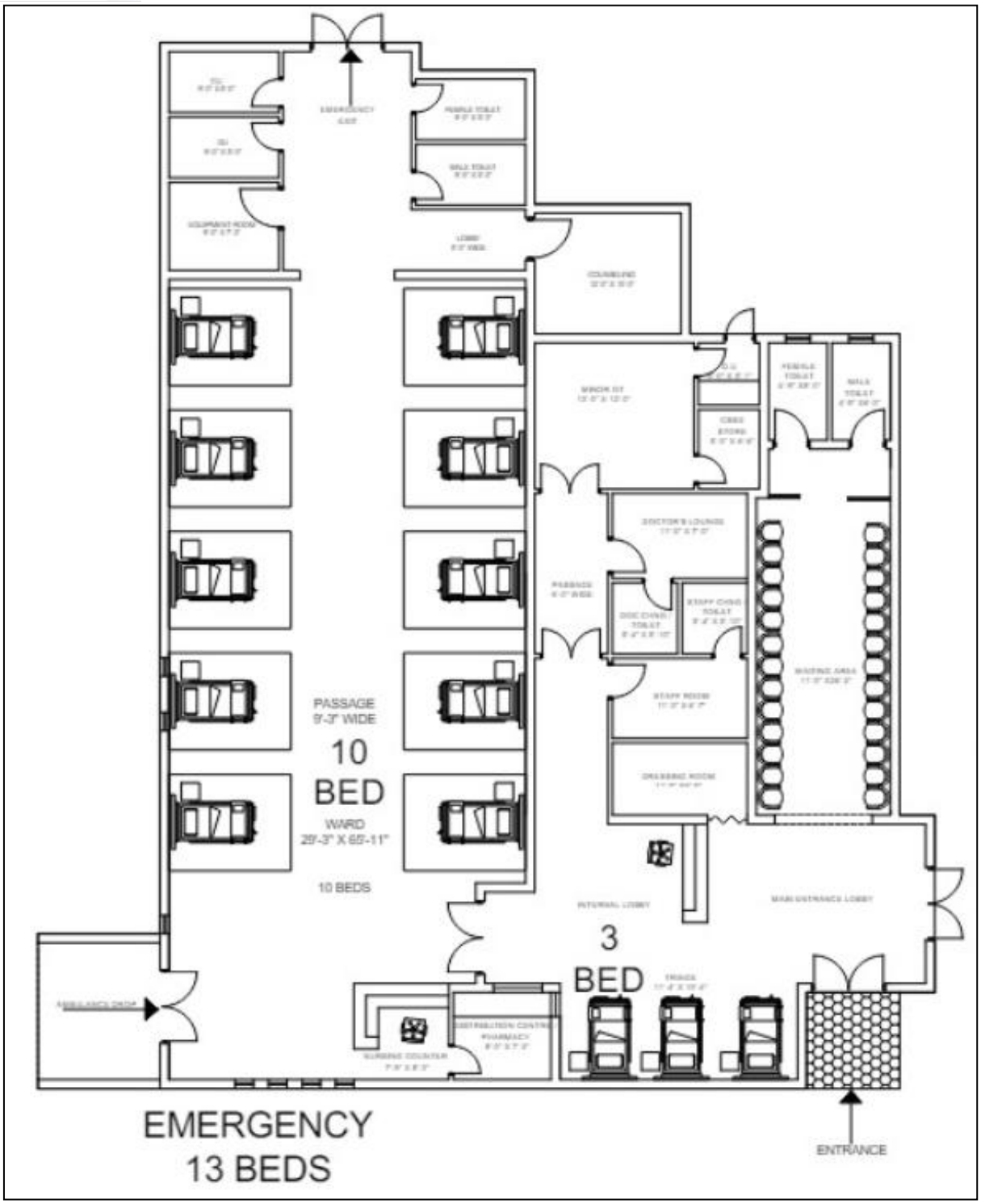
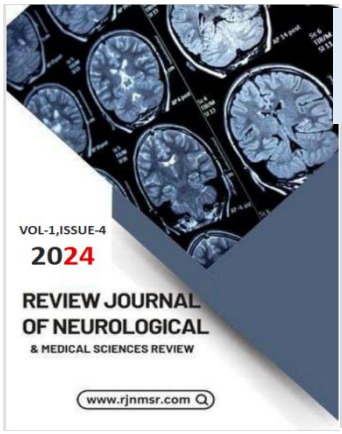


Figure 14 Architectural plan of the A&E Department.



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In order to complete the observational study based on the environmental considerations, the developed checklist was used as shared below in table 4.2 which used 5 point likert scale with highly unsatisfied, unsatisfied, neutral, satisfied and highly satisfied values as measuring tool.

Table 02: Observational Sheet Data

S.No	Variable	Ranking
1	Natural lighting	Unsatisfied
2	Artificial lighting	Satisfied
3	Ground & landscape	Highly unsatisfied
4	Furniture layout	Highly unsatisfied
5	Color design	Highly unsatisfied
6	Space design	Highly unsatisfied
7	Noise level	Unsatisfied
8	Air freshness	Unsatisfied
9	Temperature	Unsatisfied
10	Humidity	Unsatisfied
11	Seating comfort	Highly unsatisfied
12	Seating sufficiency	Highly unsatisfied
13	Cleanliness	Unsatisfied
14	Air freshness of restrooms	Not provided in OPD, have to move to next building for it.
15	Cleanliness of restrooms	Not provided in OPD, have to move to next building for it.
16	Signage	Satisfied
17	Accessibility	Highly unsatisfied
18	Highlight top 5 issue areas	Accessibility, humidity, temperature, thermal comfort, space design & hygiene conditions.

As shown above in the table 02, major issues observed were highlighted in grey color and were mainly related to natural lighting, landscape, green elements, furniture layout, color and scheme design, space design, noise level, air freshness, humidity, temperature, seating sufficiency and comfort, availability of restrooms, and accessibility. It was clearly evident during this phase of the research documentation and observational study that there were major issues in the design of the facility as well as in its usage.

Data Collection – Patients, Attendants, Medical Team and Allied Staff

Data collection from respondents got initiated in April-May, 2024. The overall distribution of the respondents is shown below in table 4.3 and their respective percentages is shown below in table 03.

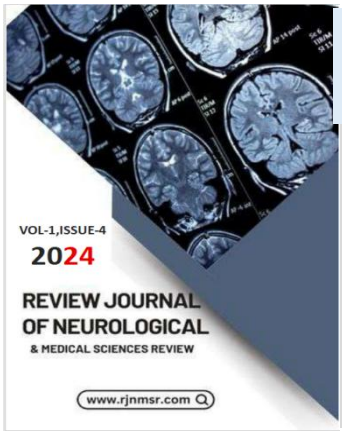

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Table 03: Respondents Distribution in Summer

Variables	Count	Age category	Count
Male	74	Less than 20	12
Female	32	20-30	20
Doctors	12	31-40	30
Nurses	17	41-50	32
Patients	40	51-60	9
Attendants	22	61 & above	3
Visitors	15		

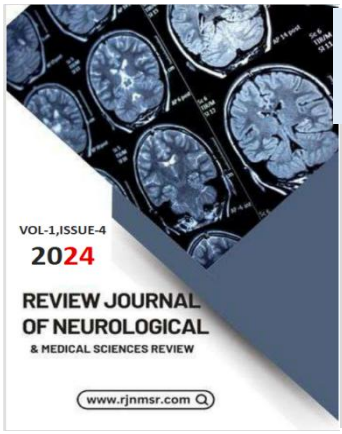
Table 04: Respondents distribution in Summer percentages

Variables	Count	Age category	Count
Male	70%	Less than 20	11%
Female	30%	20-30	19%
Doctors	11%	31-40	28%
Nurses	16%	41-50	30%
Patients	38%	51-60	8%
Attendants	21%	61 & above	3%
Visitors	14%		

As evident from the above shared data, overall total respondents were 106 out of which 77 respondents were from the patients as well as attendants side while 29 were from the medical facilitation and services side. Overall majority of sample i.e. 70% were mainly Male respondents followed by 30% female respondents. With respect to age categorization, major share was in the age group of 41-50 with 30% later followed by 28% from the age group of 31-40. The respondents overall responding to the environmental questionnaire is shown below in Table 05.

Table 05: Respondents Data

Environmental Variables						
S.No	Variable	Highly unsatisfied	Unsatisfied	Normal	Satisfied	Highly satisfied
1	Natural lighting	23	25	33	15	10
2	Artificial lighting	15	12	22	54	3
3	Ground & landscape	52	29	20	4	1
4	Furniture layout	9	37	32	20	8
5	Color design	40	23	21	12	10
6	Space design	18	37	25	17	9
7	Noise level	32	35	22	8	9
8	Air freshness	23	55	15	8	5
9	Temperature	15	48	36	5	2



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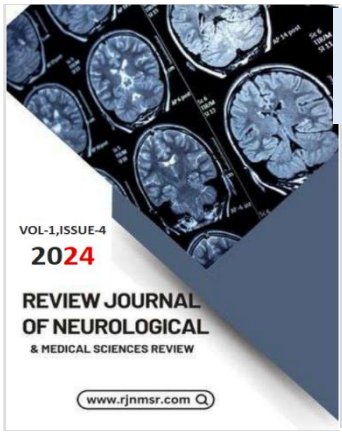
10	Humidity	24	38	26	10	8
11	Seating comfort	15	32	36	15	8
12	Seating sufficiency	42	35	24	5	0
13	Cleanliness	28	35	22	11	10
14	Air freshness of restrooms	32	35	22	8	9
15	Cleanliness of restrooms	24	31	28	15	8
16	Signage	16	15	66	8	1
17	Accessibility	32	28	31	9	6
18	Highlight top 5 issue areas	Lighting, temperature, color design, noise level, seating sufficiency, cleanliness, accessibility				

As shown above in the table 05, 17 multiple environment related variables were explored from the respondents. The grey areas mark the higher values. Natural lighting was acceptable while artificial lighting and landscape were not satisfactory. Other major unsatisfactory variables included color design, space design, noise levels, seating sufficiency, cleanliness, air freshness and cleanliness in restrooms and accessibility. Furniture layout, natural lighting, overall air freshness, humidity, seating comfort, signage were close to acceptability range. While opting for discussion it was observed that major highlighted issues included, lighting, temperature in extreme conditions, noise levels, lack of proper seating with ample seats for patients and attendants, cleanliness and accessibility needs much improvement. Hence overall the OPD department environmental performance was low in major explored areas and needed much attention in summer season. As evident from the explored data above, majority of the variables mainly were found in the “unsatisfactory” category and some of the major ones lies next to neutral which is like next to the unsatisfied category. During the process of data collection, as part of exploration, researcher discussed in detail through discussion and informal talk about the explored aspects of environmental considerations. It was clear from the respondents data and their opinions based on their responses that the people primarily were not satisfied with these critical aspects and have faced hurdles & issues earlier as well. Since, some of the respondents were also from the rural and sub-urban backgrounds and vicinities, they felt relief as they were not able to get any medical treatment prior to visiting the explored facility and were happy in the current scenario. However most of the people who have visited the facility a number of times were facing these issues and wanted these to be addressed.

Data Analysis & Interpretations

With the help of literature review and defined research methodology, data collection and its analysis was executed. It started with documentation of the OPD facility using architectural plans and was also followed by observational study by the researcher. During this phase of documentation, 14 days were used and it was done at the time when the A&E was not actively occupied while observational study was done when the A&E was actively functioning and working so that the system and operational guidelines could be understood well.



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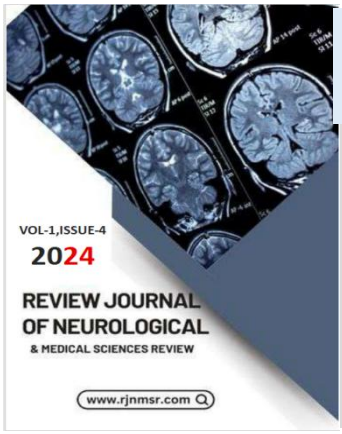
Each incoming patient received support from one or multiple attendants when entering the hospital facility. People who arrive are left off at the gate then must walk to the main A&E entrance unless they possess transportation or receive services through ambulance. Only stairs existed at this entrance so medical staff with family members and attendants needed to assist patients in wheelchairs and stretcher patients to descend to the ground floor. Patients need to pass their checkup slip to reception personnel for verification following building entry. The A&E in-charge assumes patient cases based on emergency needs and severity order when several patients arrive simultaneously. The patients can either receive an OPD referral or need to be directed to departments including IPD, Diagnostics and Radiology and Mortuary. The total time for this process spans from 15 minutes to 2 hours based on patient volume and bed availability at A&E.

The respondents reported that temperatures inside the building were 30-40 Centigrades lower than outside conditions. Vehicular access between the main gate and the main Accidents and Emergency entrance remained prohibited which caused problems for patients as well as their attendants. All patients who managed to reach the A&E entrance faced problems due to the nonexistent ramp facility. The dependent patient population requires outside assistance for help. Hospital patients faced difficulties during admission when searching for an empty bed and seeking external medical products along with support items because the core medical stock location was separate from the main facility area.

The waiting area lacks enough natural and ambient indoor illumination but the consultant rooms receive less natural light because they have only one small window. Waiting areas and corridor received better artificial lighting than patient-centered spaces and wards at the facility. There were insufficient pieces of furniture in the patient wards and attendants seating areas designed for patients. The end users of both categories experienced dissatisfaction because of elevated noise levels together with inadequate color choices and poor space organization. People must wait without proper seating allocation because adequate seating areas do not exist while previous patients need to finish examinations and depart before new critical patients can obtain care.

The A&E facility's substandard restroom systems entirely hindered medical teams and facility staff as well as their patients because of inadequate storage spaces combined with insufficient clean and dirty linen distribution systems and faulty laboratory rooms. Orthopedic patients together with gynecology patients and older patients faced significant barriers because of the absence of a ramp system. The respondents categories enabled the researcher to concentrate on understanding both their needs and functional requirements. Many nurses and medical team members explained that such environmental problems started to become a problem when construction of the building began and have hindered their best work performance due to unsatisfying indoor environments. The A&E department requires lighting enhancement together with accessibility improvements and thermal comfort upgrades and functional room and allied space facilities to achieve optimal delivery. The A&E system received better patient acceptance through improved accessibility



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and better bed availability and thermal comfort and increased seating capacity as main service quality determinants. The attendants considered seating space along with patient access and communication support systems and external medication unit access as well as outdoor sitting in a covered area together with ramp access and proper parking facilities and seating options important for their needs.

Research Findings

The research investigated the present Accident & emergency facility while documenting the operational protocols that direct management operations. The accomplishment of this objective happened through documenting the existing facility by utilizing physical measurements to create drawings and plans. Observational work and photography added to the study to understand end-user management of the facility regarding both clinical staff and patient care activities and reception of visitors and accompanying individuals. The facility shows deficiencies because it was constructed for Accident & emergency needs but the design provides insufficient capacity for growth and offers no flexibility for changes inside the current structure. Several deficiencies included inadequate access points, insufficient integration of patient facilities and attendant spaces, insufficient storage solutions and a complete absence of X-ray diagnostics in the A&E area and poor ventilation combined with excessive moisture levels and insufficient seating arrangements with inadequate design quality. The researcher documented these major problems with other technical concerns during observations. Even though space was abundant the architectural design did not follow purposes for which it was intended.

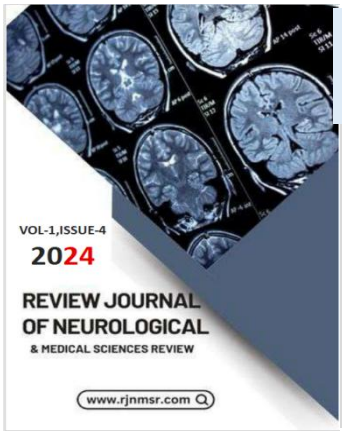
The assessment of user satisfaction through environmental variables formed the second objective of the study investigation. The user base divided itself into two main groups that researchers separated into distinct subcategories for research purposes. The research data collection process resulted from a questionnaire developers created and used both as an estimation tool and an observation foundation. The research received 106 responses with 70 percent males and 30 percent females and 38 percent respondents identified as patients and all others who did not fall under these categories made up a total of 27 percent. This environment fell short in several aspects: it lacked proper day and natural lighting as well as suffered from poor color schemes and unclean air while the noise levels were too high and temperature too hot and humidity too low. Seating was uncomfortable and internal architectural design was subpar.

The third objective concentrated on establishing design proposals which addressed the recognized problems to enhance emergency department operational effectiveness. A redesign of the internal cross ventilation system should combine HVAC with solar power collected from rooftop Solar panels while implementing open window channels into external walls to maximize daylight usage across the emergency facility.

Research Conclusions

Following were the major conclusions of the research exploration:

1. With respect to major conclusions of the research exploration, it was concluded that overall facility design had ample area for the fulfillment of design requirements however the core functional and environmental needs of the Accident



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& Emergency department based aspects with focus on social and functionality based allied parameters were ignored. Though the focus was on medical workability and its optimization through treatment and medication but design was compromised and hence overall user satisfaction was lacking.

2. It was concluded that climatic and environmental conditions were mainly ignored in the design of the facility. Lack of cross ventilation, natural day lighting or even diffuse lighting was avoided, thermal comfort was completely dependent on the HVAC system and hence indoor air quality and ambient quality of space was compromised. This also compromised the wellness needs of the services provision side.

3. Environmental variables were also ignored and there was lack of satisfaction amongst the users with major environmental as well as functional variables associated with the A&E facility design and operational usage.

4. Spaces designated for visitors, attendants and partial spaces for patients were lacking functional and operational needs with considerations for the end user workability and needs. It was confirmed through comparison of observational study and respondents data.

5. Although the exploration was done in a designated healthcare teaching facility, public prioritization for needs fulfillment or end user centric design was missing and thus only major medical and allied considerations was under focused to fulfill design needs only. Hence expansion or even optimization will be very hard due to existing maximized usage of space in the hospital and A&E vicinity.

6. Social aspects of public seating and public spaces with focus on thermal comfort and environmental based wellness for end users i.e. attendants or allied was not considered and aspects of privacy/pardah were also ignored in attendants side.

7. With respect to an overview of the research exploration, some of the key aspects which needed much attention towards improvement mainly included consideration for optimization of day lighting in the overall design of the department, managing noise and thermal comfort issues, integration of internal and external landscape design in the facility, spatial considerations for the seating spaces optimization, ensuring indoor air quality is of good level and overall facility hygiene and cleanliness is not compromised.

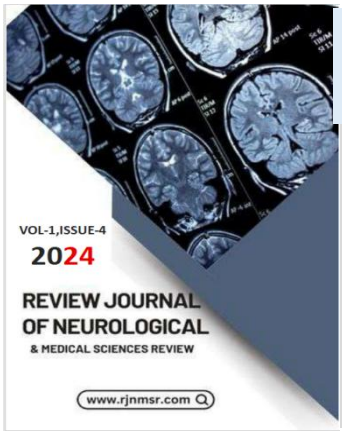
8. Though the overall design of the facility was ample with respect to area and medical needs how ever the lack of human centered approach to design and its enhancement for the improvement of the spatial experience must be incorporated.

Research Recommendations

Following were the major recommendations based on the research exploration with respect to the three objectives defined and hence focus on improving the A&E operational and functional usage.

1. Enhancing to manage the air flow mechanism and its enhancement in the entrance, allied passages, side corridors and associated spaces along with seating areas would be needed to enhance the indoor spatial experience.

2. There is a strong need to provide proper day light and prioritize its availability during the day hours without letting glare disturb the working of the department.



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With natural cross ventilation using the locally cost effective available air coolers for attendants could act as a blessing due to harsh environment and climatic conditions. These would facilitate both patients, attendants as well as medical staff serving them.

3. There is a critical need to bring in the buffer zoning to make spaces more physically and managerially manageable.
4. With improved cross ventilation even if introduction of a HVAC system is required, will be beneficial for all the human beings in the physical built-form of the department.
5. Need to improve and enhance the indoor artificial lighting.
6. With a pure psychological need as well as improvement towards making time well spent and reducing stress, there is a need to introduce indoor color scheme with arrangements and enhancements using design based aesthetic components like paintings, calligraphy, etc.
7. With enhancing need for movement and facilitation of beds/stretchers/wheel chairs movement, relocating central nursing station to other side of the main ward would help better manage the circulation within ward.
8. Addition of toilets for visitors, attendants with patients, patients and allied through using rear open spaces could be a facilitation needed for long run satisfaction of the people. One of the options could be to opt for portable cabins or prefabricated containers based design solutions.
9. With high demand of electricity and energy while facing its shortage, harnessing solar energy towards energy optimization with respect to operational needs like improved artificial lighting, HVAC working and managing cost of the rising energy could be a value addition.
10. There is a need to correlate the overall design with existing buildings in the vicinity of the department as well as future expansions to be kept considered while planning for such expansions and additions.
11. With respect to future further explorations in the current domain and context, it would be beneficial to opt for open ended questionnaire with focus group study for further development of knowledge and exploration of timeline studies.

Proposed Design Interventions

Based on the shared recommendations, following design intervention has been developed considering the future sustainable usage of the facility:

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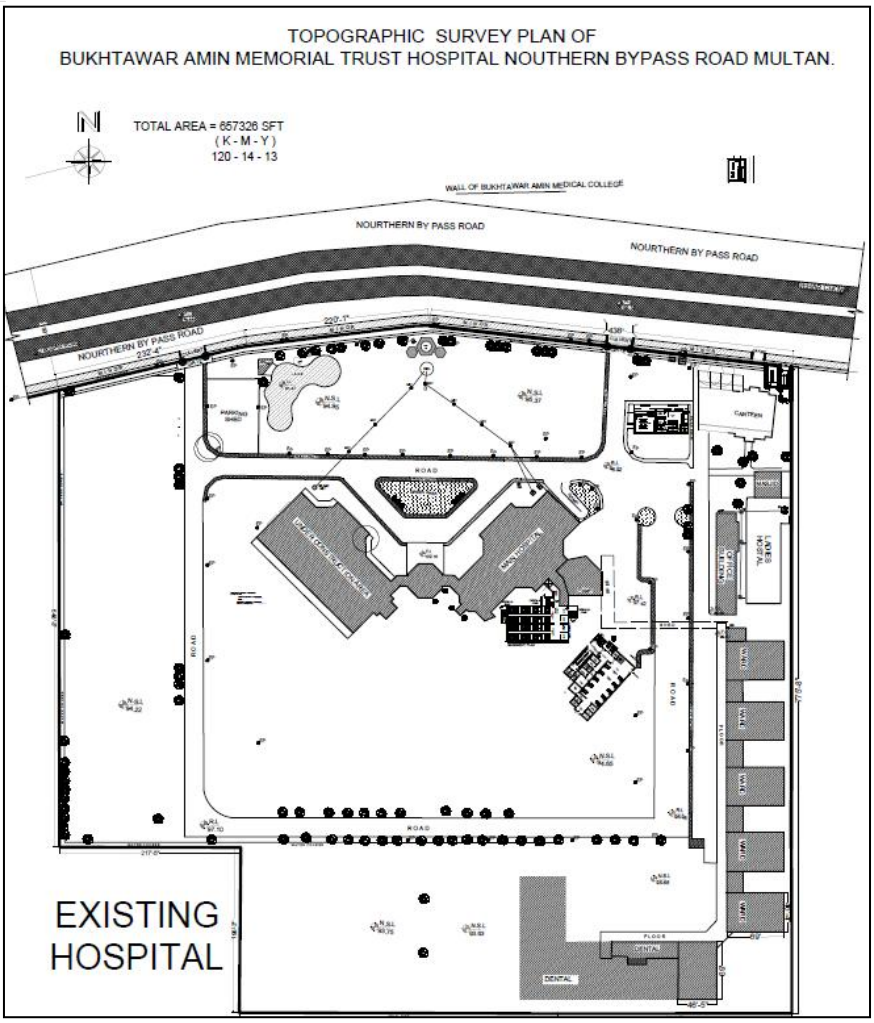

Figure 15 Existing Plan of the BAMT Hospital

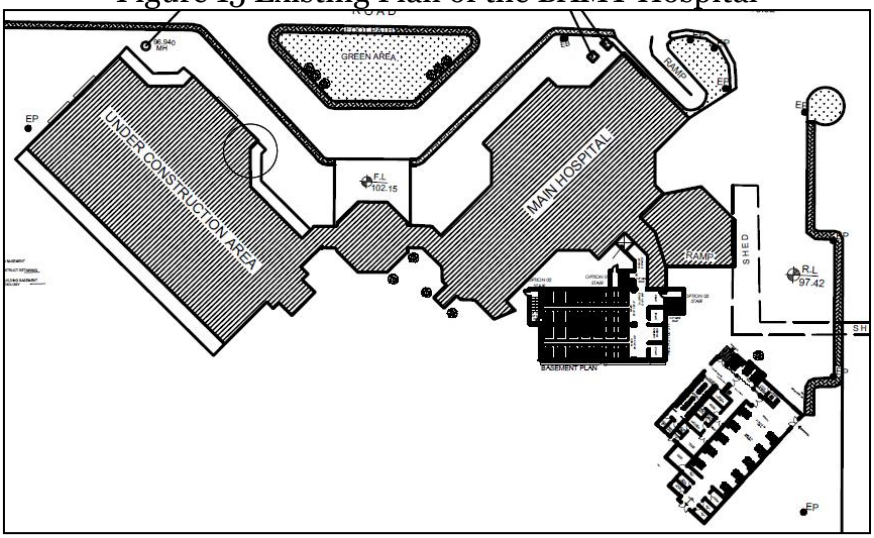

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Figure 16 Existing Emergency Department layout on site

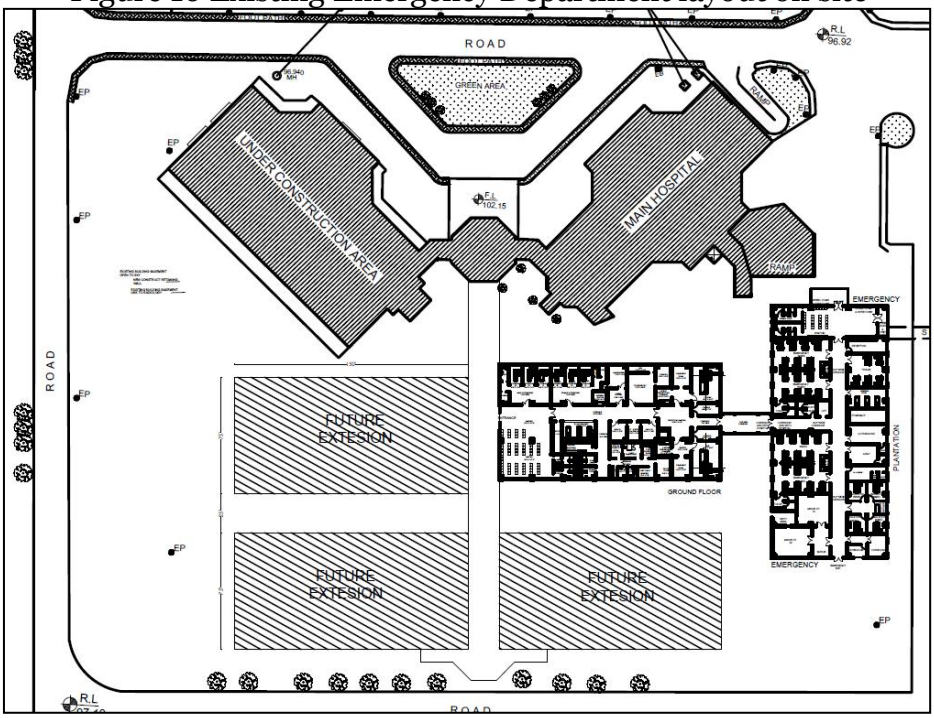
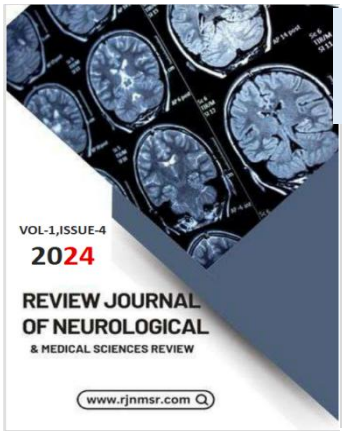


Figure 17 Proposed Emergency Department new Layout Plan



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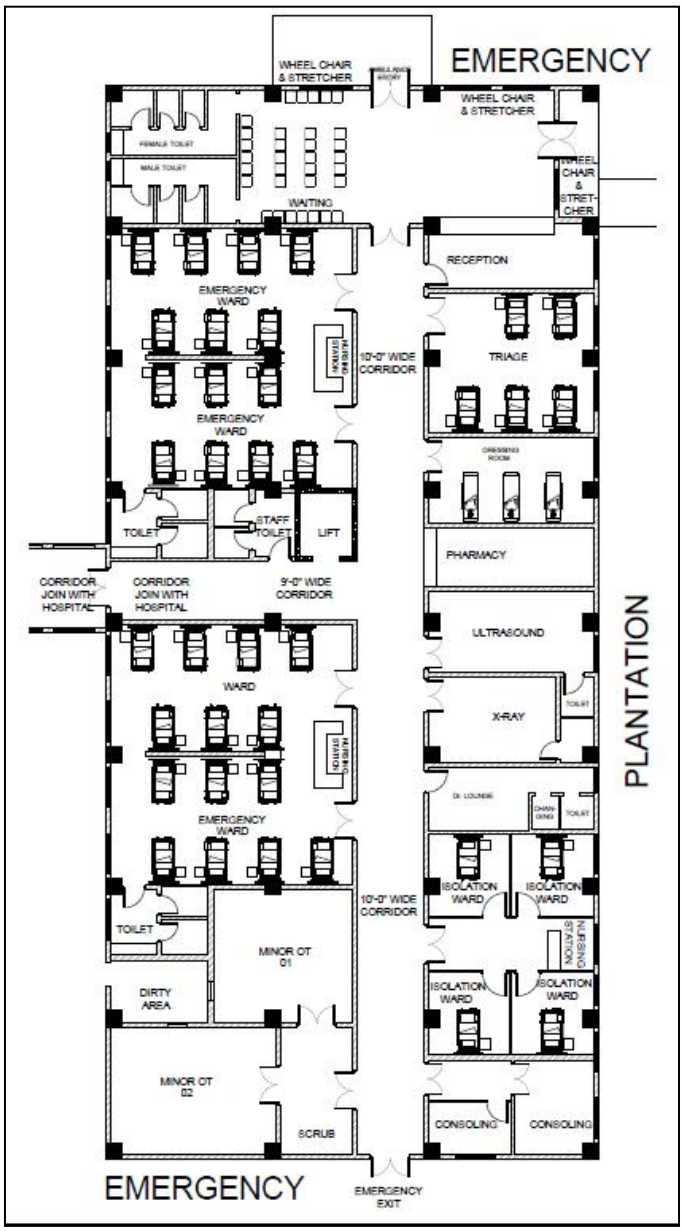
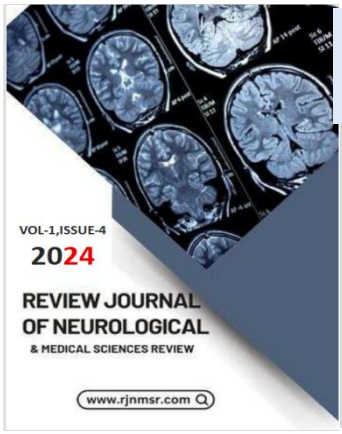


Figure 18 Proposed Detailed plan of new emergency Department

As shown above in the figure 15 to 18, new emergency department has been proposed as part of the design interventions based on the recommendations of the research. The interventions mainly add value to the existing system through incorporating the following:

1. Two Minor OT along with centralized Scrub facility.
2. Two consoling rooms which may also act as a briefing room.
3. Four Isolation room with designated and dedicated nursing station.
4. Internal diagnostics facility along with X-ray and Ultrasound within the emergency department.



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5. 14 beds based double unit with partial bifurcation for 7 beds each in male and female ward combined with central nursing station.
6. Internal Pharmacy and a separate dressing room.
7. 5 bed Triage facility in the most welcoming area of the facility.
8. Separate entry and designated reception along with waiting area and toilets for both male and female attendants.

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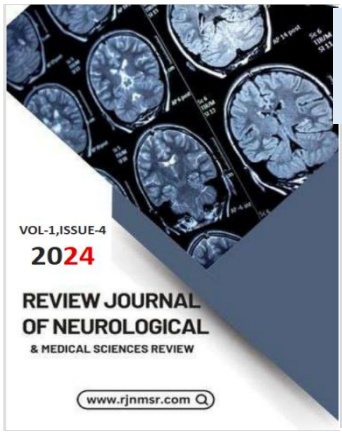

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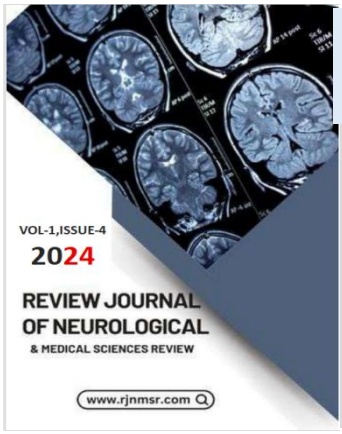

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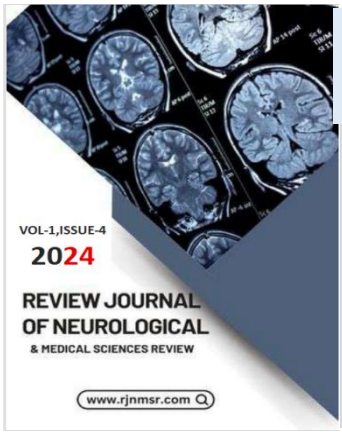

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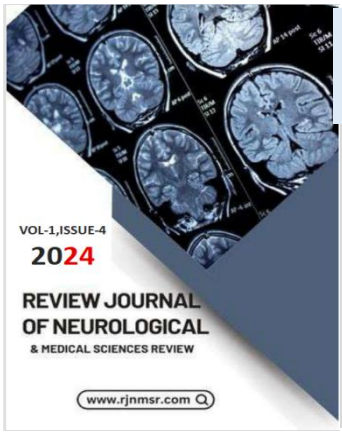

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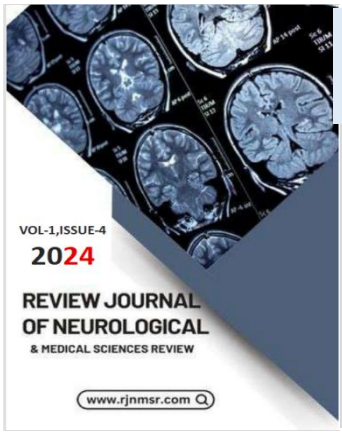

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