DESIGN GUIDELINES FOR TRAUMA ROOMS

Patient Safety Learning Laboratories (2019): Pursuing Safety in Diagnosis and Treatment at the Intersection of Design, Systems Engineering, and Health Services Research (R18) RFA-HS-19-001

KENT STATE UNIVERSITY

SUNY

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Disclaimer

This guide was developed as part of a federally funded research project supported by the Agency for Healthcare Research and Quality (AHRQ). The findings and recommendations presented are based on research and professional judgment and are intended to inform and support design decision-making.

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Preface

Traumatic injuries account for 59% of deaths among individuals under the age of 44, making trauma care a national priority and a deeply human issue. The trauma room is often the first and most critical point of care for a traumatically injured patient, where seconds matter and decisions made within the “golden hour” can mean the difference between life and death. Yet despite its central role in acute care, the design of trauma rooms has received limited research attention — particularly in how physical environments shape team performance, patient safety, and clinical outcomes.

This design guide is the outcome of a multi-year, cross-disciplinary research initiative supported by the Agency for Healthcare Research and Quality (AHRQ) through the Patient Safety Learning Laboratory program - Toward A Model of Safety and Care for Trauma Room Design. With a total budget of $2.47 million over four years, this project brought together collaborators from Kent State University (Kent, OH), Cleveland Clinic Akron General (Akron, OH), and SUNY Canton (Canton, NY). The program is part of the U.S. Department of Health and Human Services and is charged with improving the safety, quality, and accessibility of healthcare across the country. The Learning Labs promote systems-engineering approaches to address complex challenges in patient care, and this guide reflects that ethos through the integration of research, simulation, technology, and design.

Our team adopted a rigorous and forward-looking methodology that included augmented reality (AR), automated trauma room observation, full-scale mock-ups, and scenario-based simulation to explore how environmental design can influence performance during high-stakes trauma care. We grounded our work in the Systems Engineering Initiative for Patient Safety (SEIPS) model, which identifies the physical environment as one of five interdependent components of the healthcare work system.

The first year of this project coincided with the COVID-19 pandemic, which disrupted many research efforts, including ours. What began as a challenge soon became an opportunity for innovation. We adapted, adjusted our approaches, and remained committed to our shared goal: to develop evidence-based design strategies that improve trauma room function and ultimately, patient outcomes.

This guide would not have been possible without the generous support, expertise, and enthusiasm of many individuals and institutions. We are grateful to AHRQ for their vision and continued investment in healthcare safety and innovation. We also thank the advisory committee members, graduate research assistants, faculty, architects, and clinicians who contributed to this work. The insights and feedback shared by clinicians across the country played a pivotal role in shaping this guide, and we are deeply appreciative of their time and dedication. A special note of thanks is extended to Dean Mark Mistur of the College of Architecture and Environmental Design at Kent State University for his unwavering support throughout the life of this project.

It has been a privilege to lead this important work as Principal Investigator, and to contribute alongside so many dedicated colleagues and collaborators. It is our sincere hope that this guide contributes to a growing body of knowledge and helps design professionals, healthcare leaders, and interdisciplinary teams make informed, life-saving decisions as they develop the future of trauma care environments.

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Introduction

This document is intended to address the built environment of trauma treatment rooms within hospital emergency departments. While the primary focus is on general adult trauma care, the principles outlined here may also inform the design of spaces that support pediatric or specialized patient populations, though additional considerations will be required for those contexts.

This guide is not a substitute for existing regulatory or code requirements; rather, it is meant to complement them by offering practical, evidence-based strategies to enhance safety, efficiency, and usability for both patients and clinical staff. The content reflects current best practices and insights derived from a multi-year research initiative supported by the Agency for Healthcare Research and Quality. The project employed innovative methodologies such as augmented reality (AR), full-scale mock-up evaluations, automated trauma room observation, and scenario-based simulation to generate actionable design recommendations.

This guide represents the professional judgment and informed opinion of the authors and is intended to serve as a resource for architects, designers, healthcare providers, and decision-makers. It does not define minimum standards or constitute a legal "standard of care," and it should not be interpreted as such. Rather, it aims to provide forward-looking design guidance grounded in rigorous research, interdisciplinary collaboration, and real-world application.

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Design Element	Desirable Outcome	Design Strategies	Page No.
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Design Element	Desirable Outcome	Design Strategies	Page No.
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Design Element	Desirable Outcome	Design Strategies	Page No.
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Design Element	Desirable Outcome	Design Strategies	Page No.
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Design Element	Desirable Outcome	Design Strategies	Page No.
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Design Element	Desirable Outcome	Design Strategies	Page No.
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Design Element	Desirable Outcome	Design Strategies	Page No.
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1. Design Element: Layout

1.1. Desirable Outcome: Improved crowd control

Effective crowd control in trauma rooms is essential for maintaining a focused and efficient environment during critical care situations. To achieve this, implement a color-coded zoning system within the room, using visual cues such as floor markings. This helps staff and visitors quickly understand their positioning and identifies restricted areas, maintaining order during high-stress scenarios. Additionally, provide a dedicated observation area with a transparent barrier, allowing medical students, or additional staff to observe without interfering with patient care. This area should offer clear visibility while maintaining a sterile environment and include communication systems for necessary interactions. By incorporating these elements, trauma room layouts can enhance crowd management, reduce distractions, and improve overall patient care efficiency.

1.2. Desirable Outcome: Reduced travel time

Optimizing the layout of trauma rooms to reduce travel time is crucial for enhancing the speed and efficiency of emergency care. The trauma room should be strategically located to minimize the distance to the operating room (OR), allowing for quick transitions when surgery is necessary. It should also be easily accessible from the ambulance entry point to facilitate rapid patient admission. Proximity to elevators is important for swift patient transport to other hospital floors or departments. Additionally, the trauma room's location should take into account its distance from the blood bank to ensure quick access to vital blood products. Finally, positioning the trauma room near the imaging department (e.g., CT scanners, X-ray rooms) can reduce the time needed for critical diagnostic procedures. By carefully considering these spatial relationships in the hospital layout, the design can substantially reduce travel times, potentially improving patient outcomes in time-sensitive emergency situations.

1. Design Element: Layout

1.3. Desirable Outcome: Enhanced work efficiency

To optimize work efficiency in trauma rooms, the layout should incorporate several essential design strategies. Prioritize unobstructed circulation paths throughout the room, allowing staff to move freely and quickly without navigating around unnecessary obstacles. This clear pathway design facilitates rapid response times and smooth workflow during critical situations. Implement identical room layouts across multiple trauma rooms within the facility. This standardization enables medical staff to navigate and locate equipment instinctively, regardless of which specific room they're working in, reducing cognitive load and improving efficiency during high-stress scenarios. Integrate built-in decontamination and draining systems within the room itself. This feature allows for immediate cleaning and waste management without the need to leave the trauma area, maintaining a sterile environment and enabling continuous care. By incorporating these elements, the trauma room layout enhances work efficiency, allowing medical teams to focus on patient care rather than navigating their environment or managing logistical challenges.

1.4. Desirable Outcome: Improved accessibility to resources

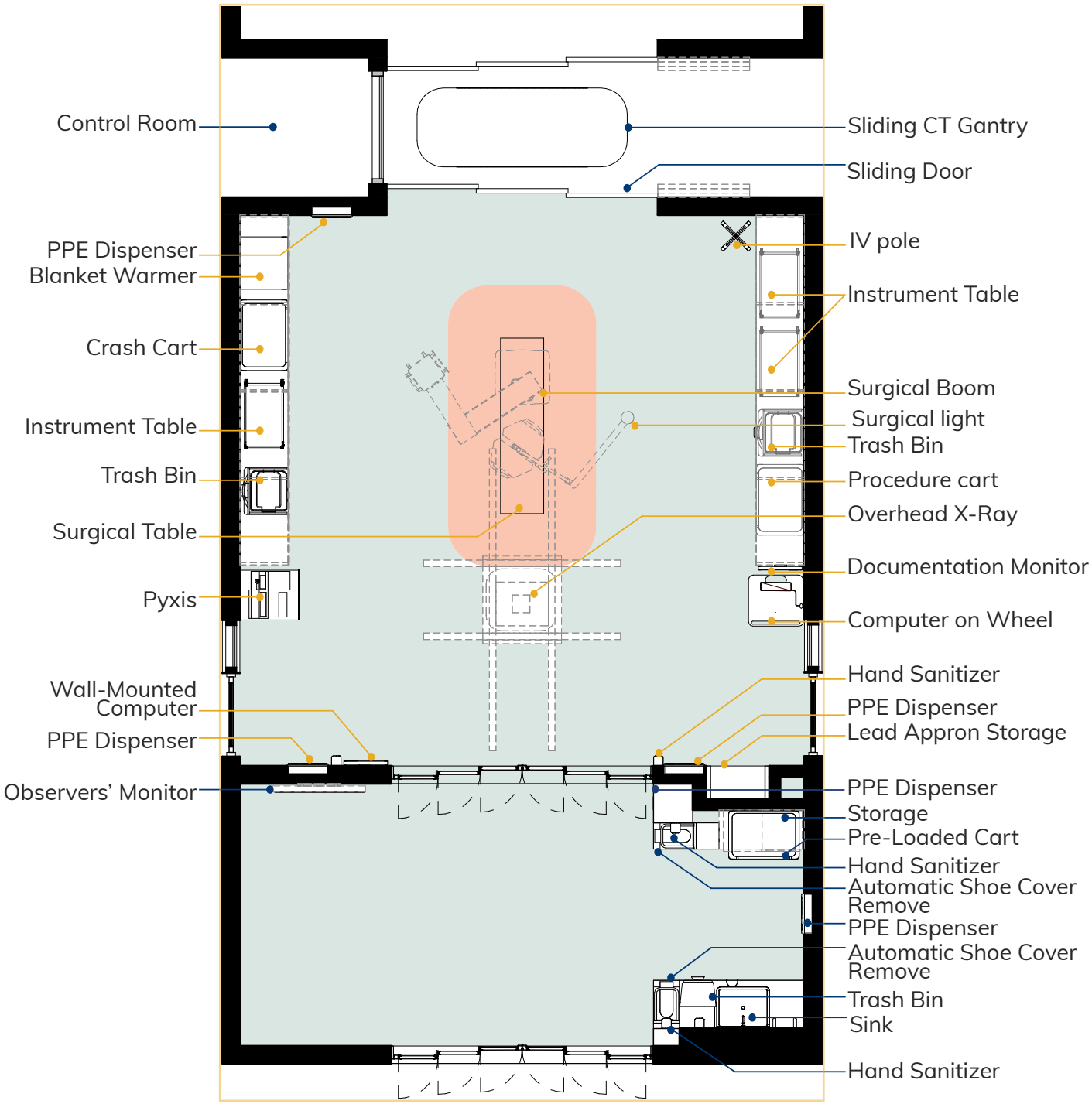
Enhancing resource accessibility in trauma rooms requires a layout that prioritizes efficient design elements. First, establish a centralized location for essential supplies and equipment, including medications, medical gas outlets, suction equipment, and airway management tools. This consolidated approach allows staff to quickly access vital resources without wasting time searching or navigating the room. Second, implement a comprehensive system of easily accessible electrical outlets throughout the space. This involves strategically placing numerous outlets at various heights and locations, including wall-mounted and ceiling-mounted options, to accommodate diverse medical equipment needs. By integrating these design elements, the trauma room layout improves resource accessibility, enabling medical teams to deliver faster, more efficient care in high-pressure emergency situations.

1. Design Element: Layout

1.5. Desirable Outcome: Improved noise control

Effective noise control in trauma rooms is crucial for maintaining a focused environment and reducing stress for both patients and medical staff. To achieve this, implement specific design strategies in the room layout. First, opt for enclosed single-patient rooms rather than open bay designs. This approach can reduce ambient noise from adjacent areas and other patients, creating a more controlled environment. Enclosed rooms also offer greater privacy and help contain equipment sounds within the space. Second, incorporate a designated observation area for external individuals such as students, or additional medical staff not directly involved in patient care. This area should be separated from the main treatment space, ideally with sound-dampening barriers, allowing observers to witness procedures without contributing to noise levels in the critical care zone. By implementing these layout strategies, trauma rooms can achieve improved noise control, fostering a calmer atmosphere that enhances communication among medical staff and potentially reduces stress-induced errors, ultimately contributing to better patient outcomes in high-pressure emergency situations.

1. Design Element: Layout



2. Design Element: Anteroom

2.1. Desirable Outcome: Enhanced workflow

To enhance workflow efficiency in trauma care settings, the incorporation of a strategically designed anteroom is crucial. This intermediate space should be positioned between the access corridor and the main trauma room, serving as a transitional area that streamlines the movement of staff and equipment. The anteroom's location acts as a buffer zone, reducing direct exposure to external disturbances and helping to maintain a controlled environment within the trauma room itself. This design allows for seamless transitions, enabling medical staff to quickly enter the trauma room with necessary equipment or supplies. It may also help in controlling access to the trauma room, allowing only essential personnel to enter during critical procedures. By carefully considering the placement and design of the anteroom, healthcare facilities can improve the overall workflow efficiency in trauma care, potentially leading to faster response times and better patient outcomes in emergency situations. The specific configuration of doors and access points between the anteroom and trauma room should be carefully considered to balance efficiency, infection control, and privacy needs.

2.2. Desirable Outcome: Better circulation

To optimize circulation and functionality in the trauma room setting, the anteroom design should incorporate several key features. First, construct the interior wall of the anteroom as a radiation barrier, enhancing safety for staff and observers during radiological procedures performed in the trauma room. This protective measure allows for continuous monitoring and quick access while minimizing radiation exposure. Second, integrate storage solutions for lead aprons within the anteroom, ensuring that essential protective gear is readily available and properly stored when not in use. This placement allows staff to quickly put on protective equipment before entering the trauma room. Third, install wall-mounted monitors in the anteroom to provide real-time information and visual access for observers. These monitors can display vital signs, imaging results, and other critical information, facilitating communication and decision-making. Lastly, apply floor graphics to clearly distinguish pathways from standing areas within the anteroom. This visual guide helps optimize traffic flow, preventing congestion and ensuring that staff and equipment can move efficiently through the space. By implementing these design strategies, the anteroom becomes a multifunctional space that enhances circulation, improves safety, and supports the overall efficiency of trauma care operations.

2. Design Element: Anteroom

2.3. Desirable Outcome: Enhanced visibility to patient

To improve visibility and maintain connection with the patient while optimizing the functionality of the anteroom, implement specific design elements. First, incorporate a display system for observers within the anteroom. This could involve installing large, high-resolution screens that provide real-time video feeds of the trauma room, allowing medical staff, or other authorized personnel to observe procedures without physically entering the critical care space. These displays can show multiple views, enhancing the ability to monitor patient care from a safe distance. Second, apply transparent barriers between the anteroom and the trauma room to provide a direct visual connection. These barriers allow for clear sight lines while maintaining physical separation. This design element enables visual monitoring of the patient and ongoing procedures, supports non-verbal communication between teams in both rooms, and helps maintain a sense of openness and connectivity. By incorporating these visibility-enhancing elements, the anteroom design supports improved patient monitoring, team communication, and overall trauma care efficiency while maintaining necessary separation between spaces.

2.4. Desirable Outcome: Enhanced security

To address security concerns in trauma care settings, particularly during high-risk situations involving criminal factors, the anteroom should incorporate a locking feature. This locking capability transforms the anteroom into a vital security checkpoint, providing an additional layer of protection for the trauma room environment while maintaining necessary flexibility for emergency care.

2.5. Desirable Outcome: Improved crowd control

To enhance crowd management in trauma care settings, the anteroom should incorporate some design features. First, include a dedicated space for external individuals like medical students, clearly demarcated within the room. Second, ensure the anteroom is sufficiently wide to comfortably accommodate both people and large medical equipment. This spacious design prevents bottlenecks and allows for smooth movement of staff, patients on gurneys, and essential equipment. By implementing these strategies, the anteroom effectively serves as a buffer zone, managing the flow of people entering the trauma room, reducing distractions for the medical team, and ensuring efficient circulation during emergencies. This design contributes to a more organized and effective trauma care environment.

2. Design Element: Anteroom

2.6. Desirable Outcome: Improved noise control

Incorporating the anteroom between the main corridor and the trauma room helps to enhance noise control in trauma care settings. This intermediate space serves as an effective acoustic buffer, reducing ambient noise from external sources. The anteroom can accommodate observers, such as medical students, allowing them to monitor the situation without contributing to noise levels in the critical care area. By providing a dedicated viewing area with sound-dampening features, the anteroom minimizes auditory distractions for the medical team working in the trauma room. This design strategy helps maintain a calmer, more focused environment in the primary treatment area, potentially reducing stress and improving communication among staff during critical procedures. The noise reduction achieved through this anteroom configuration can contribute to better concentration, fewer errors, and ultimately, improved patient care in high-stress emergency situations.

2.7. Desirable Outcome: Support educational purpose

Incorporating the anteroom, designed to accommodate medical students and other learners enhances the educational value of trauma care settings. This dedicated space allows students to observe trauma cases in real-time without interfering with critical care procedures. The anteroom should be equipped with large viewing windows or monitors displaying live feeds from the trauma room, providing clear visibility of the medical team's actions. This educational-focused anteroom design creates a valuable learning environment, enabling hands-on observation of emergency medical procedures while maintaining the efficiency and privacy of the main trauma room. By supporting this educational purpose, the anteroom contributes to the training of future healthcare professionals, ultimately improving the quality of trauma care.

2. Design Element: Anteroom

2.8. Desirable Outcome: Improved accessibility to supplies

To enhance accessibility to essential supplies and equipment in trauma care settings, the anteroom should be designed with several design features. Incorporate dedicated storage for clinicians' clothes and lead aprons, allowing staff to quickly change and access protective gear. Allocate space for a portable X-ray machine, ensuring it's readily available without cluttering the main trauma room. Install a phone for swift communication with other hospital departments or external contacts. Provide preloaded carts stocked with essential supplies, positioned for easy access and rapid deployment. This design approach transforms the anteroom into a well-organized supply hub, improving efficiency by reducing time spent retrieving necessary items. It ensures that critical equipment and supplies are immediately accessible, supporting faster response times and smoother workflow in emergency situations, while maintaining a clutter-free environment in the main trauma room.

2.9. Desirable Outcome: Improved sensory control

To enhance sensory management in trauma care settings, incorporate a dimmable lighting system in the anteroom. This feature serves dual purposes of visual and auditory control. Adjustable lighting creates a calmer atmosphere that naturally encourages quieter behavior among occupants, reducing noise transmission to the trauma room. Dimmer lights also signal a transition from bright corridors to the controlled trauma environment, psychologically preparing staff and visitors to modulate their actions. This subtle environmental cue effectively manages noise levels without explicit instructions, while supporting patient comfort during transport and allowing for reduced stimulation when needed. By integrating this lighting control, the anteroom design contributes to a more controlled sensory environment, potentially reducing stress and distractions in critical care situations.

2. Design Element: Anteroom

3. Design Element: Color-coded flooring

3.1. Desirable Outcome: Enhanced work efficiency

Implement a streamlined floor boundary system using a single-color coding to enhance work efficiency in trauma rooms. Create a clearly defined immediate access zone measuring 13’ x 9’ around the patient bed using one distinct color. This demarcation instantly communicates the critical care space to staff, ensuring clear recognition of the direct patient care area. The single-color approach provides flexibility for personnel movement without confusing restrictions. Importantly, avoid adding intricate details like dots or complex patterns within these boundaries, as they can create visual clutter and distractions. This simplified zoning enhances intuitive navigation, supports quick decision-making, and allows medical staff to focus on patient care rather than interpreting complex floor markings. The result is a more efficient workflow that can contribute to improved patient outcomes in critical care situations.

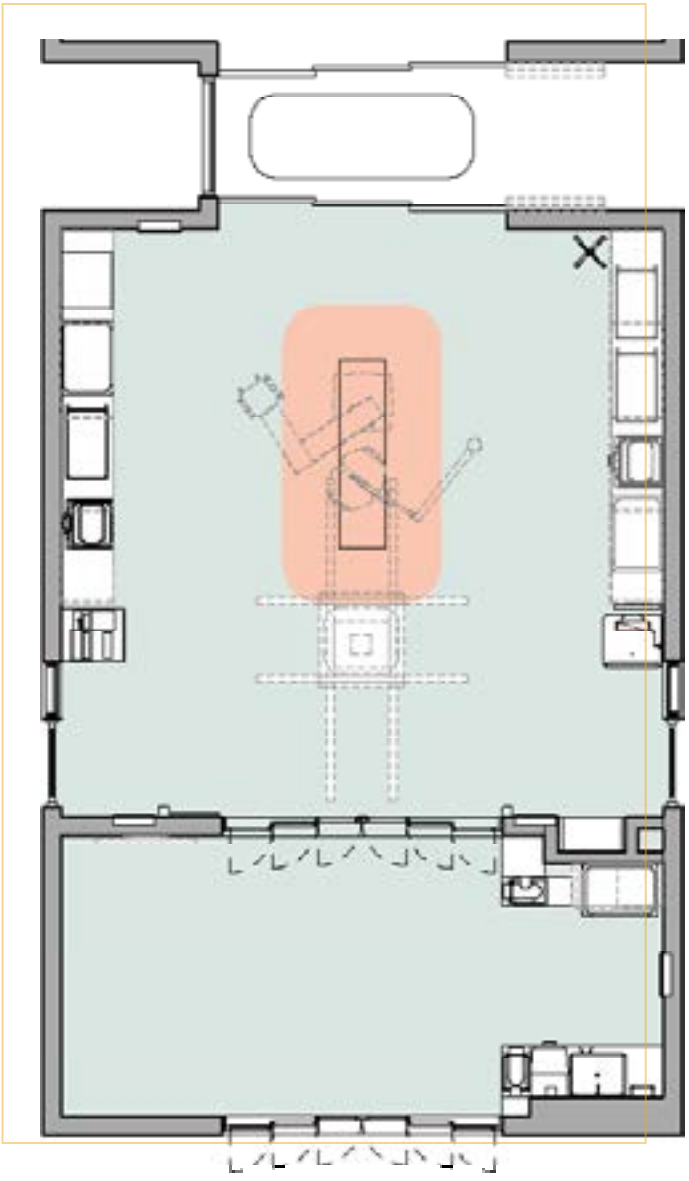
3.2. Desirable Outcome: Increased flexibility

To enhance flexibility in trauma room design, especially for scenarios involving dual occupancy, implement a system of projected boundaries. These projected boundaries can quickly divide the room into distinct patient care areas, each with its own clearly defined immediate access zone. The system enabling seamless transitions between single and dual occupancy configurations. This approach allows for rapid adaptation to changing patient needs and maintains a clutter-free physical floor space. By incorporating this boundary system, trauma rooms can efficiently accommodate varying patient loads and care requirements, improving the versatility and effectiveness of the emergency care environment.

3.3. Desirable Outcome: Reduced interruptions and disruptions

Implement a two-color zoning system in trauma rooms to clearly delineate staff positioning and minimize interruptions during critical care. Use red and yellow zones on the floor to indicate specific standing areas for trauma team members. The red zone, closest to the patient, should be reserved for primary care providers such as the lead physician and essential nurses. The yellow zone, surrounding the red zone, can be designated for secondary team members, specialists, and support staff. This color-coded system provides visual cues that help maintain order and reduce unnecessary movement or crowding around the patient. By clearly defining these zones, the design helps prevent non-essential personnel from inadvertently disrupting critical procedures. The distinct boundaries also facilitate more efficient communication and handoffs between team members, as everyone understands their designated position. This organized approach to spatial management in the trauma room can reduce interruptions and disruptions, allowing the medical team to focus more effectively on patient care and potentially improving outcomes in high-stress emergency situations.

3. Design Element: Color-coded flooring



4. Design Element: Room size

4.1. Desirable Outcome: Enhance workflow

To optimize room size in trauma care settings, design spacious and adaptable environments that prioritize workflow efficiency and flexibility. The trauma room should be generously proportioned, substantially larger than standard patient rooms, to accommodate the complex needs of emergency medical care. This expanded footprint allows for the seamless integration of essential medical equipment, from portable X-ray machines to ultrasound devices, without cluttering the workspace. The room's layout should facilitate unrestricted movement for the trauma team, enabling swift access to the patient from all sides and ensuring unobstructed pathways to vital equipment and supplies.

When determining the room's dimensions, consider the potential for disaster response scenarios. The trauma room should be capable of accommodating surge capacity, potentially allowing for the treatment of multiple patients simultaneously in extreme circumstances. This foresight in design ensures that the facility remains adaptable and resilient in the face of unforeseen emergencies or large-scale incidents. By implementing these spatial strategies, the trauma room design enhances operational efficiency, supports comprehensive patient care, and accommodates the dynamic needs of emergency medical situations. This thoughtful approach to room size and layout fosters an environment that not only meets the immediate demands of trauma care but also anticipates future needs, ultimately contributing to improved patient outcomes and more effective medical team performance.

4.4. Desirable Outcome: Efficient travel distance

To achieve efficient travel distances within the trauma room while maintaining an optimal size, careful consideration must be given to the layout and organization of the space. The design should strike a delicate balance between providing ample room for procedures and ensuring that essential supplies and equipment remain within easy reach of the medical team. This approach enhances workflow efficiency and minimizes unnecessary movement during critical care situations. When determining the room's dimensions, prioritize a layout that places frequently used items and equipment within arm's reach of key work areas. Utilize ergonomic principles to create zones of activity that cluster related functions and supplies together. For instance, position the supply storage areas, medication dispensers, and commonly used equipment along the room's perimeter, ensuring they are easily accessible from the central patient care area without requiring staff to step away from the patient. Incorporate modular and mobile storage solutions that can be easily repositioned as needed. This flexibility allows the room to adapt to different trauma scenarios while maintaining efficient travel distances. While the room should be spacious enough to accommodate the full trauma team and necessary equipment, avoid excessive size that could lead to inefficient workflows. By carefully considering these design features, the trauma room can maintain an optimal size that supports comprehensive care while ensuring that all necessary supplies and equipment remain readily accessible. This thoughtful approach to spatial planning enhances the medical team's efficiency, minimizes fatigue from unnecessary movement, and ultimately contributes to improved patient outcomes in time-critical situations.

5. Design Element: Furniture

5.1. Desirable Outcome: Enhanced patient care

To improve patient care and comfort in trauma settings, integrate a warming feature directly into the patient bed. This innovative design element allows for precise temperature control and efficient heat transfer to the patient without affecting other individuals in the room. Ensure the warming feature offers adjustable temperature settings to accommodate various clinical needs, from mild warming to prevent hypothermia to more intensive heating for severe cases. Include safety features such as automatic shut-off and temperature limiters to prevent overheating. The system should be designed for easy cleaning and disinfection to maintain hygiene standards. Additionally, incorporate intuitive controls that allow medical staff to quickly adjust settings as needed. By integrating this warming feature into the patient bed, the trauma room design enhances the ability to manage patient temperature effectively, potentially improving outcomes in critical care situations while maintaining a comfortable working environment for the medical team.

5.2. Desirable Outcome: Enhanced work efficiency

To improve work efficiency in trauma care settings, incorporate an adjustable gurney bed with advanced features such as tilting capabilities. This versatile piece of furniture allows medical staff to quickly and easily modify the patient's position without the need for manual lifting or repositioning. The bed should offer multiple adjustment options, including height variation and lateral tilting. These features enable optimal patient positioning for various procedures, from intubation to CPR, without moving the patient to different surfaces. The ability to tilt the bed also aids in managing patient circulation and respiratory function. Ensure the gurney includes easy-to-use controls, preferably with both manual and electronic options for reliability. Additionally, the bed should be designed with smooth-rolling casters for effortless movement within the trauma room or to other areas of the hospital. By implementing this adjustable gurney bed, the trauma room design enhances the medical team's ability to provide efficient, adaptable care, potentially improving patient outcomes and reducing physical strain on staff.

6. Design Element: Carts

6.1. Desirable Outcome: Improved flexibility

To enhance flexibility and efficiency in trauma care settings, implement a system of versatile, mobile carts and instrument tables. Design carts for easy maneuvering, equipped with smooth-rolling casters and ergonomic handles for quick repositioning. Incorporate adjustable work surfaces on top of these carts, allowing for height customization to accommodate different procedures and staff preferences. This adaptability ensures optimal ergonomics for various tasks, reducing strain on medical personnel. Include a set of three instrument tables of different sizes, designed to stack on top of each other when not in use, maximizing space efficiency. Position 1-2 movable instrument tables on each side of the trauma room, providing readily accessible surfaces for instruments and supplies wherever they are needed. These mobile elements allow the trauma team to quickly reconfigure the room layout based on specific patient needs or procedure requirements. By implementing this flexible cart and table system, the trauma room design improves adaptability to various clinical scenarios, enhances workflow efficiency, and supports the dynamic nature of emergency care, ultimately contributing to better patient outcomes and staff performance.

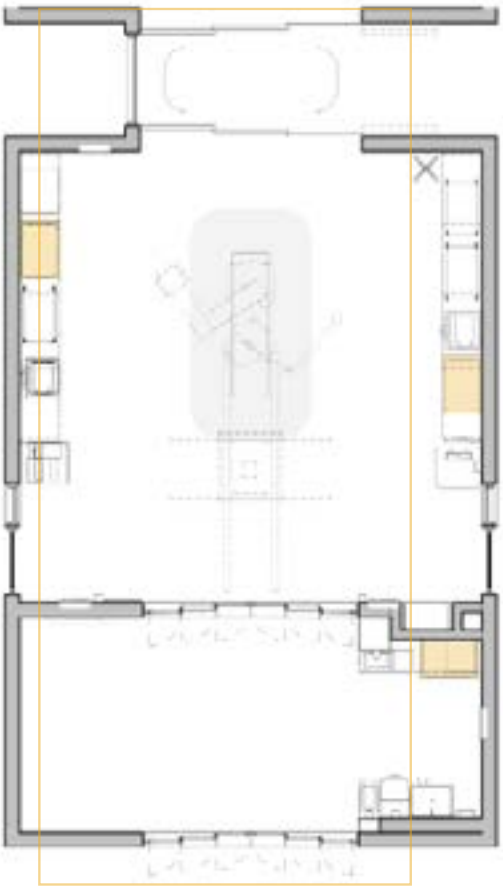
6.2. Desirable Outcome: Enhanced work efficiency

To optimize work efficiency in trauma care settings, implement a strategic cart system with several key features. Color-code carts by specific procedures or equipment types, enabling quick visual identification and access to necessary supplies. This color-coding system reduces time spent searching for items and minimizes errors in high-stress situations. Incorporate height-adjustable instrument tables, allowing staff to customize the working surface to their needs, promoting ergonomic comfort and reducing strain during prolonged procedures. Position preloaded carts in the anteroom, stocked and ready for the next patient, rather than relying on bulky storage units within the main trauma room. This approach keeps the trauma room uncluttered and allows for swift restocking between cases. These preloaded carts should be designed for easy maneuverability, enabling quick transport into the trauma room when needed. By implementing this efficient cart system, the trauma room design streamlines workflow, reduces clutter, and enhances the medical team's ability to respond quickly and effectively to patient needs, ultimately improving the overall efficiency of trauma care delivery.

6.3. Desirable Outcome: Increased accessibility

To enhance accessibility and readiness in trauma care settings, implement a strategic cart system with two key features. First, provide carts on both sides of the trauma room, ensuring that essential supplies and equipment are readily available regardless of staff positioning or patient orientation. This balanced distribution minimizes movement across the room, reducing potential disruptions and improving efficiency during critical procedures. Second, design a smart storage and charging system for crash carts. When stored, these carts should be automatically connected to power sources, ensuring that all battery-operated equipment is fully charged and ready for use. Implement a quick-release mechanism that allows the cart to be easily unplugged and moved when needed, switching seamlessly to battery operation. This design ensures that the crash cart is always prepared for immediate use while maintaining mobility during critical situations. Include clear visual indicators on the cart to show battery status when in use. Implementing these accessibility-focused strategies helps the team respond swiftly and effectively in emergencies, potentially enhancing patient outcomes through constant readiness and reduced delays in accessing equipment.

6. Design Element: Carts



7. Design Element: Cabinets

7.1. Desirable Outcome: Improved visibility

The ability to quickly locate and access necessary equipment and supplies can impact patient outcomes. Therefore, improving sightlines to items stored in cabinets is a crucial aspect of trauma room design. Position cabinets along the perimeter walls of the trauma room, ensuring they do not obstruct sightlines to the patient or impede staff movement. Prioritize placing cabinets at eye-level and within arm's reach of primary work areas. First, implement a clear and consistent labeling system for all cabinets, ensuring that labels are strategically placed for easy visibility under all conditions. This approach allows staff to quickly locate needed supplies without confusion. The second consideration which is more efficient than traditional labeling is to implement transparent cabinet doors. By optimizing cabinet locations, the trauma room design improves staff's ability to quickly locate and retrieve necessary supplies, potentially reducing response times and enhancing overall patient care efficiency in critical situations.

7.2. Desirable Outcome: Improved access to supplies

To improve access to supplies, trauma room design should incorporate several strategies. Adequate storage space is essential, with a focus on providing portable cabinets for flexibility. Equal distribution of essential supplies, such as chest tubes, on both sides of the room ensures quick access regardless of staff positioning. Cabinet placement should prioritize nurse-based locations and maintain reachable heights for optimal accessibility and ergonomics. Unobstructed pathways to supply areas are vital for swift movement during emergencies. Security measures, such as appropriate key locks, should be implemented based on hospital policies and usage requirements. For efficiency, it is advisable to cluster locked cabinets, medication dispensing systems (like Pyxis), and the scribe nurse's station in close proximity. This comprehensive approach to cabinet design and placement enhances the trauma team's ability to provide rapid, effective care in critical situations.

7. Design Element: Cabinets

7.3. Desirable Outcome: Enhanced work efficiency

To optimize workflow and space utilization in trauma rooms, cabinet design should focus on enhancing work efficiency through three strategies. First, implement indented cabinets to minimize room blockage, allowing staff to move freely without obstacles and maximize the usable floor space. Second, incorporate dedicated storage for patients' belongings, keeping personal items secure and organized while freeing up critical work surfaces. Finally, integrate built-in and adjustable shelves within the cabinets, providing flexibility to accommodate various equipment sizes and allowing for easy reconfiguration as needs change. This adaptive approach to cabinet design not only streamlines the workspace but also improves the trauma team's ability to function effectively in high-pressure situations.

7.4. Desirable Outcome: Reduced interruptions and disruptions

To minimize interruptions and disruptions during critical care situations, trauma room cabinet design should incorporate three strategic elements. First, consider implementing one-side cabinetry to reduce confusion and streamline access, allowing staff to focus on a single area for supplies. Second, eliminate locked cabinets where possible to prevent delays in accessing crucial items, though this must be balanced with security requirements for controlled substances. Finally, utilize ceiling-mounted cabinets to maximize floor space and prevent cabinets from being inadvertently pushed or moved during intense activity. This approach can optimize the use of available space and can create a more efficient workflow, reducing the likelihood of disruptions that could impact patient care in time-sensitive trauma scenarios.

7. Design Element: Cabinets

8. Design Element: Countertop/ Work Surface

8.1. Desirable Outcome: Enhanced work efficiency

To optimize work efficiency in trauma care settings, implement a strategic work surface design that balances fixed and mobile elements. Provide adequate access to work surfaces through a combination of instrument tables and a fixed countertop. Position a single fixed countertop along one side of the room, offering a stable work area for consistent tasks. Design this countertop to accommodate storage of carts and tables underneath, maximizing space utilization. The size of the countertop should be determined by the dimensions of the carts or tables it will house, ensuring efficient use of space. Opt for a fixed countertop rather than adjustable or flip-top designs to minimize maintenance requirements and ensure reliability. Complement this fixed surface with multiple mobile instrument tables, which offer greater flexibility to support various tasks and can be easily repositioned as needed. These tables serve as a better alternative to additional fixed countertops, allowing the room layout to adapt to different procedures. By implementing this balanced approach to work surfaces, the trauma room design enhances efficiency by providing stable work areas while maintaining the flexibility to reconfigure the space quickly for different emergency scenarios, ultimately supporting faster and more effective patient care.

8.2. Desirable Outcome: Increased accessibility

To enhance accessibility and workflow efficiency in trauma care settings, implement a strategic work surface design that prioritizes mobility and balanced distribution. First, provide work surfaces on both sides of the room, ensuring easy access for all team members. Instead of fixed countertops, utilize movable instrument tables as the primary work surfaces. These tables offer greater flexibility, allowing staff to quickly adjust the room layout to accommodate different procedures or equipment needs. Include a variety of sizes and heights to suit different tasks. Second, incorporate a smaller, dedicated work surface close to the scribe nurse's position. This area should be designed specifically for tasks such as writing or labeling blood samples, enhancing the efficiency of documentation and sample processing. This scribe-focused surface can be a small fixed countertop or a specially designed mobile cart with a stable writing surface. By implementing this mobile and distributed approach to work surfaces, the trauma room design improves accessibility to essential work areas, adapts easily to various clinical scenarios, and supports efficient workflow throughout the room. This flexibility can lead to faster response times and more effective patient care in critical situations.

8. Design Element: Countertop/ Work Surface

8.3. Desirable Outcome: Enhanced ergonomics

To improve ergonomics and reduce physical strain on medical staff in trauma care settings, implement a work surface design that prioritizes appropriate height for various tasks. Provide countertops and mobile work surfaces at heights that facilitate comfortable and efficient task performance. The ideal height may vary depending on the specific activities typically performed at each station. For general-purpose countertops, aim for a standard height of 36 inches, which accommodates most standing tasks for average-height individuals. For workstations that involve more detailed work or computer use, consider slightly higher surfaces (38-42 inches) to reduce neck and back strain. Incorporate adjustable-height mobile instrument tables to accommodate different procedures and staff preferences, with a range of approximately 30-44 inches. For the scribe nurse's station, ensure the work surface is at a comfortable writing height, typically around 30-32 inches if seated, or 38-42 inches if standing. By implementing these ergonomically optimized work surface heights, the trauma room design can reduce physical stress on staff during long procedures, potentially improving both staff well-being and patient care quality through enhanced comfort and reduced fatigue.

9. Design Element: PPE Storage

9.1. Desirable Outcome: Improved accessibility to supplies

To enhance accessibility to personal protective equipment (PPE) in trauma room settings, implement a comprehensive storage strategy that prioritizes quick and easy access. Install glove dispensers on each side of the trauma room to ensure immediate availability. Utilize double-sided access PPE storage units, with one end accessible from the anteroom and the other from the trauma room, facilitating seamless transitions. Include additional PPE storage inside the trauma room's cabinets for backup supplies. Incorporate dedicated space for lead apron storage within easy reach.

For rooms with connecting doors, ensure PPE is available near these access points. Use glass-fronted, unlocked cabinets for storing PPE, allowing visual inventory checks and rapid retrieval. Provide PPE in at least two distinct locations within the room to prevent congestion and ensure easy access for all staff. Consider implementing a dispensary mechanism activated by pushing a button for efficient PPE distribution.

Crucially, design all PPE storage with ergonomic considerations, ensuring that supplies are stored at heights accessible to staff of varying statures. This comprehensive approach to PPE storage design enhances workflow efficiency, reduces time spent searching for supplies, and supports proper infection control practices. By optimizing PPE accessibility, this design strategy contributes to improved safety and efficiency in high-stress trauma care environments.

9.2. Desirable Outcome: Improved workflow

To optimize workflow efficiency in trauma rooms, strategically position PPE storage units to align with natural movement patterns, minimizing additional steps for staff. Locate PPE storage along primary pathways, allowing team members to access supplies seamlessly as they enter or move within the room. Design these storage areas as "grabbing stations" rather than designated areas for donning PPE. This approach allows staff to quickly collect necessary items without obstructing traffic flow or creating bottlenecks. The grabbing station concept promotes a more fluid movement of personnel, enabling them to retrieve PPE efficiently and move to appropriate areas for putting it on. This streamlined design not only saves valuable time in emergency situations but also reduces the risk of cross-contamination by minimizing unnecessary touching of storage units. By integrating PPE storage into the room's circulation pattern and conceptualizing it as a quick-access point rather than a stationary dressing area, the overall workflow in the trauma room can be improved, supporting faster response times and more efficient patient care.

9. Design Element: PPE Storage

10. Design Element: Refrigerator/ Blood bank

10.1. Desirable Outcome: Improved accessibility to supplies

To enhance accessibility to critical blood supplies in trauma care settings, strategically position blood refrigerators within each trauma room. Place the blood refrigerator inside the trauma room, in close proximity to the patient bed, ensuring rapid access during emergencies. This immediate availability can reduce response times in situations requiring urgent blood transfusions. Specifically, locate the blood fridge at the corner of the head wall in the trauma room, as this position is considered ideal for balancing accessibility with space efficiency. This location allows medical staff to quickly retrieve blood products without leaving the patient's side or disrupting other critical care activities. By having a dedicated blood fridge in each trauma room, the design eliminates the need for staff to leave the room to obtain blood supplies, maintaining continuity of care and reducing potential delays. This approach also minimizes the risk of errors associated with retrieving blood from a centralized location during high-stress situations. The placement of blood refrigerators within trauma rooms, particularly at the head wall corner, optimizes the use of space while improving the accessibility of life-saving blood supplies, ultimately contributing to more efficient and effective trauma care.

10.2. Desirable Outcome: Enhanced security and management

To improve both security and management of critical blood supplies in trauma care settings, implement specific design elements. First, position the blood refrigerator directly within the trauma room rather than in the anteroom. This placement enhances security by keeping blood products under constant supervision of medical staff and restricting access to authorized personnel only. It also ensures immediate availability during critical situations without compromising the integrity of the supplies. Second, incorporate a monitoring system on the blood refrigerator for real-time usage tracking. This could include a digital display or integrated software that logs access times, quantities removed, and potentially even user identification. Such a system allows for precise inventory management, aids in preventing shortages, and provides valuable data for auditing and process improvement. The monitor can also alert staff to temperature fluctuations or other issues that might compromise blood quality. By combining secure in-room placement with advanced monitoring capabilities, this design approach can improve the accessibility of blood supplies and the overall management and security of these critical resources in the high-stakes environment of a trauma room.

11. Design Element: Sink

11.1. Desirable Outcome: Reduced congestion in room

To minimize congestion and optimize space utilization in trauma rooms, implement a strategic sink placement design. Position the primary handwashing sink outside the main trauma room, specifically in the anteroom. This placement serves multiple purposes in reducing room congestion. By locating the sink in the anteroom, staff can perform necessary hand hygiene procedures before entering or after exiting the trauma room, without impeding the flow of activity within the critical care area. This design choice frees up valuable space within the trauma room itself, allowing for more efficient placement of essential medical equipment and improved staff circulation. The anteroom sink location also creates a natural transition zone, reinforcing infection control protocols as staff move between the main corridor and the trauma room. Ensure the sink in the anteroom is easily accessible, equipped with hands-free operation features, and surrounded by adequate space to prevent bottlenecks during busy periods. This strategic sink placement contributes to a more streamlined and efficient trauma room environment, potentially improving the speed and effectiveness of emergency care delivery by reducing physical obstacles and minimizing unnecessary movement within the main treatment area.

11.2. Desirable Outcome: Improved work efficiency

To enhance work efficiency in trauma care settings, implement a strategic sink placement design with complementary sanitation options. Position the sink adjacent to the door in the anteroom, facilitating a logical “wash-in and wash-out” workflow for staff entering and exiting the trauma room. This placement ensures that hand hygiene is conveniently integrated into the natural movement patterns of medical personnel, promoting consistent adherence to infection control protocols without disrupting the flow of care. Complement the sink with easily accessible hand sanitizer stations within the trauma room and anteroom. This provides a quick alternative for hand hygiene when full handwashing is not necessary or time is critical, further streamlining workflow. Place sanitizer dispensers at key points such as near the patient bed, equipment stations, and exit points. Avoid placing the sink in the corner of the anteroom, as this can create congestion and limit accessibility during busy periods. Instead, opt for a more central or easily approachable location that allows multiple staff members to access the area simultaneously if needed. By implementing this efficient sink placement strategy along with supplementary hand sanitization options, the trauma room design can improve work efficiency. It enables staff to maintain proper hygiene practices without unnecessary movement or delays, ultimately supporting faster and more effective patient care in time-sensitive emergency situations.

11. Design Element: Sink

11.3. Desirable Outcome: Reduced wasted space

To optimize space utilization in trauma care settings while maintaining essential hygiene standards, implement a sink placement design that minimizes redundancy. The primary strategy is to provide a shared sink between two adjacent trauma rooms, typically positioned in a shared anteroom or a carefully designed alcove accessible from both spaces. This shared sink approach can reduce the footprint dedicated to hand hygiene facilities, freeing up valuable space within each trauma room for critical medical equipment and staff movement. Limit unnecessary sinks within the main trauma rooms themselves. By consolidating hand washing to the shared sink in the anteroom or alcove, you eliminate the need for individual sinks in each trauma room. This not only saves space but also reduces plumbing complexity and maintenance requirements. Ensure that the shared sink area is designed for efficiency and ease of use. It should be large enough to accommodate simultaneous use, if necessary, with clear access paths from both trauma rooms. Equip the sink with hands-free operation features and high-efficiency water fixtures to further enhance its utility. By implementing this shared sink strategy and limiting unnecessary fixtures, the trauma room design can reduce wasted space while maintaining high standards of hygiene and infection control. This approach allows for more efficient use of the available area, potentially improving the overall layout and functionality of the trauma care environment.

11. Design Element: Sink

12. Design Element: Doors

12.1. Desirable Outcome: Enhanced work efficiency

To optimize work efficiency in trauma care settings, implement a design element that eliminates the door between the anteroom and the main trauma room. This open layout concept can enhance the flow of staff, equipment, and supplies between these two crucial areas. By removing the physical barrier of a door, medical personnel can move swiftly and unimpeded between the anteroom and the trauma room. This seamless transition is particularly critical during emergencies when every second counts. Staff can quickly retrieve supplies, bring in additional equipment, or enter and exit the trauma room without the delay of opening and closing a door. The absence of a door also improves visibility between the two spaces, allowing for better communication and coordination among team members. Staff in the anteroom can more easily monitor the situation in the trauma room and respond rapidly when needed. By eliminating the door between the anteroom and trauma room, the design can improve work efficiency, facilitating faster response times and smoother workflow in critical care situations. This open concept supports the dynamic nature of trauma care, allowing for more effective team coordination and ultimately contributing to improved patient outcomes.

12.2. Desirable Outcome: Reduced interruptions

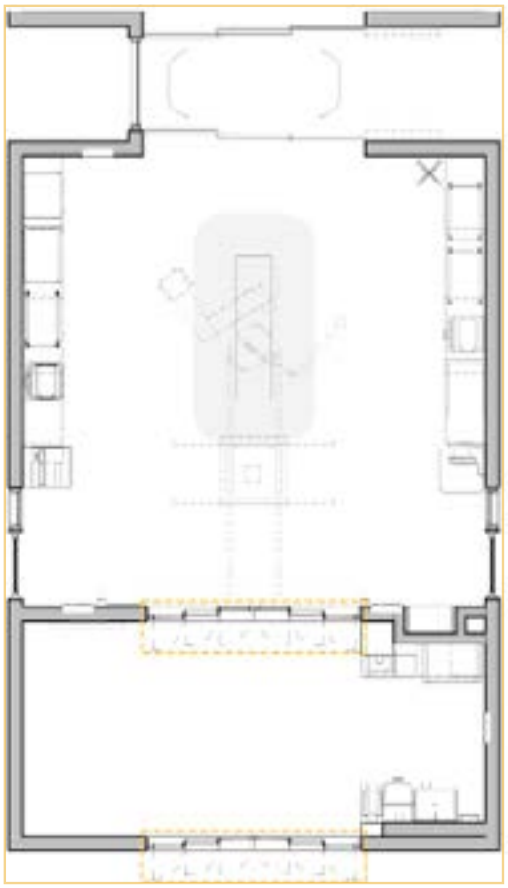
To minimize disruptions in trauma care settings while maintaining a level of separation between spaces, implement an innovative door design using projected boundaries rather than a physical door between the anteroom and trauma room. This design allows for unimpeded movement of staff and equipment during critical situations while still offering a barrier that can reduce unnecessary traffic and interruptions.

12. Design Element: Doors

12.3. Desirable Outcome: Improved noise control

To enhance noise control in trauma care settings, implement a dual-door system by providing doors for both the anteroom and the trauma room. This strategic door placement creates an effective acoustic buffer zone, reducing noise transmission between the main corridor and the critical care area. The anteroom door serves as the first barrier, containing much of the ambient noise from the hospital hallways. The second door, leading from the anteroom to the trauma room, further isolates the critical care space from external sounds. This double-door configuration allows for a gradual reduction in noise levels as one moves from the public areas into the trauma room, creating a more controlled and quieter environment for patient care. Ensure both doors are equipped with soft-closing mechanisms and sound-dampening materials to minimize noise from their operation. This dual-door system can improve the acoustic environment within the trauma room and help contain equipment sounds and urgent communications within the critical care area, preventing disturbance to adjacent hospital spaces and vice versa. By implementing this door strategy, the trauma room design can enhance noise control, fostering a calmer atmosphere that supports clear communication among medical staff and potentially reduces stress for both patients and caregivers during critical procedures.

12. Design Element: Doors



13. Design Element: Lighting

13.1. Desirable Outcome: Efficient delivery of care

Lighting design in trauma rooms plays a crucial role in the efficient delivery of care, directly impacting the medical team's ability to perform life-saving procedures with precision and speed. A well-planned lighting system should illuminate the space effectively and adapt to the varied and dynamic needs of trauma care. The design of lighting in these critical care environments requires a thoughtful approach that combines functionality, flexibility, and user control.

Central to the lighting design is the implementation of an advanced overhead lighting system that minimizes shadow casting. This is typically achieved through the use of multiple light sources or large area lights that provide diffuse, even illumination across the entire patient care area. Convenient control over the lighting environment is essential for the efficient delivery of care in trauma situations. Install multiple lighting control switches at strategic locations throughout the room, ensuring that staff can quickly adjust lighting levels without stepping away from the patient. Integrate dimming capabilities for all light sources to allow fine-tuning of the illumination levels. This feature is particularly important for procedures that may require darker conditions, such as ultrasound examinations or the use of fluoroscopy equipment. The ability to quickly dim or brighten specific areas of the room enhances the versatility of the space and supports a wide range of medical interventions. By implementing these comprehensive lighting design strategies, the trauma room environment can enhance the medical team's ability to deliver efficient, precise care.

13.2. Desirable Outcome: Improved lighting comfort

To improve lighting comfort and control in trauma rooms, implement a comprehensive system that enhances both functionality and well-being. Install advanced dimming capabilities for all light sources, allowing precise adjustment of intensity from full brightness to very low levels. Incorporate indirect lighting alongside walls, inspired by theater design, to provide soft, diffused illumination that reduces glare and creates a calming atmosphere without disturbing the patient. Integrate tunable LED technology, enabling staff to adjust the color temperature from warm to cool tones, supporting biological rhythms and optimizing visibility for various procedures. Equip the room with strategically placed control panels and wireless options for seamless lighting adjustments. Include specialized task lighting, such as adjustable LED spotlights and personal headlights, for focused illumination during intricate procedures. This multi-faceted approach ensures efficient care delivery while prioritizing visual comfort for both patients and healthcare providers in high-stress trauma situations.

13. Design Element: Lighting

13.3. Desirable Outcome: Improved lighting control

To achieve improved lighting control in trauma rooms, a multi-faceted approach that empowers staff with enhanced ability to manipulate the lighting environment is essential. This strategy not only supports the efficient delivery of care but also allows for rapid adaptation to the diverse and often unpredictable needs of trauma situations. By implementing advanced control systems and incorporating specialized lighting tools, the trauma room can become a more responsive and effective environment for critical care. Central to improving lighting control is the installation of an intuitive and accessible control system. Implement multiple control panels strategically placed throughout the room, ensuring that staff can adjust lighting from various positions without stepping away from the patient.

To address the need for specialized lighting during specific procedures, integrate pencil lights and provide high-quality, adjustable headlights for staff use. Pencil lights, with their focused beam, offer precise illumination for detailed work without affecting the overall room lighting. These can be mounted on flexible arms near the patient bed or made available as handheld devices, allowing for quick deployment when needed. Headlights provide a mobile, hands-free lighting solution that moves with the wearer, ensuring consistent illumination regardless of position. Equip these headlights with adjustable intensity and beam width to suit various procedures. By implementing these strategies to increase staff control over lighting and incorporating specialized lighting tools, the trauma room becomes a more adaptable and efficient environment for delivering critical care. This enhanced lighting control not only supports the technical aspects of medical procedures but also contributes to improved staff performance and, ultimately, better patient outcomes in high-stakes trauma situations.

13.4. Desirable Outcome: Enhanced work efficiency

To enhance work efficiency in trauma rooms through optimized lighting design, implement a multi-faceted approach that prioritizes convenience and flexibility. Install additional lighting switches at strategic locations throughout the room, ensuring that staff can quickly adjust illumination without stepping away from critical tasks. Integrate an adjustable light boom system, allowing for precise maneuvering of focused lighting at various angles to accommodate different procedures and patient positions. This adaptable solution provides targeted illumination exactly where it is needed, enhancing visibility during complex interventions. For general lighting, embed high-quality LED fixtures directly into the ceiling, eliminating the need for traditional surgical lights in most trauma scenarios. This streamlined ceiling design maintains an uncluttered overhead space while providing ample, shadow-free illumination for the majority of trauma procedures. By combining easily accessible controls, versatile directional lighting, and efficient embedded ceiling illumination, the trauma room's lighting system boosts operational efficiency, allowing healthcare providers to focus on delivering rapid, effective care without lighting-related interruptions or adjustments.

14. Design Element: IV Pole

14.1. Desirable Outcome: Increased accessibility

To increase accessibility and optimize the use of IV poles in trauma rooms, a dual-strategy approach that combines integration with existing structures and adaptability for patient transport is essential. This design strategy can enhance the efficiency of care delivery and contribute to a more organized and spacious trauma environment. Integrate IV functionality into the medical column or boom system, freeing up floor space and positioning fluids and medications within easy reach. This integration should include multiple hooks for various bags and pumps, with 360-degree rotation capability. Implement a detachable IV pole system for the trauma bed, featuring a lightweight, quick-release design for efficient patient transport and discharge. This mobile solution should be height-adjustable and compatible with standard IV pumps. By combining fixed and mobile IV solutions, the trauma room maintains a clutter-free environment while ensuring continuous, accessible IV support throughout the patient's care journey, from admission through discharge.

15. Design Element: Sharps

15.1. Desirable Outcome: Improved accessibility

To enhance accessibility and safety in handling sharps within trauma rooms, implement a thoughtful approach to sharps container placement and design. Install large, wall-mounted sharps containers on both sides of the room, ensuring they are easily accessible from any position around the patient. These containers should feature wider openings to facilitate quick and convenient disposal of sharps, reducing the risk of accidental sticks during high-pressure situations. Position the containers within the main trauma room, not in the anteroom, to minimize staff movement during critical procedures. Use securely bolted wall mounts for the sharps boxes to prevent accidental dislodging and ensure stability. These comprehensive sharps management setup not only increases accessibility but also promotes a safer working environment, allowing healthcare providers to focus on patient care without compromising on proper sharps disposal practices.

15.2. Desirable Outcome: Enhanced safety

To enhance safety in sharps handling within trauma rooms, implement practical solutions that prioritize both efficiency and protection. Install foot pedal-activated sharps containers that allow hands-free operation, enabling quick and convenient disposal during fast-paced procedures. These containers should be permanently wall-mounted rather than attached to patient beds, eliminating potential risks to patients from accidental contact or movement. Wall mounting also provides a stable, fixed location that staff can reliably access without compromising patient safety. The hands-free operation reduces the risk of needle sticks and cross-contamination, while the fixed position ensures consistent access without introducing hazards to the patient care area. This approach to sharps disposal combines practical functionality with essential safety measures, creating a more secure environment for both patients and healthcare providers during trauma care.

16. Design Element: Waste management

16.1. Desirable Outcome: Increased accessibility

To improve waste management and increase accessibility in trauma rooms, implement a comprehensive system of carefully placed waste containers. Position a large, foot pedal-operated bin near the entrance door for convenient disposal during staff entry and exit, complemented by another sizeable container adjacent to the sink for efficient disposal during cleanup procedures. Install smaller waste bins near the patient's head area for immediate access during procedures, and place additional containers on each side of the room to ensure disposal points are always within reach of staff. All containers should feature foot pedal mechanisms for hands-free operation, reducing infection risk and improving workflow efficiency. Incorporate mobile waste bins that can be easily repositioned based on specific procedure requirements or team preferences. This thoughtful distribution of waste containers, combining both fixed and movable options, creates an efficient waste management system that supports smooth workflow patterns while maintaining a clutter-free environment during trauma care delivery.

17. Design Element: General equipment

17.1. Desirable Outcome: Increased accessibility

To maximize accessibility of general equipment in trauma rooms, establish a centralized storage and organization system that keeps essential tools and devices within immediate reach. Position frequently used equipment in dedicated zones around the patient care area, ensuring that vital instruments and monitoring devices are readily accessible from multiple approach points. Implement wall-mounted storage systems and mobile equipment carts carefully placed near high-activity areas, minimizing travel distance and reducing time spent searching for necessary items. This concentrated arrangement of equipment, with clear organization and proximate placement, enables healthcare providers to maintain focus on patient care while accessing required tools swiftly and efficiently. The thoughtful consolidation of equipment in centralized, easily accessible locations supports rapid response times and seamless workflow during critical trauma interventions.

17.2. Desirable Outcome: Enhanced delivery of care

To enhance delivery of care in trauma rooms, integrate a comprehensive setup of frequently needed tools and control systems. Install a dedicated electric razor storage unit within the trauma bay for immediate access during surgical preparations, eliminating delays in time-critical situations. Mount a centralized digital control panel at a convenient height and location, consolidating lighting and temperature controls into one intuitive interface for quick environmental adjustments. Incorporate redundant suction systems by installing additional wall-mounted units to complement the surgical boom, ensuring capacity for multiple patients during surge scenarios. This arrangement, combining readily available surgical tools, streamlined environmental controls, and duplicate suction access points, creates a highly functional space that adapts to varying patient loads while maintaining efficient workflow patterns. The thoughtful placement of these elements supports seamless care delivery and rapid response capabilities in high-pressure trauma situations.

17. Design Element: General equipment

17.3. Desirable Outcome: Reduced disruptions

To reduce disruptions in trauma rooms, embrace wireless technology solutions that minimize cable clutter and enhance mobility. Implement Bluetooth-enabled medical devices, such as ultrasound probes, that eliminate the need for physical connections and allow seamless movement around the patient. This wireless approach not only reduces tripping hazards and equipment entanglement but also enables staff to perform diagnostic procedures more efficiently without managing cumbersome cords. The integration of cordless technology creates a cleaner, more organized workspace while improving the team's ability to maneuver freely during critical procedures. By minimizing physical obstacles and connection points, wireless solutions help reduce interruptions in workflow and enhance the overall efficiency of trauma care delivery.

17.4. Desirable Outcome: Enhanced work efficiency

To enhance work efficiency in trauma rooms, implement a streamlined system that combines automated access control with optimized equipment placement. Install badge readers at entry points for quick team sign-in, eliminating manual documentation and enabling immediate tracking of personnel during trauma responses. Position essential equipment such as suction units, electrical outlets, ophthalmoscopes, and patient monitors in a centralized location, creating an intuitive hub for critical tools and devices. This consolidated arrangement minimizes time spent locating and accessing equipment, reduces unnecessary movement around the room, and ensures that all vital resources are within immediate reach of the trauma team. The combination of automated access systems and centralized equipment placement creates an efficient workspace that supports rapid response times and maintains smooth workflow patterns during critical care delivery.

17. Design Element: General equipment

17.5. Desirable Outcome: Improved noise control

To improve noise control in trauma rooms, implement a system that combines active noise cancellation with optimized communication tools. Place microphones and speakers strategically to detect and neutralize disruptive sounds in real time, ensuring a quieter environment for focused care. Transition routine interactions to computer-based communication, such as digital logs and messaging apps, reducing verbal exchanges that contribute to noise. Additionally, utilize telecommunication tools like video calls for consultations, enabling clear communication among staff without generating unnecessary auditory disruptions. This combination of noise-canceling technology and streamlined communication enhances acoustic control, promotes a calmer atmosphere, and ensures effective coordination during high-pressure situations.

17.6. Desirable Outcome: Enhanced patient care

To enhance patient care in trauma rooms, incorporate radiant heating systems above patient beds to maintain optimal warmth during procedures. Position overhead radiant panels strategically to deliver gentle, consistent heat directly to the patient, preventing discomfort from cold exposure. This localized heating approach ensures that patients remain warm without the need to heat the entire room, supporting both comfort and clinical efficiency. By maintaining body temperature, the radiant heat system minimizes the risk of hypothermia, promotes relaxation, and enhances patient well-being during critical care interventions. This targeted solution ensures that thermal comfort is seamlessly integrated into the trauma care environment, improving overall patient outcomes.

17. Design Element: General equipment

17.7. Desirable Outcome: Increased reliability

To increase reliability in trauma rooms, implement wired technology to ensure stable connectivity without dependence on batteries. Equip essential devices—such as patient monitors, communication systems, and diagnostic tools—with hardwired connections to eliminate the risks of signal interruptions or power failures associated with wireless or battery-operated equipment. Position network ports and power outlets efficiently around the room for seamless access, ensuring that critical systems remain continuously operational during procedures. This approach reduces downtime, avoids the need for frequent battery replacements, and guarantees uninterrupted performance. The use of wired technology enhances the reliability of life-saving equipment, supporting smooth workflow and ensuring consistent care delivery during high-pressure scenarios.

18. Design Element: X-ray equipment

18.1. Desirable Outcome: Enhanced delivery of care

To enhance the delivery of care in trauma rooms, incorporate in-room X-ray capabilities to streamline diagnostic processes. Position portable or wall or ceiling-mounted X-ray systems within the trauma space, enabling immediate imaging without the need to transfer patients to radiology departments. This on-site setup minimizes delays, allowing clinicians to quickly assess injuries and make critical decisions in real-time. By reducing patient movement, in-room X-ray technology enhances comfort and lowers the risk of further injury. The seamless integration of diagnostic tools within the trauma environment ensures faster, more efficient care delivery, improving outcomes during urgent medical interventions.

18.2. Desirable Outcome: Increased mobility/ accessibility

To increase mobility and accessibility in trauma rooms, integrate a combination of portable and ceiling-mounted X-ray machines with advanced maneuverability. Portable X-ray machines enable rapid imaging at the patient's bedside, allowing clinicians to perform diagnostics without moving the patient, especially in critical conditions. Complementing this, ceiling-mounted X-ray units on movable tracks with rotatable arms provide greater flexibility, easily reaching various angles and positions within the room. This dual approach ensures that imaging equipment is always accessible, whether for minor adjustments or comprehensive diagnostics, without disrupting the flow of care. The enhanced mobility of these systems promotes faster interventions, reduces patient handling, and supports seamless care delivery during high-pressure situations.

18. Design Element: X-ray equipment

18.3. Desirable Outcome: Reduced interruptions

To reduce interruptions in trauma rooms, incorporate built-in imaging capabilities directly within space. Integrate X-ray systems into the room's design allowing imaging to be performed seamlessly without transferring patients or rearranging equipment. This setup minimizes the need for staff to leave the room, ensuring continuous care and reducing workflow interruptions during critical procedures. By eliminating the logistical challenges of moving patients to radiology, built-in imaging capabilities promote smoother operations, faster decision-making, and uninterrupted patient care, enhancing overall efficiency during trauma interventions.

18.4. Desirable Outcome: Enhanced work efficiency

To enhance work efficiency in trauma rooms, utilize specialized gurneys designed to accommodate X-ray plates sliding directly underneath the bed. These gurneys streamline the imaging process by allowing radiographs to be taken without lifting or repositioning the patient, saving valuable time and reducing physical strain on staff. The ability to position X-ray plates effortlessly beneath the patient ensures quick and precise imaging, minimizing workflow disruptions during procedures. This design strategy not only speeds up diagnostics but also improves patient comfort by reducing unnecessary movement. Integrating these specialized gurneys into the trauma setting promotes faster care delivery and optimizes staff efficiency during critical interventions.

Additionally, incorporating real-time monitors on portable X-ray machines allows immediate access to imaging results without the need to transport patients or move between rooms. This real-time display streamlines decision-making, enabling faster diagnosis and treatment. Additionally, projecting X-ray results onto an overhead monitor ensures that all team members have a clear view of the imaging, fostering better communication and coordination during critical moments. Integrating the ability to show ultrasound results on the same overhead monitor further enhances efficiency by consolidating multiple diagnostic tools into a single, easily accessible display. This multi-functional approach reduces delays and enhances team collaboration in emergency settings.

18. Design Element: X-ray equipment

18.5. Desirable Outcome: Reduced disruptions

Displaying X-ray films on a dedicated monitor eliminates the need to dim the lights during procedures, which can disrupt ongoing tasks and divert attention away from patient care. By having a well-placed monitor for imaging, the team can access critical diagnostic information without compromising the lighting needed for other activities, thereby maintaining a smoother workflow.

19. Design Element: CT scanner

19.1. Desirable Outcome: Enhanced delivery of care

To enhance the delivery of care in trauma rooms, deploy a multi-faceted CT scanner system adapted to emergency needs. Allocate a minimum of two dedicated CT scanners for the emergency department to ensure rapid imaging availability, reducing wait times during peak demand. Incorporate portable CT scanners to eliminate the need for patient transportation, enabling immediate bedside diagnostics, particularly for critical or unstable patients. Additionally, use sliding CT scanners that operate between dual rooms, facilitating real-time diagnosis for multiple patients without delays. This combination of fixed, portable, and sliding CT technologies ensures continuous imaging access, accelerates clinical decision-making, and optimizes care delivery during emergencies.

19.2. Desirable Outcome: Reduced traveling time

To reduce traveling time in trauma care, implement proximate and dedicated CT scanners strategically located adjacent to the trauma rooms. This setup allows for immediate access to imaging without the need for patients to be transported to a separate imaging department, cutting down on delays. Additionally, utilize sliding CT scanners with dual rooms that enable seamless transitions between imaging and treatment areas. This design eliminates the necessity for patient transfer, allowing staff to conduct scans quickly and efficiently while the patient remains in a safe, familiar environment. By minimizing traveling time, these strategies enhance the overall speed of care delivery and improve patient outcomes during critical interventions.

19. Design Element: CT scanner

20. Design Element: Computer for scribe nurse

20.1. Desirable Outcome: Increased mobility and flexibility

To increase mobility and flexibility in trauma rooms, implement mobile computers for scribe nurses, allowing them to move freely while documenting patient information. These portable devices enhance maneuverability, enabling nurses to be present at the bedside and engage directly with patients during critical care moments. By incorporating wireless technology, the need for cumbersome cables and fixed stations is eliminated, allowing scribe nurses to access and input data from any location within the trauma area. This increased mobility not only facilitates real-time documentation but also fosters better communication among the care team, ultimately enhancing the efficiency and quality of patient care during high-pressure situations.

20.2. Desirable Outcome: Reduced disruptions

To reduce disruptions in trauma rooms, employ mobile computers for scribe nurses that are designed to adapt to various situations without obstructing the pathways of other team members. These portable devices allow scribe nurses to document patient information efficiently from any location within the room, ensuring they can remain actively engaged in the care process while avoiding physical interference with ongoing procedures. By facilitating movement and positioning, mobile computers enable nurses to seamlessly transition between tasks, maintaining a clear workflow and minimizing interruptions. This design strategy enhances documentation accuracy and contributes to a more organized and focused trauma environment, ultimately supporting improved patient care.

20.3. Desirable Outcome: Enhance work efficiency

To enhance work efficiency in trauma rooms, implement a computer system for scribe nurses that includes a live stream of the patient's top view, facilitating real-time documentation during procedures. This visual access allows nurses to monitor patient status and accurately capture critical information without needing to rely solely on verbal communication. Pair this with a user-friendly interface, such as an iPad, which enables quick navigation and input, minimizing time spent on documentation tasks. Additionally, incorporating a small work surface for notetaking ensures that nurses can jot down important observations, when necessary, further streamlining their workflow. Together, these strategies optimize documentation processes, improve accuracy, and allow scribe nurses to focus on delivering high-quality care in dynamic environments.

20. Design Element: Computer for scribe nurse

21. Design Element: Booms

21.1. Desirable Outcome: Enhanced work efficiency

To enhance work efficiency in trauma rooms, integrate easily articulated booms designed to hold essential medical equipment within reach of caregivers. These flexible booms can be positioned to provide immediate access to tools and devices, minimizing the need for staff to move around the room or search for equipment during critical moments. Additionally, providing a second boom for use during double occupancy allows for simultaneous care of multiple patients, ensuring that each one receives the attention and resources they need without delay. This arrangement promotes a more organized and efficient workflow, enabling healthcare providers to focus on delivering timely and effective interventions in high-pressure environments.

21.2. Desirable Outcome: Enhanced flexibility

To enhance flexibility in trauma rooms, utilize a movable medical column or boom on a “U” shaped ceiling track. This design allows for easy repositioning of medical equipment, enabling caregivers to adapt the setup based on patient needs and specific procedures. By incorporating a three-axis movement medical column instead of traditional wall-mounted suction systems, potential blockages to circulation paths are minimized, ensuring unobstructed access for staff. This versatility promotes a dynamic care environment where equipment can be adjusted quickly and efficiently, supporting a range of treatment scenarios while maintaining optimal workflow and patient safety.

21. Design Element: Booms

21.3. Desirable Outcome: Enhanced workflow

To enhance workflow in trauma rooms, position the life support system using a medical column that is suspended from the ceiling, allowing for complete freedom of movement in three axes. This design enables healthcare providers to access necessary equipment easily and adjust its positioning without obstruction, optimizing the use of space. By opting for a three-axis movement medical column instead of traditional wall-mounted suction systems, potential blockages to circulation paths are minimized, ensuring a clear and unobstructed workflow. Additionally, the ability to adjust the column's location in the ceiling accommodates left- or right-handed staff, promoting comfort and efficiency during critical care delivery. This configuration fosters a more streamlined and responsive environment for patient treatment.

22. Design Element: Surgical light

22.1. Desirable Outcome: Enhanced workflow

To enhance workflow in trauma rooms, utilize a single surgical light mounted on the boom, which is sufficient for residents' usage during procedures. This design allows for targeted illumination, providing the necessary light for focused tasks without overwhelming the space. Additionally, embedding another surgical light in the ceiling can optimize lighting for macro-level trauma procedures, ensuring that all areas of the surgical field are well-lit. Having two surgical lights improves visibility and accessibility, allowing the surgical team to work efficiently and effectively without needing to reposition equipment frequently. This arrangement supports a smoother workflow, enhancing overall patient care during critical interventions.

23. Design Element: Information display

23.1. Desirable Outcome: Enhanced visibility to patient information

To enhance visibility of patient information, placing monitors on different sides of the room ensures 360-degree views of patient vitals for the entire care team. This efficient positioning allows all staff members to easily access critical information without having to reposition themselves frequently. Additionally, incorporating larger glide scope monitors and anti-glare displays further improves visibility, making it easier for healthcare providers to monitor patient conditions at a glance. For specific roles, such as the scribe nurse, having dedicated monitors on the opposite wall ensures they can track patient data without obstruction, facilitating more accurate documentation.

23.2. Desirable Outcome: Enhanced delivery of care

Integrating real-time patient information technology into the information display system can enhance the delivery of care. By providing up-to-date data on patient vitals, lab results, and other essential metrics, staff can make informed decisions quickly, leading to more timely interventions. This seamless flow of information ensures that the care team remains aware of any changes in the patient's condition, improving responsiveness during critical moments.

23.3. Desirable Outcome: Ease of access to information

Incorporating visualization of medical history through the information display streamlines access to important patient data. By integrating real-time patient information technology, healthcare providers can quickly retrieve and review medical histories, allergies, and previous treatments directly from the monitors. This easy access reduces time spent searching for information and enables staff to focus more on providing quality care.

23. Design Element: Information display

23.4. Desirable Outcome: Improved crowd control

Telecasting cases through a bird's-eye view for observers can improve crowd control in trauma rooms. By providing a live feed of the procedure, this strategy allows onlookers to remain informed and engaged without crowding the surgical area. This arrangement helps maintain a clear and organized environment, minimizing disruptions to the care team while ensuring that educational opportunities are still available for those observing the procedure.

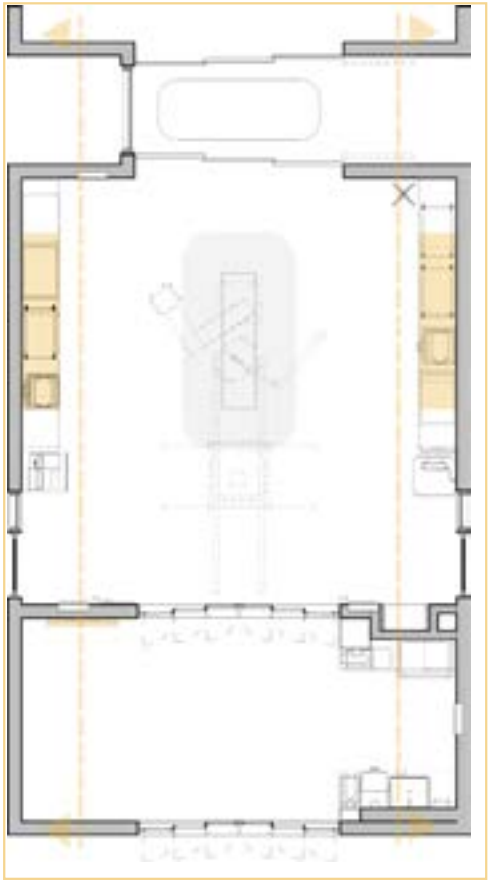
23.5. Desirable Outcome: Improved noise control

Live streaming cases to an anteroom for observers effectively reduces unnecessary noise in the trauma room. By allowing attendees to view the procedure remotely, this approach minimizes the distractions caused by observers asking questions or discussing the case within earshot of the care team. Consequently, the environment remains focused and quiet, allowing healthcare providers to concentrate fully on the task at hand.

23.6. Desirable Outcome: Improved comfort for staff

To enhance staff comfort, the placement of monitors should consider ergonomic principles. By positioning the information displays at optimal heights and angles, staff can easily view the screens without straining their necks or adopting uncomfortable postures. This ergonomic consideration not only boosts comfort but also supports staff efficiency and reduces fatigue during long shifts, enabling better focus on patient care.

23. Design Element: Information display



24. Design Element: Scribe nurse station

24.1. Desirable Outcome: Enhanced visibility to patient

To enhance the scribe nurse's visibility of the patient during procedures, incorporating an elevated platform is an effective design strategy. This allows the scribe nurse to maintain a clear line of sight to the patient and the procedure area, ensuring they can accurately document and monitor critical events without obstruction. The elevated position provides a better vantage point, improving their ability to observe the process and respond quickly to updates or changes in patient condition. This setup supports seamless coordination between the scribe nurse and the medical team, ensuring accurate and timely documentation of care.

25. Design Element: Materials

25.1. Desirable Outcome: Improved noise control

To improve noise control in trauma rooms, the incorporation of soundproof barriers and noise-dampening techniques is essential. These materials can be integrated into walls, ceilings, and floors to minimize sound transmission, creating a quieter environment that supports clear communication and reduces stress for both staff and patients. Using noise-dampening materials, such as specialized acoustic panels, can enhance the room's acoustics, ensuring that necessary sounds, like alarms or patient communications, are easily heard without excess noise interference. Additionally, applying acoustic treatments to mobile furniture, especially those made of steel, helps reduce noise during movement, preventing unnecessary distractions in a high-pressure setting. These design strategies collectively promote a more focused and controlled atmosphere in trauma rooms, optimizing auditory conditions for care delivery.

26. Design Element: Computer

26.1. Desirable Outcome: Increased mobility and flexibility

To enhance mobility and flexibility in trauma rooms, computers mounted on wheels allow for greater maneuverability, enabling staff to position technology where it's needed most without hindering movement. These mobile workstations can be quickly transported to various areas, ensuring immediate access to patient data or documentation tools. Additionally, height-adjustable computers on wheels accommodate the varying needs of scribe nurses, allowing for quick adjustments to match user height and ergonomic comfort. This adaptability ensures that staff can efficiently perform tasks while remaining mobile, supporting dynamic workflows in fast-paced environments.

26.2. Desirable Outcome: Enhanced work efficiency

Integrating proximity sensors or badge login systems into computers can help improve work efficiency by reducing the time required for manual login procedures. With these technologies, staff can quickly and securely access patient information by simply approaching the workstation, eliminating delays associated with entering credentials to log into computers. This streamlined login process ensures that healthcare providers spend less time managing technology and more time focused on patient care, enhancing overall efficiency in trauma room operations.

27. Design Element: Ultrasound

27.1. Desirable Outcome: Enhanced accessibility to equipment

To improve the accessibility of ultrasound equipment in trauma rooms, various design strategies should be implemented to ensure quick and efficient access during critical procedures. Portable ultrasounds offer flexibility, allowing staff to bring the device directly to the patient with minimal effort. The handheld “butterfly probe” provides even greater convenience due to its compact design and ease of use, making it ideal for fast-paced environments. For more permanent solutions, integrating an ultrasound machine within the room on a boom allows for quick access without occupying valuable floor space. Additionally, mounting the ultrasound on a ceiling track further frees up floor space, ensuring that staff can move about without obstruction. These solutions provide streamlined access to ultrasound technology, enhancing the room’s functionality and supporting rapid decision-making during emergencies.

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About the Author

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Dr. Bayramzadeh served as the Principal Investigator of a $2.4 million federally funded research initiative supported by the Agency for Healthcare Research and Quality (AHRQ), focused on advancing the design of trauma rooms to enhance safety, performance, and patient outcomes. Her research utilized a combination of cutting-edge methodologies, including augmented reality, full-scale mock-up evaluations, and scenario-based simulations, and led to the development of publicly available, evidence-based design guidelines.

Her research has been recognized nationally with numerous awards, including the HCD 10 – Researcher Category, HCD 10 – Educator Category, the EBD Touchstone Award: Gold, and inclusion in the AIA AAH U40 List of Healthcare Design's Best Under 40. She is also the recipient of Kent State's President's Faculty Excellence Award and the Excellence in Graduate Student Mentoring Award.

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