

Human Factors Design Evaluation Project

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In this paper, I will evaluate the physical environment and health information technology (HIT) design of the ambulatory surgery center (ASC) where I am currently employed. In my evaluation, I have focused on how the design of the environment, placement and functionality of technology, and workflow processes affect nursing duties, patient safety, quality of care, and the general well-being of the staff.

I conducted this assessment at a small ambulatory surgery center in a suburb of Dallas, Texas. The nursing unit includes a combined pre-operative and post-anesthesia care area with six curtained bays, a central nursing station, two operating rooms, and adjacent support areas including sterile processing, medication storage, and staff workspaces. I evaluated these areas collectively to understand how physical layout and HIT design influence nursing workflow and patient safety.

Human factors design is a core concept in nursing informatics because system design directly affects how clinicians interface with technology and their environment (Dennis et al., 2022, Chapter 8). Inefficient layouts, poorly integrated technology, and inadequate ergonomic setups contribute to fatigue, workarounds, and increased risk of errors (Schwappach et al., 2025). On the other hand, environments developed with human factors principles in mind can decrease cognitive and physical strain, support safe workflows, and improve clinical outcomes. My paper provides an evidence-based evaluation of the ASC's strengths and areas for improvement.

Interactions With Nursing Staff

I obtained nursing staff input through informal, in-person interviews and direct observation during routine clinical operations. Approximately six registered nurses from pre-operative, PACU, and operating room areas, as well as two CRNAs and the nurse manager,

participated in these discussions. The nursing staff were actively engaged throughout the assessment process, and their input considerably influenced this evaluation. Conversations focused on usability, workflow efficiency, ergonomic strain, and safety concerns related to the physical environment and HIT systems. I identified themes based on repeated issues raised across roles and shifts. Many daily workflows rely on workarounds rather than intended system design, particularly in documentation and patient movement.

Staff input revealed safety risks not immediately apparent through observation alone, including unsecured access points, aging stretchers with unreliable locks, a lack of patient lift devices, and musculoskeletal strain related to tablet-based charting. CRNAs reported frustration with manual vital sign documentation in one operating room due to a lack of EHR integration. Nurses also identified strengths, such as good unit visibility, adequate lighting, and reliable employee Wi-Fi. Incorporating staff perspectives ensured the evaluation reflected real-world practice and human impact.

Site Assessment

Nursing Unit Layout

The ASC is organized in a compact, roughly circular layout that allows efficient movement between patient care and storage areas (see Figure 1). The lobby is located at the front of the facility. A badge-access door connects the lobby to the pre-operative/PACU area.

The combined pre-operative/PACU area contains six curtained bays and a central nursing station with two desktop computers. While the curtain design supports visual monitoring, it limits privacy and contributes to ambient noise. Storage space in this area is limited, leading to supplies being stored behind or beneath mobility equipment, which creates inefficiencies along with physical strain. Automatic doors connect this area to the operating suites.

The operating room (OR) area is accessed through touch-activated doors that do not require badge access. Adjacent to the entrance is the medication room, with two OR suites located directly across from it. A short hallway between the ORs contains two small desks and a shared desktop computer designated for physician use, and it connects to a perpendicular corridor that houses the sterile supply room, IT closet, electrical room, and medical gas storage. Due to limited storage space, walls throughout the OR area and adjacent hallways are lined with large equipment, including OR tables, a surgical microscope, and soiled linen and waste trolleys, creating clutter in high-traffic areas. Beyond the OR suites is the soiled handling room, followed by a narrow hallway leading past sterile processing to the staff locker rooms and bathrooms. This area also contains a back entrance and shelving for clean scrub storage, with the men's locker room providing a small workstation for physician laptop use.

Just beyond the locker rooms is a door leading to the employee breakroom, which contains a table, six chairs, a sink, microwave, coffee maker, and refrigerator. Another door leads back out to the reception area, which also contains the administrators' offices and two additional desktop computers for staff use.

Location of Technology

The unit houses technology in multiple locations: two desktop computers for nursing staff are located at the nursing station, two behind reception, and one in each OR. There are an additional two desktop computers designated for the reception staff. The administrator and the nurse manager each have a laptop with an extended desktop display. Finally, a desktop computer is located in the OR hallway for physicians' use and is sometimes used by other staff when physicians are not present. Nurses rely heavily on tablets for documentation. Some tablets are

configured to print discharge instructions while others are not, requiring nurses to maneuver between workstations to print discharge instructions.

While patient monitors automatically transmit vital signs to the electronic health record (EHR) in most areas, OR 1 is equipped with an older monitor that does not interface with the EHR. As a result, CRNAs must manually enter vital signs during procedures, increasing documentation burden and distraction during high-risk periods of patient care.

The ASC utilizes HST Pathways eChart as its EHR. eChart is a web-based EHR that does not require software installation for nurses to access it (HST Pathways, n.d.). The ASC restricts access to the employee Wi-Fi network and does not allow access from the guest or any other network. Security protocol requires users to log in twice to access the EHR.

Types of Equipment Available

The unit is equipped with standard ASC equipment: patient monitors, anesthesia equipment, a 12-lead EKG machine, a single crash cart, and a great deal of specialty OR equipment for multiple service lines. Despite its small size, the ASC recently added several new service lines, significantly increasing the amount of equipment stored throughout the building. The facility does not use barcode scanners for medication administration or patient identification; all verification is performed manually. Stretchers are older models that need frequent repairs and manual height adjustment, increasing physical strain during patient transfers. The facility does not have patient lift equipment; this deficit is a frequent source of staff frustration when patients who are bariatric are accepted for procedures.

Existing Physical Environment

Nurses described fatigue related to prolonged standing, frequent bending, and repetitive reaching for supplies stored at non-optimal heights. Storage areas are extremely limited and

often overfilled, requiring staff to maneuver around equipment or temporarily store it in hallways, further restricting movement and often obstructing access to fire extinguishers and the gas shut-off panels. According to the Occupational Safety and Health Administration (OSHA), cramped and cluttered working environments contribute to physical strain and may increase the likelihood of falls or near-miss events (OSHA, n.d.).

Security, Access Control, and Environmental Awareness

A recurring theme among nursing staff was concern about physical security and access control throughout the ASC. The facility has security cameras throughout the building, but they are currently non-functional. Staff described a lack of secure barriers separating the public lobby from patient care areas, particularly between the lobby and the pre-operative/PACU area. Nurses pointed out that while the main door from the lobby into this primary patient care area is secured by badge access, there is another door into the same area that does not lock at all. From there, no badge access is required to enter further into the facility. In theory, an unauthorized person could enter through the unsecured door and have access to almost the entire building, including both ORs, sterile supply, and staff locker rooms. The only access points that require badge access are the door just described, the administrator's office, the pharmacy, and the facility's back door. Other outer doors, such as the door to the medical gas room, can be locked from the inside; however, if they are left unlocked, there is no badge access required, representing another weak point in building security.

Staff also expressed discomfort with the screening of vendor representatives and other non-clinical personnel. While vendors are now screened through Reprax, nurses reported that representatives rarely wear the credentialing badges provided by that company, making it difficult to verify authorization.

Environmental Conditions and Sensory Factors

Nurses identified environmental factors, such as temperature and noise, as influencing both comfort and performance. An off-site facilities team controls the building temperatures, and thermostats throughout the facility only display temperature. Staff reported frequent discomfort from cold temperatures in the pre-operative/PACU and OR areas, ranging from 54 to 66 degrees Fahrenheit.

Noise levels were also a frequently mentioned concern. While alarm systems are essential for patient monitoring, nurses noted that competing sounds can make it difficult to distinguish urgent alerts from ambient noise, particularly with the outdated code blue system.

Furniture and Flooring

Furniture throughout the ASC includes height-adjustable chairs with limited lumbar support, small desks, and stools used for IV placement. At each desktop computer, a chair is present; nurses stated that they typically use rolled-up blankets to provide additional lumbar support. The OR nurses usually stand at the counter when charting on desktop units in the OR suites; these units are not height-adjustable and are not comfortable to sit at because there is no leg space under the counter.

Anti-fatigue mats are placed in select areas such as scrub sinks and the soiled utility room, but are not widely available because stretchers frequently catch on them. Flooring is appropriate for a clinical environment, but it contributes to fatigue during prolonged standing.

Nursing Staff Input

Nursing staff feedback was vital to this evaluation, giving essential insight into how the physical and technological designs function in actual practice. The interviews revealed both

strengths in the existing design and numerous workarounds adopted by staff to compensate for the ergonomic and technological deficiencies.

Functionality

While the nurses I interviewed were far more concerned with the challenges they face, they also identified several aspects of the ASC design that do function effectively and support clinical workflows. The compact facility, with its roughly circular layout, was described as a major strength, as it allows nurses to sustain visual and auditory surveillance of patient care areas and to move quickly between pre-op/PACU, ORs, and storage areas.

Staff noted that the lighting throughout the facility is generally adequate for clinical tasks and does not contribute to visual strain during documentation or patient care. Employee Wi-Fi connectivity was reported to be highly reliable, enabling tablets to function consistently as intended. The nurses stated that when the technology is working as designed, the ability to chart at the bedside on the tablet helps preserve accuracy and reduces the need to chart at the end of the shift.

The nurses unanimously conveyed their appreciation for the ASC's generally positive culture, noting that a strong sense of teamwork often helps compensate for the physical and technological difficulties they face. A shared sense of awareness and willingness to help each other helps mitigate some risks, such as the lack of both formal staff communication systems and patient call buttons.

Challenges

Despite these strengths, nursing staff reported several challenges affecting clinical workflow, patient and staff safety, and overall well-being. The most frequently reported issue was musculoskeletal stress related to the extensive use of tablets for charting. Limited

availability of ergonomically structured desktop workstations forces staff to rely heavily on tablets, often while standing or seated on stretchers. Nurses said they frequently have neck, back, and shoulder pain at the end of their shifts from looking down at the tablet screens. These concerns are supported by research demonstrating increased physical strain and discomfort when using mobile devices, such as tablets, in non-neutral postures (Tomita et al., 2022).

Equipment-related concerns were also presented as major challenges. Aging stretchers that often require repair were a pain point; OR nurses stated they routinely keep a foot on the wheel lock during patient transfers due to a general distrust in the locking mechanism's reliability. Additionally, staff identified the absence of patient lift equipment as a major safety concern for both staff and patients. They shared examples of patients with high BMIs who fell or required assistance from the fire department due to the lack of appropriate lifting equipment.

Security vulnerabilities were also emphasized by nursing staff. Nurses reported that anyone can walk behind the reception desk and into patient care areas due to unsecured access points. Two doors lead directly into clinical areas; only one requires badge access. The second door is frequently propped open for temperature control, creating an even greater security risk. The employee breakroom door, which is behind reception, is also unsecured and unlockable, and is yet another entry point into the deeper parts of the facility.

Processes intended to strengthen security and HIT downtime preparedness instead promote frustration. One example is the downtime documentation process implemented during wireless network failures. Nurses reported that the paper charts provided during downtime do not align with the electronic workflow, leading to confusion, documentation gaps, and increased error risk. Additional workflow inefficiencies include the need for multiple EHR logins due to security policies and restrictions on printing from tablets, which require nurses to move between

workstations and disrupt care processes. Prior research has shown that poorly aligned HIT increases cognitive workload and contributes to clinician burnout (Cahill et al., 2025).

Impact of Existing Ergonomic Design

In addition to current ergonomic challenges, the ASC's existing design poses risks for the future integration of artificial intelligence (AI)–supported clinical tools, such as automated documentation, decision-support alerts, and predictive workflow systems. Without improvements to workstation ergonomics and workflow alignment, AI-enabled systems may increase cognitive burden rather than reduce it, leading clinicians to delay data entry, override alerts, or mistrust automated recommendations (Owoyemi et al., 2025).

Nursing Workflow Impact

The current ergonomic design of this ASC substantially affects how clinical duties are performed. Many tasks are routinely completed through workarounds rather than the intended, compliance-adherent process. These conditions increase cognitive load and reduce situational awareness during routine and high-risk clinical tasks, particularly documentation and patient transfers. Over time, the need to compensate for ergonomic and technological shortcomings contributes to fatigue, inefficiency, and greater reliance on workarounds, all of which elevate the risk of error and negatively affect care quality (Cahill et al., 2025).

Patient Safety Impact

Several ergonomic challenges in the unit directly affect patient safety. Stretcher locks that do not work reliably, the lack of lift equipment, and blocked access to emergency carts all increase the risk of patient falls, delayed emergency response times, and staff injuries. The lack of consistent integration for patient monitoring equipment, especially the requirement for manual

vital sign entry in one operating room, creates opportunities for transcription errors and incomplete documentation.

As AI-supported clinical systems are increasingly designed to assist with monitoring, alerts, and decision-making, these safety risks become more significant. AI tools depend on accurate, timely data and clear user engagement. When physical ergonomics and usability are suboptimal, clinicians may delay data entry, override alerts, or mistrust automated recommendations, increasing the risk of technology-related harm (Schwappach et al., 2025).

Quality of Care Impact

Ergonomic strain, frequent interruptions, and stressful work environments can all add up to impact the quality of care we provide. When nurses experience physical discomfort or fatigue, it becomes much harder to stay focused, communicate clearly, and be fully present for their patients and their families (Schwappach et al., 2025). If nurses are already tired or overwhelmed, even the best AI systems may not help as intended. Ensuring that technology is designed with both ergonomics and clinicians' needs in mind is essential to support patient-centered care (Owoyemi et al., 2025).

Plan to Address Identified Challenges in Ergonomic Design

To address these challenges, leadership should implement a prioritized approach starting with the most urgent safety and security concerns. Once these are managed, the next steps should focus on ergonomic changes and updates to HIT to help staff in their daily work and to prepare the unit for future use of artificial intelligence tools.

Facilities management should prioritize improving security by ensuring badge access is required at all clinical entry points. Staff should cease propping doors open to control the temperature, since this creates a security risk. Instead, leadership should develop a process for

reporting uncomfortable temperatures to facilities management that expedites adjustments, so staff do not need to rely on unsafe workarounds. Additionally, IT should restore security cameras to a functioning condition. Replacing older stretchers and making sure all wheel locks work properly, while not HIT-related, should be an absolute priority to prevent injuries to both patients and staff. Adding patient lift devices would also help staff safely care for bariatric patients and reduce the risk of injury during transfers.

Providing staff with supportive chairs, adjustable-height workstations, and tablet stands would help reduce the physical strain associated with long shifts and repetitive tasks. Technology improvements should start by ensuring all operating rooms have HIT, especially by upgrading older patient monitors so they can send data directly to the EHR. Nursing, informatics, and quality leadership should update the paper documentation used during system downtime to align with the electronic workflow, which will reduce confusion and the risk of errors when the system is down.

Leadership should evaluate and implement proposed changes using a structured sociotechnical framework. Nursing leadership, facilities management, and information technology staff should all be involved in planning and carrying out these changes. Owoyemi et al. (2025) point out the importance of checklists and iterative evaluation when deploying new technologies or system changes in clinical settings. The team should measure the impact of each change using practical indicators, such as staff reports of musculoskeletal discomfort, the time required to complete documentation, the number of safety events, and overall staff satisfaction. By testing each change in the actual clinical environment and making adjustments as needed, the team can ensure that both ergonomic and technology updates are effective before they are implemented throughout the center.

Conclusion

During this evaluation, I observed that nurses often use workarounds to address limitations in both the physical environment and available technology, even though the ambulatory surgery center generally functions well. These findings emphasize the need to incorporate human-centered design principles from the outset rather than waiting to address safety concerns after they occur. This evaluation strengthened my understanding of how closely physical ergonomics, technology design, and nursing workflow are interconnected, and how even small environmental limitations can meaningfully influence safety and care quality.

This assessment also points to the need for better ergonomic planning as healthcare organizations bring in more advanced digital tools and AI systems. For these technologies to work well, they must fit into current workflows and be supported by a physical environment that meets staff needs (Owoyemi et al., 2025). Addressing ergonomic and design issues before implementing new technology can help ensure the technology actually reduces staff workload and safety risks, rather than worsening them.

Generative Artificial Intelligence (AI) Attestation

I attest that I used a generative AI tool in accordance with course guidelines and assignment-specific permissions. I used ChatGPT (OpenAI, 2026) on January 29, 2026 for the purpose of generating an outline for my paper. The prompt(s) used included: “Can you help me develop an outline for my paper using my handwritten notes?” I used ChatGPT again on February 9, 2026 to critique my paper and create a floor plan from a drawing. I used Grammarly on February 9, 2026 to check grammar and sentence clarity (Grammarly, 2026).

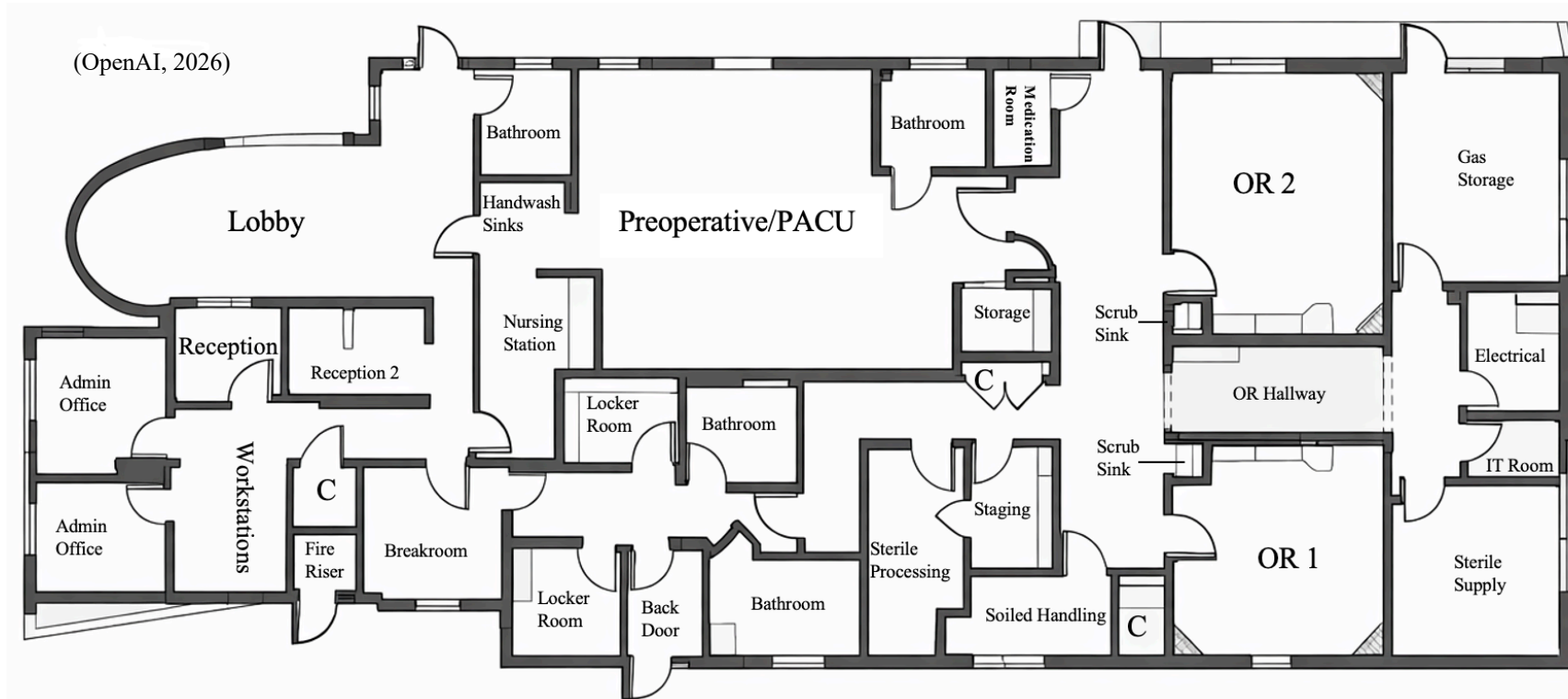
All AI-generated content was critically reviewed, edited, and appropriately integrated with my own academic and clinical reasoning.

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Figure 1

Legent Outpatient Surgery Floor Plan



Note. This figure depicts the general layout of the ambulatory surgery center, including patient care areas, operating rooms, nursing workstations, storage locations, and staff flow pathways relevant to this human factors evaluation. C = Closet.