



# Essential ergonomics in the healthcare facility design process

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## Abstract

In the Interior Health Region of the Province of British Columbia, Canada, ergonomic review of any renovations or new building is considered an essential part of the health care facility design process. Over the past several years insight and expertise has been gained into the role an Ergonomic Specialist can provide at each step of the facility design process from the initial space planning and functional programming through the design development stages, into building construction and finally the post occupancy evaluation. Documentation of this essential and exciting role is provided. Exploration into the differences in the architectural drawings from schematic design through to construction drawings is highlighted. The importance of front line staff involvement and methods to fully elicit their professional and functional expertise to assist in designing the optimal work environment is emphasized. Examples of how the Ergonomic Specialist can provide this feedback in "design language" either directly to the drawings or in a more formal format is reviewed.

*Keywords: participatory ergonomics, healthcare facility design*

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## 1. Introduction

It has become apparent that a careful ergonomic review should be an integral part of health care facility design in order to minimize work place accidents and injuries for workers as well as provide an optimal environment for patients [1,2,3,4,5,6,7,8,9,10,11,12]. It is clear that working in health care environments can pose both a physical and mental risk to its workers. Due to the aging nature of the health care work force, long shifts, continually changing technologies and the frenetic nature of health care work the potential for injury is apparent [1]. The Worker's Compensation Board (WCB) reports that 11.4 % of days lost from work due to injury come from Healthcare workers efficiently and safely can translate into the opportunity for better delivery of care to the patients it serves. For

even though these workers only make up 5% of the province's workforce. From 2001-2004 this equated to 1,756,981 work days lost among health care workers in British Columbia, Canada, due to work related injuries [13].

Considering the severity of these findings, it was deemed essential, by Interior Health, a health region in the province of B.C., that the factors contributing to work place injury be further explored in an effort to develop potential prevention and mitigation strategies. It was evident that careful design of the healthcare work environment, utilizing front line staff expertise and ergonomic principles, could have a profound impact on worker safety. As well, it was evident that by designing a clinical space to allow staff to work instance the ergonomic recommendation to have a minimum of 800mm (24") clear space on either side of

a toilet allows the staff to provide the necessary assistance for the patient to safely use the toilet [14]. As a result of this ergonomic input, the health region's ergonomic specialists are now asked to provide the facility design team with design recommendations during the initial functional programming phase through to the design development phase and into post occupancy evaluation of all the region's renovated or newly built health care facilities.

Following the lead provided by ASSTSAS in Quebec and their writings on participatory ergonomics [9,10] and the initial experience gained from the ergonomic specialists involvement in Interior Health's facility design process for the last 8 years, formally defining the potential ergonomic specialist role in each step of the facility design process was thought to be of value to architects, healthcare planners and other healthcare organizations.

### *2.1 Systematic review of the literature*

A systematic literature review was completed using Pubmed, Ebsco and the eMedical Library, occupational health and safety websites, and other health authority and health research agency websites world-wide. The keywords used for the search were healthcare facility design, participatory ergonomics and individual key words such as safety and optimal patient care. All related articles between 1976 and 2005 were read and evaluated for evidentiary contribution.

### *2.2 Ergonomic intervention in facility design processes*

Between 1998 and 2005, the ergonomic specialist was involved in the facility design process of many healthcare facilities renovations and new buildings. This involved consultation with many front line staff, architects, planners and other design team members, observation of front line staff members performing their work tasks in their current or a simulated work environment, informal discussion with staff regarding their tasks and the types of design problems they encountered in their current facility, site visits, review of the area injury rates and project specific literature reviews.

## **3. Results**

The ergonomic specialist role in the health care facility design process has been incorporated into the Interior Health's facility design process as follows:

### *3.1 Programming*

During this stage, a Functional Programmer defines the amount of space and operational requirements required for a department based on the scope of work for the project and the current patient load and population of the community and potential growth into the future.

*Ergonomic role:*

- Ensure an objective of the project is to develop a safe environment for both staff and patients.
- Ensure that any health and safety standards (e.g. staff restorative space, noise, staff communication systems, lighting, air exchange, equipment) are included.
- Ensure programmer is aware of the space requirements needed for use of patient lift equipment and bariatric equipment. Provide dimensions if possible.
- Provide any relevant injury statistics to the Planner.
- Encourage separate material/equipment circulation from patient/staff circulation if at all feasible.
- Conduct a literature review on evidenced based design and best work practice of the proposed area. Provide any pertinent findings to the design team.

### *3.2 Order of magnitude (OoM)*

This early stage of budgeting is usually only used for large building or renovation projects when securing of funds is required. Generally Planners prefer to go from programming straight to schematic design.

During this stage, the rough estimated costs of the project are calculated by a Quantity Surveyor (QS) and based on the figures it is determined whether the project should continue to schematic design or not. The figures of OoM are rarely used to determine the final budget.

*Ergonomic role:*

- Ensure Programmer/Planner aware of major capital equipment needs related to staff safety and the approximate costs.

### 3.3 Schematic design (SD) (programming may be included in this step or done initially as above)

During this stage, the Planner and Architect meet with the facility Steering Committee. This committee is comprised of a committee chair (usually site administrator), department manager(s), plant services representative, physician(s), Information Management and Information Technology representative (IMIT), infection control and workplace health and safety. During these meetings (usually three in total), the architect presents proposed conceptual drawings of the design and the committee must work with the Architect and Planner to agree on a preferred floor plan and physically sign off the drawings before the plan can go to the QS. The QS then provides the planner with more specific cost estimating. It is this QS number from the schematic design that is used to determine the project budget.

#### *Ergonomic role:*

- Follow points outlined above if programming not done independent of schematic design
- Assess user characteristics and provide Architect/Planner with a brief summary of any special needs of the users (patients, staff, physicians, visitors) they may not be aware of.
- Briefly determine what tasks will be performed by all users. Further assess only those tasks that are unfamiliar to the design team or those that are known to be high-risk activities. Determine the design implications of these tasks. Work with front line staff via focus groups or informal on the job observation/problem solving to determine potential solutions to these concerns. Provide Architect/Planner with ONLY the design implications of this information.
- Ensure ramps are avoided if at all possible. If not possible provide information on ramp incline ratio that is safe for a healthcare environment (e.g. 1/20 ratio) and recommend inclusion of midway step.
- Assist in determining what rooms/tasks should be performed close together, and which separate. This will begin to outline adjacencies between workstations, rooms, and departments.

### 3.4 Design development stages 1: initial DD meeting with design development committee

If the budget is approved from the SD stage then the project moves into design development. During this stage, the floor plan signed off by the Project Steering Committee during the SD stage is further developed. Ergonomics takes a much larger role during the design development (DD) stage. In DD, the Planner and Architect meet with a committee consisting of a committee chair (same site administrator as SD), department front line staff, plant services, miscellaneous program representatives, workplace health and safety and infection control. This group is responsible for signing off on all drawings. Included during this stage are also all of the other engineering consultants involved with the project. During these meetings, the Architect ensures drawings are revised based on feedback from the user representatives. This is usually carried out in several focus groups. The purpose of this stage is to ensure that the final working drawings of each department incorporates optimal workplace health and safety conditions, comfort, efficiency of layout (adjacencies, communication, and movement patterns), and work quality requirements for Interior Health employees as well as incorporating comfort, safety and medical need requirements for patients seeking treatment/care at the facility.

#### 3.4.1 Stage 1: initial DD meeting with design development committee

##### *Ergonomic role:*

- Review drawings and document any ergonomic concerns identified.
- Assist the Planner, if needed, with arranging site visits and clearly define objectives and expected outcomes of each visit. In addition, offer to provide staff with a guidance letter that clearly outlines the design development process and their role as well as the roles of other members of the multidisciplinary team in the design process.
- Participate in the focus group sessions by assisting staff with understanding the drawings, asking for solutions to ergonomic concerns and other design problems and probing for answers to various questions posed by the Architects/Planners.

- Assist the staff in fully understanding the plan and how it relates to their current job activities through informal interviews.
- Determine if further work simulations / mock-ups / sites visits are required for the front line staff to better understand their needs as related to the details of the design. Assist the Architect and Planner in conducting these.
- Encourage and if needed, assist the manager to display the design drawings in a place that all staff working in the area can review and comment on. Ensure the drawings are updated as more developed designs are completed.

#### 3.4.2 Stage 2: 50% of working drawings complete

During this stage, the plans are further refined incorporating electrical and mechanical drawings and fine-tuned using feedback from the staff during the focus groups and interviews. Departments that are being redesigned provide equipment lists of the equipment that will be relocated or purchased for the newly designed area. Sign-off at this stage is mandatory to ensure everyone who is part of the design development committee is in agreement as to how the project is developing. On large projects, 3 million and over or where the Architect/Planner feels the project is going over the set SD budget, a 50% check is usually done by the QS to ensure the project is still coming in on budget.

##### *Ergonomic role:*

- Review drawings prior to the focus group meetings and document any ergonomic concerns.
- Participate in the focus group sessions to determine the detailed design of each piece of millwork, the placement of equipment and supplies and the requirements of any modular furniture. This may require further informal interviews and job shadowing with front line staff.
- Provide the Architect/Planner with any standardized equipment and ensure they are aware of the equipment specifications as they relate to the design (e.g. plumbing needs for a bathing system, electrical and structural support needs for the ceiling lifts). Example of IH equipment standards that impact design include office furniture and office detail equipment, bathing systems, ceiling lifts, fold down grab bars and floor sinks. Examples of ergonomic design

standards include patient washrooms, acute care bed head walls, dictation booths and bathing rooms.

- Ensure space provided and equipment placement in patient care areas is adequate for staff to assist with patient handling activities (e.g. transfer zones, space for staff to assist on either side of the toilet) and for mobility of wheeled equipment. Review door widths and door swings from both an ergonomic and workflow perspective to ensure that they meet the needs of the staff and patients in each room.
- Determine if further work simulations / mock-ups are required.
- Encourage use of modular workstations wherever feasible to allow flexibility for change in the future. Consult with modular furniture supplier for design ideas and provide these to the design team.
- Work with IMIT and/or plant engineering, and the front line staff to determine the exact requirements of the patient to staff (“nurse call”) communication needs, the staff to staff communication needs and/or the staff duress system needs. Summarize these needs and provide this information to the Architect and Planner. Ensure the electrical consultant has incorporated these needs into the design plans. This may require a separate meeting with the staff, electrical consultant, and system(s) supplier.
- Assist the Purchasing Department with equipment selection when needed to ensure ergonomic considerations are included in equipment selection criteria and ensure, if in place, regional equipment standards are followed.
- If plans include ceiling lifts, facilitate meetings with the ceiling lift supplier and staff committee to determine site needs. Arrange for the ceiling lift company to receive a copy of the 50% design development drawings. Request the ceiling lift company provide room-by-room drawings incorporating the ceiling lifts to the site committee for review and then provide the architect with the finalized ceiling lift plans. Ensure the track installation responsibilities are clearly documented in the project specifications.

### 3.4.3 Stage 3: 70% of working drawings complete

During this stage, millwork and working elevations are introduced and the plans are finalized. Staff involved on the design development committee must again sign off the drawings to confirm that they will meet the needs of the staff in their department.

#### *Ergonomic role:*

- Review each workstation and millwork elevation and cross section to ensure working height and depths incorporate staff/patient needs and ergonomic principles. This may require further informal discussions with the front line staff and mock-ups. Provide documented ergonomic concerns.
- Review the electrical drawings/documentations to ensure they have incorporated all the necessary components of the staff to staff / nurse call / staff duress systems whether hard wired or wireless, the electrical outlets for the ceiling lift chargers, appropriate access to light switches for both staff and patients, capacity for flexible lighting levels where needed, practical placements of cable, phone and computer data outlets and head of bed wall requirements. In patient care areas, ensure that the electrical plugs that will be accessed by staff are placed at the appropriate height and not at the standard 460mm height (18") wherever feasible. Ensure ceiling mounted lights are positioned so as not to interfere with ceiling, curtain or IV tracking.
- Review the mechanical drawings to ensure they have incorporated the specifications for some of the standardized equipment and to ensure that the sprinkler system and HVAC will not interfere with the ceiling tracking systems.
- Develop staff and patient pre-building questionnaire to assess staff's perception of the design process and staff and/or patients perspective of the current working environment from a functional and safety viewpoint.

### 3.4.4 Design development stage 4: 95% of working drawings complete

During this phase, the drawings are reviewed in detail to ensure that the design includes all design features agreed to by the design development committee. The committee reconvenes to review the drawings as a group and then have the responsibility of

final sign-off. The 95% drawing go to QS for final estimating and to confirm the project is still within the SD approved budget. If the QS numbers come back and all is in check, the project is completed by all consultants and is ready to proceed to Tender.

#### *Ergonomic role:*

- Review drawings and project specifications to ensure all ergonomic recommendations have been incorporated into plans.
- Distribute questionnaire to staff and patients.

### 3.5 Final contract documentation

This is the detailed written specifications that the architect provides that clearly outline all aspects of construction. The contractors will follow this documentation when building and coordinating activities.

### 3.6 Construction

Prior to the beginning of construction, the project is passed from the Planner to a Project Manager.

#### *Ergonomic role:*

- Consult, when required, on design problems that may become apparent during the building phase.

### 3.7 Post occupancy evaluation

Assess front line staff perception of the design 3-6 months post occupancy. Evaluation indicators (injury statistics, absenteeism, and recruitment/retention) are also used to evaluate the design.

#### *Ergonomic role:*

- Assist with or carry out these evaluations.

## 4. Discussion

It was evident in the literature review that incorporation of ergonomic principles and front line staff expertise can be very beneficial to optimally design health care spaces to meet the increasingly complex needs of patients and to mitigate injuries to healthcare staff. Joceyln Villeneuve's outstanding work on the contribution of ergonomics in the design of a hospital [14] clearly outlines how participatory ergonomics can compliment the architecture process.

This paper is intended to further define the role of ergonomics at each stage of the facility design process. The Interior Health's facility design process referred to is similar to many facility design processes utilized as is evident in the literature and therefore the information should be easily transferable to other healthcare organizations. As this is an emerging discipline, the intention is that by further defining the role it will assist ergonomic specialists currently working in healthcare to better assist in this process and it will provide design teams with a better understanding of how ergonomic specialists can specifically contribute to healthcare facility design. It is meant to be a dynamic document that will continue to be refined and amended. Continued evaluation of healthcare facility design, best clinical practices and ergonomic intervention in this process will assist in optimal design of healthcare spaces.

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