# Patient-Population Based Design: A Needs-Assessment Approach for Designing Healthcare Environments

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## ABSTRACT

This paper addresses four of the suggested topics: 1] Basic Architecture Services for Hospitals—Improved Design Techniques; 2] Healthcare Delivery Trends and Issues—Emerging Medical Trends & Needs-Based Assessments; 3] Service Delivery Issues and Opportunities—Specialty Centers at All Levels; 4] The University Teaching Hospital—Academic Health Science Centers & The Teaching/Research Environment.

Traditionally, healthcare environments are designed to support diagnosis and treatment of aliments rather than identifying environmental factors that foster wellness for those aliments. When designing healthcare spaces to foster wellness, it is crucial to first understand the particular patient illness being served and then determine the fundamental needs for that patient population; this process is referred to as Patient-Population Based Design and has been successfully employed in a range of completed facilities, encompassing acute to long-term care and serving specific patient populations as diverse as rehab and dementia care. This paper presents for the first time the use of Patient-Population Based Design in an outpatient setting, further reinforcing the validity of this process as a universal approach to needs-assessed healthcare design. Furthermore, the patient population for this new facility is an ideal learning case due to the variation of patient needs, spanning the full range of neuro-psychiatric diseases from Lou Gehrig's, Multiple Sclerosis, Parkinson's, and Alzheimer's to resistive Psychosis. The primary tool for this process is a Population-Based Matrix; a template of this tool is included for readers use in their institutions. This article outlines the concept and illustrates in detail a case study utilizing this design process.


## ARTICLE

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### Conceptual Perspective

Consider two questions: 1] Where on the continuum does health end and disease begin? 2] How healthy can a diseased individual be? I believe our healthcare environments should begin with these questions in mind, and specifically address how we as designers can design from a perspective of wellness rather than illness.

Modern healthcare environments are typically designed with an illness perspective, focusing on spaces that function to support diagnosis and treatment of an aliment rather than a wellness perspective, which identifies environmental factors maximizing wellness for that aliment. For the latter, the designer must understand more than what supports wellness for the general population; the designer must first understand the disease being served and then translate what wellness would look like for the patient population with that particular illness in order to potentially impact the individual's wellbeing. This is a process referred to as Patient-Population Based Design, which begins with a needs assessment outlining the patient's clinical diagnosis, the environmental goals that are therapeutic for that illness, and the environmental features that would foster independence from the disease or aliment.

The method used in Patient-Population Based Design begins with an Assessment Matrix detailing the

four fields of: Illness Definition, Clinical Presentation, Environmental Goals, and Environmental Features, which are then cross referenced with the specific patient illness being served as determined by the institution or healthcare provider. A sample Needs-Assessment matrix is shown in Table 1 with the four fields noted on the left and the patient populations across the top; the three populations exhibited here, Dementia, Psychosocial, and Complex Medical, are three of six distinct patient populations as determined by this specific long-term care institution serving residents in an inpatient setting.

For any healthcare provider or institution, the process for developing a Needs-Assessment matrix requires that the Illness Definition and Clinical Presentation fields be developed by clinicians specializing in the patient populations being served; the Environmental Goals and Environmental Features are then developed by the architectural team through a review of the literature, evidence-based documentation, and anecdotal but proven experience.

The matrix has been designed as a generic tool capable of generating specific results for any patient population, and following this process ensures its generalizability. Prior to this process, environments for age-based populations (such as pediatrics or senior care) were subconsciously or intuitively modified to be child or elderly "friendly" designs, but the formal, conscious process proposed here is intended to create a universal process with a wellness perspective in healthcare settings. Also note that the universal process inherent in Patient-Population Based Design allows for customization to meet specific needs while remaining flexible for other populations, which differs from "accessibility" design where a high standard is set to accommodate individuals with varying abilities but can unintentionally restrict options for some patient populations. The end-objective of a universal, patient-based process that can be generalized to a variety of settings is to have a process that increases the likelihood that healthcare environments will be designed to foster health rather than emphasize illness.

To date, Patient-Population Based Design has been employed in a range of completed facilities, encompassing acute to long-term care hospitals serving specific patient populations as diverse as rehab and dementia care settings. This paper presents for the first time the use of Population-Based Design in an outpatient setting, further reinforcing the validity of this universal process for healthcare design.

## Case Study

The case presented is a newly constructed translational medicine facility combining research labs with patient clinics dedicated to serving severe neurological and psychiatric diseases. Vancouver's University of British Columbia Centre for Brain Health is a 135,000-square-foot clinical research facility containing wet and dry labs in addition to patient clinics, all of which are dedicated to serving the full range of neuro-psychiatric diseases from Lou Gehrig's disease, Multiple Sclerosis, Parkinson's, and Alzheimer's to resistive Psychosis. Designing environments for the treatment and cure of chronic neurological and psychiatric disorders are among the greatest challenges in healthcare architecture, made even more so when the driving vision for this institution was to maximize patient research.

The success of Patient-Population Based Design was crucial in this case study because the client's objective was to have 100% patient participation in clinical research. As a benchmark for this high expectation, patient participation in research is known to range from as low as 2% based on a 2007 study of US cancer clinical trials, to as high as 67% according to a 2007 study of Canadians volunteering for randomized, controlled trials.[1] [2] Notably, even if research funds are unlimited, little research will be done if there are no patients upon which studies can be conducted; therefore, patient participation is critical. Research participation is always a patient dilemma and especially so for the neurological patient, as he or she may feel 'untreated' in a controlled study and donating brain tissue post-mortem requires sensitive ethical considerations; clinical trials for cancer patients carry similar risks as there is always a chance a new treatment may be ineffective or worse than their current treatment. For patients of any clinical diagnosis, before they can commit to clinical research they must first have felt cared for—and that means the architectural environment must meet their physical and emotional needs. A wellness-based setting allows patients to consider research dilemmas and prepares them for time sacrificed, tissue or organs donated, and risk missing a miracle drug or treatment. A wellness-based setting reinforces patients' trust that researchers and clinicians are committed to the patient's care regardless of the outcome. Hence the importance of Patient-Population Based Design.

This case is ideal for exhibiting the generalizability of Patient-Population Based Design because the needs of neuro-psychiatric patients are frequently contradictory. For example: patients with neurological diseases most often have opposing movement disorders such

TABLE 1: Sample Assessment Matrix

| | DEMENTIA | PSYCHOLOGICAL | COMPLEX MEDICAL |
|---|---|---|---|
| DEFINITION | Unable to manage self-care at home or in community settings due to progressive dementia or non-progressive cognitive impairments.<br>*Indefinite length of stay* | Complex psychosocial problems often due to a medical diagnosis. Rehabilitation is the ultimate goal for this population. Goals of treatment include lessening of symptom severity, improvement in ability to relate to others, improvement in ability to perform activities of daily living, and reduction of specific target behaviors that impact the resident's ability to interact safely and socially in another environment.<br>*Varied length of stay* | Multiple medical problems with concomitant psychosocial issues. Most residents are alert, oriented and able to communicate. However, despite being cognitively intact, many have significant social or behavioral issues. Unlike the Psychosocial population whose therapeutic goal is rehabilitation back into the community, the Complex Medical residents' behavioral goal is to restore social interactions for maximum independence in a group setting.<br>*Indefinite length of stay* |
| CLINICAL PRESENTATION | • Alzheimer's Disease<br>• Multi-Infarc Dementia (MID)<br>• Short-term memory impairment<br>• Judgment impairment due to perception (such as left/right neglect)<br>• Impulse control due to an unmet need or anxiety (such as wandering) | • Spinal cord injury<br>• Multiple sclerosis<br>• Substance abuse<br>• Delusional presentations<br>• Depression<br>• Judgment impairment or impulse control due to behavioral problems (such as acting out) | • Mild retardation<br>• Spinal cord injury<br>• Cerebral vascular accident (CVA)<br>• Continuous Dialysis (CAPD)<br>• Diabetes<br>• Wound care<br>• Huntington's |
| ENVIRONMENTAL GOALS | Dependent upon environment for a therapeutic setting with the goal of safety and security. | Like Dementia residents, Psychosocial residents are also dependent upon their environment as a therapeutic setting, but the goal is clarification of the environment as opposed to comfort and predictability of the environment. | Due to the psychosocial component of Complex residents' care, their environmental needs are similar to the Psychosocial residents' needs with an additional requirement to accommodate medical care. |
| ENVIRONMENTAL FEATURES | Cueing opportunities (such as which room is their bedroom, where is the toilet room, etc.) provide important visual "clues".<br>• Personalization of rooms (such as "memory cabinets", picture rails, etc.) helps reclaim a sense of self-identity, maximizes attention span, and reinforces directional cueing.<br>• Stimulation control (such as private bedrooms, small-group dining rooms, etc.) help minimize intake overload.<br>• Stimulation outlets (such as indoor/outdoor wandering paths, come-and-go activities, etc.) allow release of anxiety and agitation.<br>• Security issues (such as protection from aggressive residents, non-axial entries and exits, etc.) increases feelings of security and improves emotional well-being.<br>• Creative resolution of paradoxes (such as need for stimulation but problems of over stimulation, need for predictability versus value of prompting curiosity, etc.).<br>• High spatial/storage needs to accommodate bulky assistive devices unique to the declining dementia resident (such as "ultimate walkers".) | Orientation to place (such as wayfinding) helps the resident adjust to the environment.<br>• Personalization of rooms (such as private rooms) helps reclaim a sense of self-identity as well as reduce territorial issues.<br>• Behavior control (such as small-group dining rooms, time-out rooms, etc.) helps modify inappropriate actions.<br>• Behavior outlets (such as access to the outdoors, vigorous activities, etc.)<br>• Range of security issues (such as protecting frail residents from psychosocial residents, observation of the residents for behavior control, etc.)<br>• Rehabilitation opportunities (such as cooking, self-medication, group therapy, egalitarian rooms, etc.)<br>• Average spatial/storage needs associated with skilled care residents. | • Orientation to place (such as wayfinding) helps the resident adjust to the environment.<br>• Personalization of rooms (such as private rooms) helps reclaim a sense of self-identity as well as reduce territorial issues.<br>• Behavior control (such as small-group dining rooms, time-out rooms, etc.) helps modify inappropriate actions.<br>• Behavior outlets (such as access to the outdoors, varied activities, etc.)<br>• Range of security issues (such as protecting frail residents from psycho-social residents, observation of the residents for behavior control, etc.)<br>• High spatial/storage needs to accommodate numerous assistive devices unique to the medically-dependent Complex Medical resident, which are often bulky and high maintenance (such as Vail beds, Broda chairs, PVC toilet frames, power wheelchairs that need re-charging, etc.) |

as the simple need to stop and rest while others have difficulty starting and stopping altogether; patients with psychiatric disorders need shielding from overstimulation but simultaneously need to visually scan all that the environment may pose for them; lack of spatial clarity stresses both patient populations for different reasons, such as neurological patients distracted by the physical effort navigating even simple environments, while psychiatric patients become easily confused due to the mental effort navigating unfamiliar settings. Developing a matrix of environmental needs for this range of patients highlights features that support both populations while calling attention to features that exacerbate either patients' condition. While Patient-Population Based Design hones in on specific patient needs, the end-result is a facility design that is not narrowly customized to one single patient population but instead is flexible enough to support a variety of patient needs.

Before and after floor plans illustrate how Patient-Population Based Design thinking was utilized to support the neuro-psychiatric patient population while remaining functional for the general patient population. The Pre-Design diagram (see Figure 1) shows the preliminary clinic layout as a loop corridor with doors at both ends of the loop and a single waiting zone. The Design diagram (see Figure 2) shows the final clinic layout with a single primary corridor, only one option for both entry and exit, and internal clinic sub-waiting in addition to the main waiting zone.

In this final clinic layout, three critical design parameters are established:

- Single clinic entry and exit;
- Redundant pathway;
- Break points.

How these three design elements maximize the environment for both neurologically impaired patients as well as patients with psychiatric conditions is summarized in Table 2.

These three design parameters for the Centre for Brain Health each address the unique day-long clinic visits experienced by both patient populations, who typically cycle in and out of waiting and clinic exam rooms between various procedures or consultations. General design parameters not specific to this case study, but to be anticipated for any facility serving neurologic and/or


FIGURE 1: Pre-Design Clinic Plan

FIGURE 2: Final Design Clinic Plan

TABLE 2

| CENTRE FOR BRAIN HEALTH | POPULATION | |
|---|---|---|
| | NEUROLOGICAL | PSYCHIATRIC |
| SINGLE CLINIC ENTRY EXIT | Same way in and out is physically more manageable with less seek-and-find wasted movement due to its predictability; | Same way in and out is emotionally more manageable with less unknowns and requires less thought due to its predictability; |
| REDUNDANT PATHWAY | Single shorter corridor is physically more manageable with less seek-and-find wasted movement due to its predictability;<br><br>Single decision point (one turn off corridor) is physically more manageable with less seek-and-find wasted movement due to its simplicity; | Single corridor is emotionally more manageable with less unknowns and requires less thought due to its predictability and visibility<br><br>Single decision point (one turn off corridor) is emotionally more manageable with less thought due to its memorability; |
| BREAK POINTS | Sub-waiting alcoves offer stopping points for rest of physical movement;<br><br>Sub-waiting alcoves offer landmarks from which to mark physical progress. | Sub-waiting alcoves offer escape points to pull away from corridor traffic;<br><br>Sub-waiting alcoves offer landmarks from which to gauge mental effort. |

psychiatric patients are summarized in Table 3. Overall, patients with neurological ailments have a weakened sense of space with safety as a primary concern, therefore design parameters should focus on things they touch; patients with psychiatric conditions have a vulnerable sense of self with composure as a primary concern, therefore design parameters should focus on things they see.

A review of the literature reinforced and influenced the environmental parameters that would be ideal for neuro-psychiatric patients. One concept put forward by Antonovsky [3] states that individuals with numerous emotional resources, referred to as a high Sense of Coherence (SOC), were more confident and therefore better able to adapt to stressful situations.* Patient-Population Based Design assumes that patients may have a high SOC, and offers them an environment with choices to meet their physical and mental needs when in a stressful situation; more importantly, for patients who do not have a high SOC, the patient-population designed environment offers supportive features appropriate for several levels of coping ability.

The concept of Cognitive Maps put forward by Dilani [4] [5] stresses that landmarks in buildings are closely related to the perception of stress and can serve as reference points for easier orientation. In the Centre for Brain Health, the sub-waiting alcoves are distinct elements creating a Cognitive Map that fosters the neurological patient's need for rest and reassures the psychiatric patient's need for escape, thereby reinforcing the well-being of both populations.

## Case Study Specifics

Beyond the concern for Population-Based Design, two concepts in the final clinic layout were specific to maximizing overall clinic efficiency for the Centre for Brain Health: Clinic Pods and Dual-Purpose Exam Rooms. Figure 4 illustrates how the total 18-exam room clinic was configured into self-contained pods comprising six exam rooms, two support rooms, and a touch-down space for staff and sub-waiting alcove for patients. This pod concept simplified the patients' experience by reducing his or her exposure down to a smaller number of rooms, while increasing the staff's efficiency through in-the-pod access to support rooms and work space. Figures 5 and 6 illustrate how the same exam room functions either for an exam-table neurological

TABLE 3

| NEURO-PSYCH POPULATION CONTINUUM: GENERAL ENVIRONMENTAL NEEDS | | |
|---|---|---|
| MOVEMENT | COGNITION | PSYCHOSIS |
| Pacing is key to their movement through the environment;<br><br>Focus on features that allow stopping & starting, such as:<br><br>*Corridor 'pull outs' or niches;*<br><br>*Deeper elevator / entry vestibules;*<br><br>Create a 'new normal' environment by acknowledging / celebrating differences / imbalance through asymmetry such as:<br><br>*Corridors lit from one side;*<br><br>*Parallel planes treated differently;*<br><br>Predominately seated population, therefore:<br><br>*Assume low view angle with focus on floor more than ceiling (typical 60-degree cone of vision is from about 8 feet, 6 inches down to the floor);*<br><br>*Consider wheelchair 'rear view mirrors' for backing out of elevators, exam rooms, etc.;*<br><br>*Assume reach is limited regardless of front or side approach;*<br><br>*Push plates needed throughout patient pathway.* | Guide their (limited) thinking;<br><br>Focus on features that are touched more so than seen and offer simple decisions, such as:<br><br>*Bathroom stall swivel latches;*<br><br>*Sliding doors where ever possible (5# limit).*<br><br>Therapeutic way finding, such as:<br><br>*Strong differentiation between left versus right;*<br><br>*Shortest distance to meaningful space;*<br><br>*Previewing of adjacent spaces through transparency will create visually open plans for orientation;*<br><br>*Details that differentiate (asymmetrical color coding, staggered doors, etc.) will trigger individual cueing.* | Limit choice & decision-making;<br><br>Focus on features that are seen more so than touched and offer predictable cues, such as:<br><br>*Hand rail different color than wall;*<br><br>*Small alcoves with 1 or 2 seats;*<br><br>Avoid creating paradoxes through predictable spaces that progress from small to large (alcove, sub-waiting, full waiting to lobby); each space will act as transition space and enhance their sense of control;<br><br>Stimulating spaces will over stimulate; smaller groups & waiting rooms help minimize intake overload/over stimulation and reduce territoriality;<br><br>Simple decision points at meaningful spaces (a space they will use) reduces anxiety;<br><br>Behavior outlets (access to the outdoors, quite rooms, time-out rooms, etc.) help dissipate or modify inappropriate actions. |

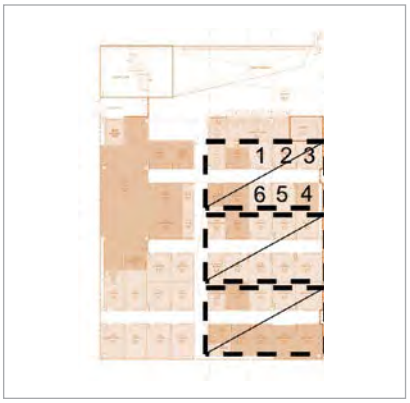


FIGURE 4

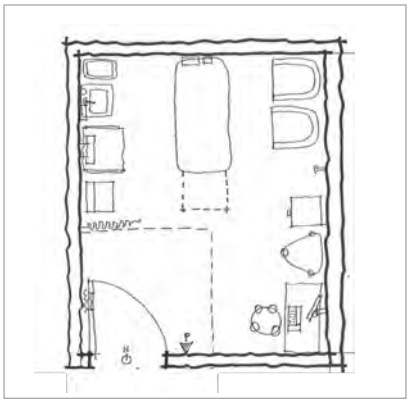

FIGURE 5

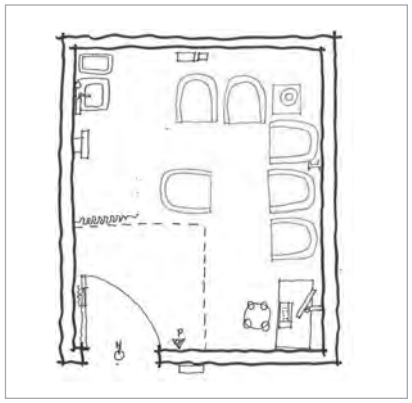

FIGURE 6

assessment or for a group-seating psychiatric consultation. This dual-exam room concept was achieved by fixing only the door and sink location with all other items being movable, allowing the clinic to flex from neuro to psychiatric services as needed.

Also specific to the Centre for Brain Health were sustainability goals. Because this building is a translational medicine facility combining research labs with patient clinics, only 60% of the building needed to have the 10 to 12 air changes per hour that is required in most research labs compared to only 4 air changes per hour needed in the patient clinics. With this in mind, separate zone systems were created for each area to maximize energy savings; the building systems overall were designed for the populations within, rather than the lowest common denominator for all. In addition to a variety of sustainability measures, one of the most important was access to natural light, which pours into the facility through three different atriums, one of which is dedicated solely to patients in the clinic proper, allowing the healing effects of natural light in a protected zone.

## Footnote

* Antonovsky, A. pg. 725 "If adaptive coping is indeed the secret of movement toward the healthy end of the health ease/disease continuum, then primary attention must be paid to what I had earlier called "generalized resistance resources" [4]. What came to concern me more and more, however, was a theoretical understanding of why such resources-wealth, ego strength, cultural stability, social support-promoted health. Or, to put it in other words, what did they have in common? I came to call the answer to this question the sense of coherence (henceforth, SOC). Resources were seen as leading to life experiences which promoted the development of a strong SOC, a way of seeing the world which facilitated successful coping with the innumerable, complex stressors confronting us in the course of living. The SOC is defined as follows: a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement."

## References


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(2) "Identifying Motivations and Barriers to Patient Participation in Clinical Trials." *Jennifer M. Jones,* PhD, *Joyce Nyhof-Young,* PhD, *Jakov Moric,* BSC MD, *Audrey Friedman,* MSW, *Woody Wells,* MD, & *Pamela Catton,* MD Journal of Cancer Education, *Volume 21, Issue 4,* 2007.

(3) "The structure and properties of the sense of coherence scale" by *Aaron Antonovsky,* PhD *Social Science & Medicine Volume 36, Issue 6,* March 1993, Page 725-733.


FIGURE 7: Centre for Brain Health

(4) Alan Dilani, PhD (2001) Design and Health—The Therapeutic Benefits of Design, p. 31-38.

(5) "Architecture and Design, Healthcare Buildings as Supportive Environments" by *Alan Dilani,* PhD World Hospitals and Health Services, International Hospital Federation, *Volume 36, Number 1,* 2000.

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