Best practices: An Environment-Behavior (E-B) model for Alzheimer special care units

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Introduction

Writing on design features in Alzheimer special care units (SCUs) Lawton[1] laments that "despite two decades of activity, very few relevant findings are available from traditional research" on their therapeutic and quality of life effects. Ohta and Ohta,[2] Hyde[3] and Cohen & Weisman[4] have also commented on the lack of available data on the effects of SCU design on residents. Lawton suggests that the expert opinion survey method employed by Zeisel, Epp, and Demos[5] for housing for seniors be applied to environments for Alzheimer-type residents.

This paper applies the approach Lawton suggests to develop an Environment-Behavior Model for SCUs that describes and organizes the influences that the physical environment of Special Care Units has on residents and caregivers. This Environment-Behavior (E-B) model sets the stage for a consensus evaluation of the effects of SCU environments on residents and caregivers by making explicit the relationship between environmental influences and behavioral effects, including behavior, perception and attitudes. The model comprises eight primary environmental characteristics and 16 secondary ones.

Exit control

- Immediacy of control
- Unobtrusiveness

Wandering paths

- Continuousness
- Wayfinding

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Individual away places

- Privacy
- Personalization

Common space structure

- Quantity
- Variability

Outdoor freedom

- Availability
- Supportiveness

Residential scale

- Size
- Familiarity

Autonomy support

- Safe
- Prosthetic

Sensory comprehension

- Noise management
- Meaningfulness to residents

First, a review of the field determines variables, concepts and physical design elements others have examined. These are classified into:

- Design performance criteria (e.g., residents able to wander easily);
- Design features, characteristics, spaces, and objects in the physical environments of SCUs (e.g., looping corridors); and
- Measurable therapeutic goals and outcomes of design features (e.g., reduced agitation).

Second, we organize these three in terms of the critical design performance criteria each design feature is intended to achieve.

Third, on the basis of this analysis, expert consensus data and observational data from visits the authors have made to over 50 SCUs in New England, the Midwest, Florida, Texas and Europe, we developed an E-B Model for the interactive effects of these three areas of concern.

... the way that people perceive, use, react to and in other ways interact with that object takes place over time, dynamically.

Methodology

To test and refine the model and its related outcome measures, the authors employed a consensus expert research questionnaire. Respondents included a convenience sample of administrators with hands-on experience operating SCUs, and 10 experienced researchers in the field of Alzheimer SCUs. Both groups reviewed and ranked the E-B Model in draft form on a 7-point scale representing the degree to which particular environment-behavior relationships represent state of the art research findings. On the basis of these questionnaire results, the authors deleted criteria that were clearly wrong, modified wording that was confusing, and added sections that were missing.

The rankings of the expert researchers are presented at the end of the article. First, the experts' responses to a draft of the model are presented. On the basis of these expert rankings and their detailed comments, the authors revised the draft model to reflect the breadth of expert comment and experience as well as to integrate what at times turned out to be opposing views and legitimate differences of opinion by experts faced with the same empirical data.

For example several experts interpret available data to demonstrate that the best bedroom arrangement for all Alzheimer residents, all the time, is a private bedroom, shared with no one else. Another equally distinguished group on our panel feel that research shows that bedrooms shared between two residents are more beneficial to some patients all the time. The E-B Model mediates these views.

The final version of the E-B Model presented here is a result of the authors incorporating the experts' views. This version was also distributed to and ranked a second time by the same panel of experts. The second expert ranking is presented as well. In general, the second rankings show a marked consensus improvement over the earlier rankings. Those few features still ranked low by some experts in the second ranking reflect persistent differences among the experts.

Organization of the model

The following construct of the relationship between the physical environment and those who use it underlies the Special Care Unit Environment-Behavior (E-B) Model that this paper describes. While designing and constructing a building results in a static physical object, the way that people perceive, use, react to and in other ways interact with that object takes place over time, dynamically. The apparently static design decisions that interior designers, architects, and facility operators make therefore lead to dynamic

results. Such Environment-Behavior interactions can have either beneficial or dysfunctional side effects—outcomes—for those who live, work and play in the setting. Well planned settings have more positive E-B side effects than poorly planned ones.

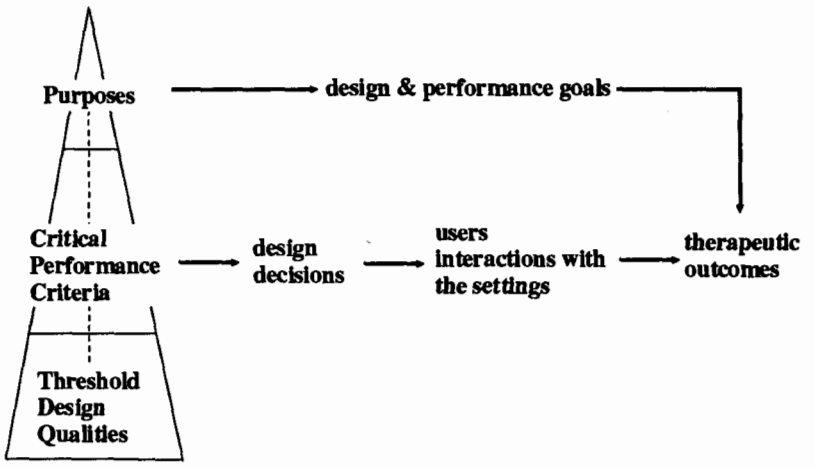
Threshold design qualities and critical performance criteria

When we describe a setting in terms of its design qualities we tend to use general criteria that do not distinguish how that particular setting is different from others. For example we could describe many environments in the following terms:

- Accessibility
- Air quality
- Cleaning ease
- Comfort
- Convenience
- Efficiency
- Function
- Health
- Image
- Information clarity
- Privacy
- Safety
- Security
- Size adequacy
- Stress reduction
- Ventilation

For a setting to work even adequately each of these design qualities must be met to a minimum threshold level. But these qualities do not define what makes that particular type of setting unique for its special use. In order to identify its uniqueness we have to describe the setting in terms of those qualities or performance criteria that are critical to the setting's nature and purposes. In order for the setting to fulfill its function it must respond to these particular criteria above and beyond threshold criteria.

Figure 1. The relationship between a facility's purposes, performance criteria, design decisions and therapeutic outcomes.



For example, in special care units, accessibility to disabled persons is clearly a basic quality to be met. But this does not distinguish special care units from other health care environments or all public buildings. Having wandering pathways that provide opportunities for residents to walk and exercise, and making the entire sensory environment comprehensible to residents with dementia, are features that distinguish special care units from other settings. The eight concepts that the E-B Model comprises reflect Critical Performance Criteria for Special Care Units.

The purposes of a setting are the reasons for its existence ... another term for purpose in this context is goal.

The purposes of a setting are the reasons for its existence. The environment of a special care unit, for example, is successful if it helps provide an improved quality of life for residents, helps caregivers do their job with the least possible stress, and creates a sense of security for everyone who uses it including family members. Another term for "purpose" in this context is "goal."

Critical performance criteria represent specific expectations and predictions as to how people are most likely to interact with and use the built environment. Performance criteria are the qualities we can observe and measure to determine how well the design decisions made in an environment meet their goals and purposes.

Decisions are made in environmental design (as well as in management and operations) to support performance criteria and goals selected as furthering the purposes of the facility. For example, to support greater control for special care unit residents over their own lives, design decisions focus on plans that foster safety, security and supportive prosthetic items as well as a sensory environment that residents can

Table 1. Comprehensive performance criteria groups.

Comprehensive performance criteria group	Performance criteria in literature			
	Calkins[7]	Cohen/ Weisman[4]	Hiatt[8]	Lawton[1]
Confinement and feedback			confinement security and feedback	
Orientating and understandable	wayfinding/ orientation		room identification	knowledge of the environment
Safe and secure	safety & security	eliminating environmental barriers	safety	safety & health
Prosthetic and supportive	competence in daily activities			activities of daily living and negotiability
Appropriate stimulation		sensory stimulation without stress	stimulation	stimulating quality and challenge
Socialization/privacy	privacy and socialization	public to private realms	interior and exterior orientation	social affordance and privacy
Wandering areas		opportunities for meaningful wandering	wandering loops	
Personalization	personalization		personal possessions	individualization
Comfortable and familiar		things from the past		cultural integration
Contact with out of doors		positive outdoor space	access to outside spaces	
Contact with nature & animals		other living things		stimulating quality
Differentiated common space		clusters of small activity spaces		
Residential		non-institutional character		
Personal control				personal control

easily understand. These help residents overcome physical barriers and find their way.

Settings affect and are affected by those who use them: the furnishings, the color of the walls, their size, the location of the kitchen. In a residential assisted living facility for people with Alzheimer's disease or in a health care setting such as an Alzheimer special care unit, desired therapeutic effects include having as many of these interactions as possible lead to a better quality of life and as few distress behaviors as possible for residents and caregivers.

The model described here focuses on physical environment, not the influence that the management and organizational environment of special care units has on therapeutic outcomes. Questions related to such features as staffing patterns, staff-to-resident ratios, the timing of activities, staff training, empowerment and organizational support for innovative treatments have been left for a later article.[6]

Comprehensive performance criteria groups

To develop a concise list of per formance criteria for SCU desig the authors analyzed the writings o experts in the field of Alzheimer car and research. Table 1 presents a lis of 14 performance criteria that com prehensively includes the desig performance criteria that Calkins, Cohen & Weisman,[4] Hiatt[8] and Law ton[1] identify in their research o SCU units. In some cases, such a

Table 2. Link between E-B model concepts and comprehensive performance criteria.

8 E-B Model Concepts	Comprehensive performance criteria
1. Exit control	confinement and feedback
2. Wandering paths	wandering areas orienting and understandable
3. Individual away places	socialization/privacy personalization personal control
4. Common space structure	socialization/privacy differentiated common space
5. Outdoor freedom	safe and secure contact with out of doors contact with nature and animals
6. Residential character	comfortable and familiar residential contact with animals
7. Autonomy support	safe and secure prosthetic and supportive personal control
8. Sensory comprehension	appropriate stimulation orienting and understandable

"safety and security," and "socialization and privacy," all four authorities include the performance criterion in their lists. "Prosthetic and supportive" and "contact with nature and animals" are categories mentioned by fewer than four (by two each). These are included to ensure a comprehensive list.

Environment-behavior concepts

The second critical step in constructing the model was to analyze and combine the 14 derived performance criteria into eight Environment-Behavior (E-B) Concepts for SCUs. The result is a system that includes one boundary condition (exits), four spatial categories (private, shared, paths, outdoors) and three ambient qualities (residential, autonomous, comprehensible). These eight E-B Concepts reflect state-of-the art knowledge in an easily understood system that can be employed with common sense to design a special care unit, review plans for one and evaluate how well an SCU works.

Each of the eight E-B Model concepts links a design feature to performance criteria. Each concept supports the functioning of the others. Residential character and outdoor freedom, for example, indirectly help in supporting residents' autonomy. In the E-B Model, the concepts are in turn linked to therapeutic outcomes and quality of life improvements for both residents and staff.

Table 2 demonstrates the relationship between the eight E-B Model Concepts and the Comprehensive Performance Criteria identified in Table 1.

Taken altogether, these eight E-B Model Concepts can be employed to describe, design, review plans for, and evaluate the effectiveness of environments in special care units. Spatially the E-B Model is an exhaustive descriptive system: it includes five E-B Model Concepts that describe interior private and common spaces, the corridors that connect them, exterior spaces, and the boundary around all these spaces. Three of the E-B Model Concepts describe ambient conditions that foster basic programmatic goals of residential quality, support for independence, and sensory comprehension.

The final step in constructing the E-B Model was to identify two critical dimensions of each E-B Model Concept from our research, from published literature, and from the expert panel responses. Critical dimensions of an E-B Concept are measurable characteristics of the environment-in-use that serve as empirical indicators of the degree to which the concept describes a particular setting. For example, the unmeasurable E-B Concept "common space structure" comprises the two dimensions "quantity" and "variability," both of which are measurable.

In a health care setting such as an Alzheimer special care unit, desired therapeutic effects include having as many of these interactions as possible lead to a better quality of life and as few distress behaviors as possible for residents and caregivers.

The E-B Model for SCUs is presented as a system with all eight factors interrelated to each other. Relationships between factors and outcomes are presented that should be taken as indicators of empirical

Table 3. Definition of E-B Model Concepts.

8 E-B Concepts	Definition	Dimensions
1. Exit control	Boundary conditions of each special care unit; the surrounding walls, fences, doors and how they are locked or otherwise limit and allow people to come and go.	A. Immediacy of control B. Unobtrusiveness
2. Wandering paths	Circulation space residents use for wandering and moving around.	A. Continuousness B. Wayfinding
3. Individual away places	Spaces--primarily bedrooms--assigned to and mostly used by a limited number of residents.	A. Privacy B. Personalization
4. Common space structure	Sizes, relationships and qualities of spaces used by all residents in the special care unit.	A. Quantity B. Variability
5. Outdoor freedom	Residents' access to common areas out of doors and the way these places support residents' needs.	A. Availability B. Supportiveness
6. Residential scale	Degree to which the size of the special care unit reflects a large family space and the degree to which the special care unit uses residential furnishings, design features, and personal objects.	A. Size B. Familiarity
7. Autonomy support	The ways in which the facility encourages and supports residents to use their remaining faculties to carry out basic tasks and activities independently and with dignity.	A. Safe B. Prosthetic
8. Sensory comprehension	The degree to which the sensory environment--acoustic, visual, thermal, odor and kinesthetic environments–in all spaces, may confuse residents.	A. Noise management B. Meaningfulness to residents

trends, not mechanical absolutes. For example, it is generally accepted that access to well-designed open space is critical to residents' well-being. A member of the expert panel points out that "while outdoor space is highly desirable, the failure of this factor alone will not cause agitation, depression, sleep-wake disturbances, or staff stress."

Therapeutic outcomes

The literature on SCUs is replete with calls for specification and measurement of causal relationships between the physical environment, goals and desired outcomes for patients and providers.[4,8] Surprisingly little research has been carried out to specify and measure these relationships. Cohen & Weisman[4] propose that the environment be "conceptualized in terms of...therapeutic goals." Such goals also can be seen as improvements in dementia residents' quality of life.

Dementia residents can react quite normally to environmental stressors. In fact, some behaviors that appear to be the result of the disease, may be primary or secondary effects of the physical environment. For example, pacing among residents may be the result of agitation from stress or an irritant, while walking is the natural behavior. Being locked in all day, except for controlled walks out of doors, can make some residents claustrophobic and thus agitated. Therapeutic effects are sometimes improvements in a resident's well-being or quality of life through reduced environmental or organizational stress enabling a normal response (eg. walking instead of pacing), rather than curing any disease-related dysfunction.

The distinction between reducing stress-related behavior and curing a disease is an important one for caregivers of residents with dementia. It helps them develop an attitude towards residents as normal yet disabled people whose quality of life needs to be maintained rather than as sick people who need to be cured.

Based on visits to seventeen special care units, Mace[10] lists the following as outcomes of special care:

- Decreased restlessness and agitation;
- Diminished hallucinations;
- Decrease in socially inappropriate behaviors;
- Reduced use of psychotropic medication;
- Improved orientation;
- Maintenance or increase of weight;
- Regained sense of humor;
- Decreased symptoms of anxiety;
- Increased awareness of self in relation to others

EXIT CONTROL—Delayed door openers and touch pads located in the flower border provide control and unobtrusiveness.

Many more outcomes referred to in the body of the E-B Model are drawn from the literature and from our expert panel's comments. The full list (see Appendix) represents part of the still wider range of therapeutic outcomes that further model development and research will identify. The description of therapeutic outcomes in this article are those that are influenced by the physical environment. They demonstrate both possible outcomes for each category and the quality of the outcomes the physical environment influences.

In the remainder of this paper each E-B Model Concept is defined along with the two related dimensions it comprises. Each dimension is defined in terms of its enactment in (1) a high and (2) a low value situation, generating in combination four-cell tables. Each cell of the table represents a condition correlated to therapeutic outcomes, and contains a performance based therapeutic outcome statement. In the upper left cell of each table is a description of a special care unit in which both dimensions rank high. For Concept 7, Autonomy, the upper left cell describes an environment that is extremely safe and prosthetically supportive of the needs of residents. The lower right cell describes situations in which both dimensions are sorely lacking. The other two diagonal cells (lower left and upper right) represent in-between conditions where one dimension is met well and the other poorly. Following each table is a narrative description of each cell including predictions about the therapeutic outcomes likely to occur in each of the four conditions.

1. Exit control

Definition: The immediacy of control over ways to get out of the unit via locks, alarms, surveillance or other methods, and the lack of awareness among residents of their ability to get out. Visually hidden features of which people are unaware are called "unobtrusive" features, so we employ that term here.

A special care unit with high value on exit control will first have signals and other control devices—such as keypad openers—that keep the exits well controlled with few delays in warning signals. Second, doors, door handles and security devices will be minimally visible, or unobtrusive, thus not providing residents with visual invitations to leave the unit or facility. This means residents in such units are safe as well as minimally frustrated by the visual invitation to leave. A special care unit with a low value for exit control would be open with residents clearly

Exit control

Immediacy of control	Unobtrusiveness: High	Unobtrusiveness: Low
High	Secured exits with little or no delay in control, designed so that residents are unaware of exits, locks, and security devices.	Secured exits with little or no delay in control, but residents are aware of doors, door handles, locking devices and signals.
Low	Doors with few controls and slow-response time security signals. Residents are neither aware of doors nor of whatever security devices do exist.	Exits with few controls and slow response time. Residents realize there are exits with a lack of barriers.

aware of the lack of exit control, and retrieved by staff eventually if they leave.

The two dimensions—or variables—making up exit control are immediacy of control and unobtrusiveness. The four-fold table that results from the intersection of these two dimensions is:

Exit control design criteria

- *High Control/ High Unobtrusiveness:* SCUs in which exits out of the unit, rather than into a secured courtyard, are highly controlled and in which exits and exit controls are sufficiently disguised or unobtrusive so that residents are unaware of them, will result in fewest exit attempts, lower use of restraints and least agitation.
- *High Control/ Low Unobtrusiveness:* SCUs with visible doors and windows that are highly controlled with visible controls will cause agitation among residents generally, particularly for wanderers confronted with locked doors, and in turn will lead to anxiety and management problems for staff.
- *Low Control/ High Unobtrusiveness:* SCUs with open doors that residents do not perceive to unsecured and potentially dangerous indoor or outdoor areas, result in noise and commotion when exit attempts are made or may have tragic effects if residents happen to find them. Staff who have to be more vigilant in such settings will waste time on exit attempts and will use restraints more. When exits are sufficiently unobtrusive so that residents do not realize they are available, residents will not be frustrated.
- *Low Control/ High Unobtrusiveness:* Facilities with unsecured doors and windows of which residents are aware will cause the greatest agitation for staff and create physical safety and security problems for residents.

2. Wandering paths

Definition: The degree to which the special care unit accommodates therapeutic walking among residents and support residents' ability to have a sense of the pathway as a place.

A special care unit with a high value on wandering paths is one in which corridors and other pathways in the unit and in any enclosed resident outdoor space are: easy to use, represent a continuous trip, and provide residents using corridors and pathways with understandable visual cues and interesting events that support therapeutic walking. Cues are indicators of appropriate behavior. A sign is an overt cue indicating where to go (directions) or how to behave ("No Smoking"). A less overt cue might be a change in floor covering helping residents sense the difference between a hallway and a bedroom.

One side effect of experience along pathways such as engaging artwork, changes in texture, and views into activity areas is that they make the trip more interesting for residents. This in turn provides residents with motivation to stop and attend to an object, view or experience, and eventually to move to the next place along the pathway. It also provides staff with environmental aides to help residents move to a destination or along the

WANDERING PATHS—Paintings and activity boards along pathways increase interest.

pathway. Low value for wandering paths within a unit would be assigned to a special care unit with a limited and uninteresting corridor as the only place wandering residents can use to walk.

For cognitively intact people "wayfinding" is the term used to describe how a cue or a sign indicates the location of some place or object. For Alzheimer residents we are using this term to also include sensory cues and events that interest, engage, and orient them in space without necessarily indicating a future destination. The same cues may be used by staff to help residents find a destination.

The two dimensions of wandering loops are continuousness and wayfinding. The four-fold table that results from the intersection of these two dimensions is:

Wandering paths design criteria

- *High Continuousness/ High Wayfinding:* Reduced aggressive behavioral outbursts, improved sleep-wake cycle and improved muscle tone and cardiovascular health of residents will occur in SCU's with high continuousness and high wayfinding in their wandering paths. There will also be higher satisfaction among staff who will not be called upon to redirect residents or assist them in wayfinding as frequently. Special care units or facilities in this category have corridors and paths that interconnect to form a continuous loop with no or few corners to turn or dead ends to confuse wanderers. They also have understandable cues, daylight and views to activity areas along the path.
- *High Continuousness/ Low Wayfinding:* Units with a continuous pathway that provides residents with confusing or boring cues and few or no cues for wayfinding will result in movement-related problems for both residents and staff. Such units are likely to have only slightly negative outcome measures, however, because both characteristics—continuous-ness and wayfinding—independently enable resident movement. Therapeutic outcome measures in facilities with this type of environment are likely to be similar to those with the inverse condition—low continuousness and high wayfinding.
- *Low Continuousness/ High Wayfinding:* The negative side effects of special care units with straight, dead-end corridors may be mitigated by interest-catching features along the pathways and at the end of corridors that tend to make it natural for residents to figure out how to continue their wandering even in non-loop environments, and by activity programs that engage residents.
- *Low Continuousness/ Low Wayfinding:* Facilities with limited and uninteresting places to walk therapeutically will have increased agitation among wandering residents, conflict among residents and conflict between residents and staff.

Wandering paths

Continuousness	Wayfinding: High	Wayfinding: Low
High	Clearly linked pathways with visual cues and events along the way.	Continuous but boring or confusing loops.
Low	Dead end corridors but with clear cues and interesting elements along the way.	Unvarying, boring, confusing dead end corridors.

3. Individual away places

Definition: The extent to which residents have their own definable bedrooms which they can decorate and furnish with their own belongings and to which they can retreat to get away from the resident group.

High ratings for individual away places are given to facilities with only private bedrooms (other than those shared by family members), and with a policy that residents may bring some of their own furnishings, such as an armchair or dresser, and may decorate their room as they like. Facilities with bedrooms shared by two residents using mainly the facility's furniture, but with a bulletin

INDIVIDUAL AWAY PLACES—Bedrooms with residents' personal objects serve as social retreats.

board that each resident is encouraged to decorate separately with personal mementos would receive a lower rating. SCUs rated lowest on individual away places have only ward sleeping arrangements in which neither residents nor their families have any opportunity to provide a personal touch.

The two dimensions of individual away places are therefore privacy and personalization. Privacy, measured by the number of people sharing a room, is thus usefully broken into three categories:

- *High privacy:* Most residents in the unit are in private rooms,
- *Medium privacy:* Most residents in the facility are in two person rooms, and
- *Low privacy:* Most residents in the unit are in wards.

The six-fold table that results from the intersection of these dimensions is:

Individual away places design criteria

The therapeutic side effects of every design feature depend on how staff members program the use of space. Individual away places ranking is particularly affected by the way space is used. If the program focuses on common space use, diverting residents from their rooms except when sleeping, resting, dressing, and visiting with family, then high privacy is more therapeutic than low privacy. Sometimes two person and perhaps even ward rooms may be therapeutic for certain residents because of the social interaction they encourage. We assume here that some private time is scheduled as part of a therapeutic program.

- *High Privacy/ Low Personalization:* Private bedrooms with standardized furniture and few personal objects still give residents the advantage of separate quiet rooms. However, the lack of personalization can reduce the degree to which residents feel relaxed and at home in their own space.
- *Medium Privacy/ High Personalization:* Bedrooms shared by two Alzheimer residents, each of whose space is differentiated by personal objects and decoration, and with some visual privacy, can

Individual away places

Privacy	Personalization: High	Personalization: Low
High	Private bedrooms furnished and decorated by residents' own belongings.	Private bedrooms with standardized furnishings.
Medium	Shared rooms with little privacy but where residents keep and display personal belongings.	Rooms shared with one other person, moderate opportunity for privacy, little personalization.
Low	Wards within which residents may keep their own furnishings and personal belongings.	Wards with no chance for personalization.

COMMON SPACE STRUCTURE—A dining room and a linked therapeutic kitchen provide differentiation in common spaces.

also have therapeutic side effects. When each roommate has some control over a defined physical space, including windows and lighting, and when roommates are compatible, there may be social advantages for some residents to share a room. These advantages may outweigh the disadvantages of lost privacy, with resulting outcomes similar to units with more single bedrooms.

- *Medium Privacy/ Low Personalization:* Without an opportunity to personalize one's own space in two person rooms, losing privacy can reduce residents' sense of identity, and thus increase depression and agitation.
- *Low Privacy/ High Personalization:* In three person bedrooms and larger wards negative interaction among residents and consequently staff tension is likely to increase. Personalization may ameliorate this negative outcome, yet lack of boundaries will lead to residents using each other's possessions and spaces, increasing the potential for conflict.
- *Low Privacy/ Low Personalization:* Residents all sleeping in standardized wards will result in the lowest measurable resident therapeutic outcomes.

4. Common space structure

Definition: the mutual effects of the number of activity areas and the differentiation of features and use in these areas represent a special care unit's common space structure. these design elements affect the opportunities residents have to engage in therapeutic social interaction by providing cues for and supporting appropriate behaviors.

Special care units with a high common space rating have several different common activity areas such as a dining area, a sitting area, a TV room, an activities room and a therapeutic kitchen. They may be in separate rooms or in a large single space planned for and adaptable to multiple activities. A special care unit with a single, small and not very well defined multi-purpose room would receive a low common space structure rating.

Two dimensions of structured common space are therefore quantity and variability. The four-fold table that results from the intersection of these two dimensions is:

Common space structure design criteria

- *High Quantity/ High Variability:* Outcomes will be highest when there are between

Common space structure

Quantity	Variability: High	Variability: Low
High	Several activity spaces highly differentiated by function, such as therapeutic kitchen, dining and activities.	Several different common spaces all with the same use and decor.
Low	Only a few, but quite distinctive, activity areas.	Only one undifferentiated common area.

three and five activity areas of varying decor and use, in one multi-use or several separate spaces. For example, residents will be most actively engaged, family satisfaction will be highest and there will be a therapeutic amount of resident-staff interaction. The optimum number of activity areas will vary depending on both overall size of the unit and the number of residents. Below this range there is not enough opportunity for choice of level and type of interaction. Above this range staff are burdened by the difficulty of surveillance and residents become confused.

- *High Quantity/ Low Variability*: Alzheimer units with an appropriate number of activity areas that are all the same and have no specific physical cues indicating appropriate behaviors will be most confusing to residents. While a sustained activities program can overcome this confusion and the resulting agitation, such a layout will increase dependence on activities organized by staff, and require greater staff surveillance.
- *Low Quantity/ High Variability:* When there are too few activity areas, high variability can only be achieved by changing features over time i.e. moving tables and chairs, or decorating the space. Staff members will need to take the time to schedule residents' use of these spaces carefully and to set up the spaces for each activity. This arrangement is likely to result in increased staff workload and stress and potential confusion among residents faced with changing settings.
- *Low Quantity/ Low Variability:* One single-use, undifferentiated common space in a special care unit places a burden on residents to interact with each other continuously and with little differentiation of activity. This configuration will lead to withdrawal and conflict among residents, and staff burnout.

5. Outdoor freedom

Definition: The degree to which a special care unit's outdoor space is immediately accessible to residents, and the extent to which this outdoor space is specially planned for use by dementia residents.

A special care unit that receives a high ranking on outdoor space has an immediately adjacent secure outdoor space on the same level as the special care unit, where caregivers perceive the space to be safe and secure enough that residents are given largely independent access to the space, and has physical elements that are designed to support Alzheimer residents to function effectively outdoors. A facility that provides residents only limited and occasional access to the out of doors and then only to a space that is not specially planned for use by this group of residents, ranks lowest on outdoor space. Where outdoor space is ranked low, its design is assumed to meet threshold qualities for security and safety. Two dimensions of outdoor space are therefore availability and supportiveness. The four-fold table that results from the intersection of these two dimensions is:

Outdoor freedom design criteria

- *High Availability/ High Supportiveness:* Positive therapeutic and quality of life side effects will be found in facilities with very accessible outdoor space perceived as safe by staff, that includes elements that research has found to support the functioning of Alzheimer

Outdoor freedom

Availability	Supportiveness: High	Supportiveness: Low
High	Adjacent outdoor space on the same level with doors open to the unit, and designed to support resident functioning.	Adjacent outdoor space open to the unit, but not well designed to meet resident needs.
Low	Excellently planned space, but not accessible to residents except infrequently on a scheduled basis.	Outdoor space not well designed and inaccessible except on an infrequent basis.

OUTDOOR FREEDOM—On-grade secure courtyard with birdbath provides choice and diversion.

residents. Supports include planters for residents to have contact with the earth, non-poisonous plants, and visibility of the unit door so residents can find their way back easily. In particular, having the outdoor space on the same level and with staff offices located to allow easy surveillance will maximize the residents' use of such space at their own discretion. Both staff and residents will be less agitated and residents will derive the greatest benefits from contact with daylight, changes in the seasons, weather changes and contact with earth and plants.

- *High Availability/ Low Supportiveness:* Availability of outdoor space outweighs its state of the art design. Poorly designed but adjacent and accessible open space generally is better for residents than inaccessible open space, depending on how bad the ambience of the outdoor space is. This assumes that the space is not so dangerous that staff limit residents' freedom of access.
- *Low Availability/ High Supportiveness:* The therapeutic impact of well-designed but far removed or blocked-off outdoor space will depend on the amount of time staff members spend escorting residents there to use the space. Positive effects can be expected to be fewer than if the space were immediately adjacent and accessible, but greater the more time residents use the space. In general, when space is not directly adjacent to the unit or where it cannot be monitored easily by unit staff, use by residents will be significantly decreased.
- *Low Availability/ Low Supportiveness:* If Alzheimer residents have little access to outdoor space and the space they do use is inappropriate to their needs, they may be agitated and depressed and have difficulty with sleep-wake disturbances and sundowning. They may also have reduced Vitamin D levels. Staff members then experience stress from resident behaviors and also suffer directly from their own loss of access to the out-of-doors.

6. Residential character

Definition: The qualities of home that most residents remember include small residential clusters, regularly shaped small group spaces, as well as residential furniture, decorations, and lighting. Residential design features include non-institutional doors, windows and hardware, and routines of activity that reflect homeand its daily repetitive schedules. A special care unit that ranks high on residential character is a homelike setting, with a small number of residents and with rooms, furniture and decor that feel like someone's home. The more residents a special care unit has, the longer its corridors and the larger its common rooms are likely to be. A low ranking unit is larger and feels more institutional. The two dimensions of residential character are size and familiarity. The four-fold table that results from the intersection of these two dimensions is:

Residential character		
	Familiarity	
Size	High	Low
High	7 to 15 residents in the residence, small rooms, and familiar furniture, furnishings and routines.	A social unit of 7 to 15 residents in a homelike setting with decor, furnishings and routines that are institutional and strange to them.
Low	15 to 30 residents in a setting that has many residential qualities in its furniture, furnishings and routines.	A unit with over 30 residents as well as institutional, unfamiliar interior features.

Residential character design criteria

- *High Size/ High Familiarity:* In settings that are small in both number of residents and the size of spaces, and that also have decor and furnishings that feel like home, residents will be relaxed and staff will treat residents personally.
- *High Size/ Low Familiarity:* In smaller settings that are more institutionally furnished and operated, residents will become restless and disoriented. Staff, who will have to carry the burden of stimulating and helping to orient residents, will become frustrated and tired.
- *Low Size/ High Familiarity:* In larger units that nevertheless are furnished residentially, residents will be overstimulated and confused by the number of people they encounter. Staff will need to be constantly aware of potential interpersonal flare ups and thus will be more tense.
- *Low Size/Low Familiarity:* In a large and institutional setting residents will be disoriented, less able to function independently, and likely to be depressed and apathetic. Staff disorientation and frustration will be high as they focus only on problem solving with few long term effects.

RESIDENTIAL SCALE— Easy chairs and bookshelves help residents feel at home.

7. Autonomy support

Definition: In special care units designed for residents to use their remaining faculties as much as possible, and designed to give staff members the feeling that residents will not hurt themselves or others if left to themselves, residents will be most autonomous. The greater autonomy residents develop in a unit, the greater is their self identity and dignity. Such units rank high on autonomy support.

High ranking units have good staff sightlines to common spaces and corridors, have surfaces and equipment to prevent residents from hurting themselves through slips and falls, and give staff enough visual and electronic information about residents to know they are safe. The layout, equipment, furniture and signs in the unit provide support for residents to dress, toilet and feed themselves to the best of their ability—to carry out activities of daily living—and the environment cues residents to behave autonomously.

Units ranking low on autonomy

AUTONOMY SUPPORT— Visible toilets help residents remain more independent.

support are designed with the assumption that residents cannot contribute to their own care and need constant help and supervision. Unit design requires that staff control resident behavior and be continually alert to possible accidents.

The two dimensions of autonomy support are safe and prosthetic. The four-fold table that results from the intersection of these two dimensions is:

Autonomy supportive design criteria

- *High Safety/ High Prosthetic:* In settings with good staff sightlines, and with design elements and devices that on the one hand prevent residents from slipping and falling, and on the other hand help them to carry out daily activities, residents will be relaxed and staff will be less concerned about residents.
- *High Safety/ Low Prosthetic:* In safe settings with few specially supportive furnishings and design elements, residents who are more dependent on staff will lose independent functioning. Staff will spend more time assisting with activities of daily living, less time in therapeutic activities, and will find their jobs less meaningful.
- *Low Safety/ High Prosthetic*: In settings with few special safety devices yet with many elements to enable residents to employ their remaining faculties in carrying out daily activities, residents will have more accidents and staff will be anxious for residents' physical safety.
- *Low Safety/ Low Prosthetic:* A hazardous institutional setting for a special care unit with few specially planned elements to help residents help themselves will result in poor therapeutic outcomes for residents and will increase burden for staff.

Autonomy support

Safe	Prosthetic: High	Prosthetic: Low
High	Interiors that are safe and prosthetic, enabling residents to use their remaining faculties to take care of themselves.	Safe interiors that nevertheless present residents with little help to carry out daily activities.
Low	Interiors that contain few special safety devices yet which support residents in carrying out tasks and	Hazardous interiors which require staff to help residents carry out most tasks and activities.

8. Sensory comprehension

Definition: The sounds residents hear, and the visual images, smells and kinesthetic experiences that they understand make up sensory comprehension. A facility with a high sensory comprehension ranking does not necessarily have the overall calmest setting, but rather it has a moderate amount of sensory input, all of which residents can understand in the context of their past experiences and their lives in the

special care unit.

The inverse, sensory confusion, may come from within the special care unit such as several radios blaring in different places at the same time or strangers coming and going frequently.

Sensory confusion may come from outside the unit, the result of the special care unit's location near a busy public street where residents see trucks and pedestrians passing by and hear screeching tires and blasting horns. A low sensory comprehension ranking is given to an SCU environment with complex signals coming at too fast a rate and containing messages that residents cannot interpret, such as people coming and going, putting on their coats and getting into and out of cars.

The two dimensions of sensory comprehension are noise management and meaningfulness to residents. The four-fold table that results from the intersection of these two dimensions is:

Sensory comprehension design criteria

- *High Noise Management/ High Meaningfulness:* The least amount of resident agitation and disorientation and therefore the least amount of staff stress in dealing with residents reacting to auditory and visual noise will be in settings with moderate amounts of highly meaningful sounds, sights, smells and feelings. These settings will also support residents' cognitive abilities and have the greatest number of residents engaged in meaningful independent activities.
- *High Noise Management/ Low Meaningfulness:* A facility in which there is care to avoid too many or too few sensory inputs, in which there are few meaningful sounds, sights, smells and other cues will tend to have residents who experience cognitive decline and engage in fewer self-motivated activities.
- *Low Noise Management/ High Meaningfulness:* Residents in special care units with a great amount of sensory input which they understand, and in bland units where noise is over-managed with unnaturally low sensory input, will be disoriented and confused, although whatever meaningful stimulation there is will help them.
- *Low Noise Management/ Low Meaningfulness:* Special care units with either too much or too little sensory input, and with whatever sensory stimulation

SENSORY COMPREHENSION— Player piano and old familiar tunes are easily understood.

Sensory comprehension

Noise management	Meaningfulness: High	Meaningfulness: Low
High	Moderate amounts of sounds, sights, smells and other experiences, all of which make sense to residents	Moderate amounts of sensory stimulation, but with content that residents do no understand.
Low	Either too many or too few sights, sounds and smells but residents can understand all of them.	Noisy and confusing, or grossly understimulating, but with few cues or stimuli meaningful to residents.

there is being difficult to understand will have the worst therapeutic outcomes in terms of resident agitation, lower functioning, and staff stress.

Summary

Every environment—a home, a baseball stadium, a market, an office building, a hospital emergency room—has defining characteristics that make it unique and different from any other setting. The eight characteristics described in this article and their interaction define a set of such unique characteristics for special care Alzheimer units in assisted living and nursing facilities. This model can be used by designers to plan SCUs, by gerontologists to prepare facility design programs for SCU design, and by clients and administrators to review and improve designs. Employing this model to vary the qualities of each characteristic and of all of them together in a special care unit will enable designers, planners, researchers and service providers to improve therapeutic outcomes and the quality of life of residents in the facilities they plan and operate.

This model also enables planners to focus on the goals and purposes that indeed make Special Care Units special. Linking critical performance criteria to an SCU's purposes can help planners distinguish between critical criteria and threshold design qualities, making evident the different results of trade-off design decisions.

In sum, the state of the art of a discipline's body of knowledge is represented by agreement among scholars and practitioners as represented by published literature and conference papers. Theoretical and practical models that reflect the state of knowledge in a field can serve as the basis for a firm foundation in present knowledge for future research and practice, and as the springboard for paradigm shifts.

With the help of a generous group of experts, the authors present this model to serve as such a foundation for future knowledge growth. After being translated into research questions and indicators, the concepts and elements of the model can be tested, refined and developed employing established methods for systematic Post-Occupancy Evaluations (POEs)[11] hopefully to

SCU plan rating checklist

This Rating Checklist is intended to facilitate application of the model to a particular facility. To assess the eight characteristics for a particular SCU fill in the details in the checklist and estimate the value of each dimension in the list. Then check the eight E-B Model concept values that result.

Name of Facility: _____
No. of residents: _____
No. of 1 bedroom: _____
No. of 2 bedrooms: _____
No. of 3 or more bedrooms: _____

Distinct common areas: Number of each
Dining _____; Activities_____; Therapeutic Kitchen _____
TV_____; Sitting/Quiet_____; Staff Meeting Area_____;
Other_____

Check the level to which each critical dimension is met in this unit: "high" or "low". After ranking the dimensions place a check next to the letter that best describes the eight characteristics of this unit.

Immediacy of Control:	High___	Low ___				
Unobtrusiveness:	High___	Low ___				
1. Exit control:	A___	B___	C___	D___		
Continuousness:	High___	Low___				
Wayfinding:	High___	Low ___				
2. Wandering paths:	A___	B___	C___	D___		
Privacy:	Hgh___	Med___	Low ___			
Personalization:	High___	Low___				
3. Individual away places:	A___	B___	C___	D___	E___	F___
Quantity:	High___	Low ___				
Variability:	High___	Low ___				
4. Common space structure:	A___	B___	C___	D___		
Availability:	High___	Low___				
Supportiveness:	High___	Low___				
5. Outdoor freedom:	A___	B___	C___	D___		
Size:	High___	Low___				
Familiarity:	High___	Low___				
6. Residential character	A___	B___	C___	D___		
Safe:	High___	Low ___				
Prosthetic:	High___	Low___				
7. Autonomy support	A___	B___	C___	D___		
Noise Management:	High___	Low ___				
Meaningfulness:	High___	Low ___				
8. Sensory comprehension:	A___	B___	C___	D___		

enlighten future generations of scholars and practitioners.

References

1. Lawton MP: Environmental approaches to research and treatment of Alzheimer's disease. In E. Light & B. D. Lebowitz (Eds.): Treatment and family stress: Direction for research. Maryland: National Institute of Mental Health, U.S. Department of Health and Human Services, 1990

2. Ohta RJ, Ohta BM: Special units for Alzheimer's disease patients: A critical look. The Gerontologist, 1988;28(6)

3. Hyde J: The physical environment and the care of Alzheimer's patients: an experiential survey of Massachusetts' Alzheimer's units. The American Journal of Alzheimer's Care, 1988;4 (3)

4. Cohen U, Weisman G: Architectural planning and design for dementia care units. In Cohen & Weisman (Eds.): Specialized Dementia Units. Baltimore: John Hopkins Press, 1991

5. Zeisel J, Epp G, Demos S: Midrise Housing for Older People, Department of Housing and Urban Development, 1978

6. Zeisel J, Klaassen T, Hyde J,: Best practices: An operational excellence model for Alzheimer special care units, forthcoming

7. Calkins MP: Design for dementia: Planning environments for the elderly and the confused. Owings Mills, MD, National Health Publishing, 1988

8. Hiatt, L: Designing specialized institutional environments for people with dementia. In PD Sloane, LJ Mathew (Eds.): Dementia Units in Long-Term Care. Baltimore: Johns Hopkins University Press, 1991

9. Mace NL: Dementia Care Units in Nursing Homes. In DH Coon (Ed.): Specialized Dementia Care Units. Maryland: John Hopkins University Press, 1991

10. Zeisel J, Harvey J: The Canadian Hospital Program: Towards a POE paradigm. In Conan M, Zimring C (eds.): Towards a critical practice of Architecture, forthcoming

Appendix: Outcome measures from body of the E-B Model

Resident quality of life outcomes
number of exit attempts
degree of use of restraints
amount of noise and commotion
quality of sleep-wake cycle
degree of privacy
positive or negative interaction among residents
degree of active engagement
quality of resident-staff interaction
degree of use of (outdoor) space
ability to function independently
dependence of residents on staff
supportiveness of cognitive abilities
meaningfulness of independent activities
number of self-motivated activities

Resident therapeutic outcomes
agitation
confusion
confusion for wanderers
disorientation
depression
accidents (harm)--degree, severity, number of
conflict among residents
relaxedness
relaxed & at home feeling
frustration
muscle tone & cardiovascular health
movement related problems
sense of self-enhancement
social overstimulation
sense of identity
conflict
withdrawal sleep-wake disturbances (see above)
sun-downing
reduced vitamin C levels
restlessness
overstimulation
apathy
cognitive decline
degree & decline in functioning
aggression & behavioral outbursts

Staff outcomes
management of problems
surveillance ability
workload
personal treatment of residents
stress
tension
frustration
anxiety–eg. over resident safety
burdened--eg. by surveillance
satisfaction
movement-related problems
conflict between residents and staff
burnout
agitation
tiredness
disorientation
concern--eg. about residents
meaningfulness of job

Family outcomes
opportunity to be alone with resident
satisfaction