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Evidence-Informed Design Recommendations for Juvenile Facilities in Sweden

Report prepared for the Swedish National Board of Institutional Care (SiS)

ROGER S. ULRICH, PhD

CENTRE FOR HEALTHCARE ARCHITECTURE
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden
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About this report

This report on evidence-grounded design recommendations for youth facilities was supported by funding from the Swedish National Board of Institutional Care (Statens institutionsstyrelse or SiS). Portions of the report by the author (R. Ulrich) originally appeared in Swedish as the research literature review and design recommendations section of a more comprehensive co-authored report on SiS facilities by the Center for Healthcare Architecture or CVA (Centrum för vårdens arkitektur) at Chalmers University of Technology, Gothenburg. Compared to the literature review and design recommendations published in Swedish, this English version has been revised and expanded.

The broader co-authored report in Swedish contains additional material about the Swedish context for institutional care, and addresses certain topics not addressed in the present English version. For example, the longer report includes information relating to youth facility schools, recreation areas, and outdoor campus spaces. This report, by contrast, focuses on evidence-informed design of living or residential units.

The more wide-ranging report was prepared by Göran Lindahl, Sofia Park, and Roger Ulrich, and was published as: *SiS vårdmiljö: En guide för lokalutvecking.* Forsknings rapport no. 9. Stockholm: Statens insitutions styrelse, 2017. IBSN 978-91-87053-55-9

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EXECUTIVE SUMMARY

EVIDENCE-INFORMED DESIGN RECOMMENDATIONS FOR JUVENILE FACILITIES IN SWEDEN

This report focuses on architectural characteristics of residential units in juvenile facilities and has the following main objectives:

- Identify empirical studies relevant to understanding the links between characteristics of the physical environment of juvenile living units and resident stress, aggressive behavior, and treatment outcomes.

- Address the lack of reasoned architectural theory for creating youth treatment/detention facilities by proposing an evidence-grounded design model or theory for creating juvenile residential units with the goal of improving treatment and safety outcomes.

- Identify design recommendations informed by evidence and theory for creating youth living units that can be plausibly expected to improve safety and treatment outcomes, and effectively support SiS treatment and staffing protocols. Discuss each design recommendation and cite relevant research from juvenile and adult justice, environmental psychology, evidence-based healthcare design, and other fields.

- Achieve a balance in the content between, on the one hand, being scientifically responsible and grounded on evidence, and on the other, being practically useful for designing youth facilities.

The focus on living areas is warranted given that the great majority of research relevant to designing juvenile facilities has been done on residential units, rather than on facility schools, recreation areas, grounds, or other spaces. Studies show that the effects of negative conditions in the physical environment of youth living units carry over to other types of facility spaces and are expressed as worsened outcomes, particularly in schools. Evidence-informed design of youth living units to mitigate crowding and other environmental stressors is important not only for reducing aggressive behavior and improving treatment outcomes within the units, but also for maintaining classrooms as comparatively safe and cooperative sanctuaries.

Methodology of literature review

To identify relevant studies, a modified Cochrane protocol for a systematic review of research was followed. The literature search revealed that few empirical studies have examined the link between the physical environment of youth facilities and resident outcomes, and most have methodological shortcomings. The outcomes receiving the most attention in studies have been aggressive behavior and other types of rule violations. Fortunately there is a substantial body of quality research relevant to designing other types of treatment, detention, and residential facilities. The most scientifically credible findings potentially relevant to designing youth facilities come from studies on other types of treatment and residential settings.

The report information and design recommendations are derived from the research literature review, workshops attended by numerous SiS staff, and information obtained

during tours of several youth facilities at locations in Skåne, Västra Götaland, and Stockholm regions.

Three-level rating system of evidence strength

A three-level rating system is used throughout the report to assist readers in understanding the strength of the research evidence underpinning each design recommendation (Ulrich, 2012).

++ ***Strong evidence***

Indicates there is a pattern of evidence from multiple rigorous studies supporting the relationship between the design feature and an outcome.

+ ***Emerging evidence***

Indicates that a relationship between the design feature and an outcome is supported by limited research evidence. Existing studies give reason to believe that the design intervention will affect the outcome, but the evidence is not yet definitive.

• ***Best practice***

Indicates that a relationship between the design feature and an outcome is not yet directly supported by research evidence. However, experience and knowledge of qualified professionals in areas such as juvenile rehabilitation and architectural practice make it plausible that the design feature can influence an outcome.

Conceptual model for designing youth living units to improve outcomes

The report proposes an evidence-informed design model that provides an organized framework for identifying relevant studies from the literature review, and explaining why specific environmental features and design recommendations can be reasonably expected to influence treatment outcomes in youth living units. For a design feature to be included in the model, there should be credible research evidence suggesting that changes in the environmental factor are linked with measurable changes in stress, aggressive behavior, and/or other outcomes. The model is based on plausible and logically consistent reasoning, and is capable of generating testable predictions.

Parts of the design model draw heavily on previous work by the author and colleagues concerning the design of improved psychiatric facilities that reduce patient stress and aggressive behavior (Ulrich et al., 2018). The model described here has been revised and expanded to include several changes tailored to youth facilities. Two key propositions underlie the design model:

Proposition 1: Youth living units designed with several stress-reducing environmental features will lessen aggressive behavior and improve treatment outcomes.

The design model proposes that architecture can help reduce aggressive behavior and improve other outcomes if juvenile living units are deliberately designed with a number of evidence-grounded environmental features that reduce resident stress. It identifies ten stress-reducing characteristics for youth residential units, and groups them into three conceptual categories: crowding stress reduction (four design features); environmental stress reduction (two design features); and stress reduction through positive distraction (four features).

Proposition 2: Youth living units designed to enable good staff observation and support a direct supervision treatment model will increase safety and treatment quality.

The model contends that a key requirement for designing effective youth living units is to achieve a good fit between the architecture and the supervision or treatment model. SiS youth facilities use a direct supervision model that encourages staff to be outside their offices and directly involved with residents, often interacting with them on an individualized basis. The supervision and observation model requires that staff move about in the interior spaces of a living unit, while maintaining good observation over communal or activity spaces and other unit areas. Good visibility or observation supports staff capability to communicate effectively with residents and anticipate problems or aggressive behavior at an earlier stage. Further, it may enable residents to feel more secure and less stressed, and foster staff sense of security.

Evidence-informed design features that reduce stress and improve outcomes in youth living units

Reduction of crowding stress in living units

Single bedrooms with private toilets and showers ++

Providing single bedrooms with private toilets and showers may be the single most important design intervention for enabling privacy access and reducing crowding stress and aggressive behavior in youth living units. This recommendation is supported by strong evidence.

Small resident group size in living units ++

Considerable evidence supports the importance of designing juvenile living units with small group sizes to improve treatment outcomes. Reports describing best practices for juvenile facilities universally and strongly recommend small group sizes in residential units.

Communal areas with semi-movable seating and ample space for residents to regulate relationships ++

Persons are sensitive with respect to maintaining appropriate interpersonal distances and respond with stress, anxiety, and often anger when others intrude into their personal space. Individuals with a history of aggressive or antisocial behavior require greater personal space distances than those with no history of such behavior. This suggests the importance of providing adequate space in lounges and other shared rooms in SiS living facilities to support the greater personal space distances that many residents may need. Semi-movable and movable seating arrangements facilitate personal space regulation, promote positive interpersonal interaction, and can reduce crowding stress and aggressive behavior in communal spaces.

Low social density (many fewer residents than rooms in a living unit) ++

Crowding research has found that social density (number of persons per room) consistently has greater effects than spatial density (space per person) on crowding stress and aggressive behavior across varied types of treatment, detention, and residential environments. A well-designed living unit with single bedrooms, private bathrooms, several communal rooms, and a garden will maintain a low social density of <0.5 resident per room, indicating the physical environment facilitates residents' ability, by *moving between different rooms*, to regulate relationships, avoid unwanted contacts, access privacy, and avoid stressors such as noise.

Reduction of environmental stressors in living units

Noise reducing design +

Evidence from randomized controlled studies of non-resident volunteers have shown that exposure to uncontrollable or unpredictable noise robustly increases stress, triggers aggressive behavior, and worsens retaliatory aggression.

Design to foster control in resident rooms +

Design features that enable residents to control or personalize their rooms support stress coping and may help diminish aggressive behavior. Research on psychiatric wards has found that control-related design features in patient rooms are associated with reduced use of isolation confinement.

Stress reduction through positive distraction

Nature space or garden accessible by residents ++

Providing a nature space or garden accessible to residents can reduce stress by providing nature views, a pleasant place to seek privacy or socialize, and fostering sense of control. Several strong studies have found that simply viewing nature (trees, plants, or water) for a few minutes can produce rapid and significant psychological and physiological reduction of stress

Nature window views +

Nature art, not abstract art +

Evidence-informed selection of emotionally appropriate art and pictures for communal spaces and therapy rooms in juvenile living units can help lessen resident stress and possibly aggressive behavior.

Daylight exposure +

Design that supports good observation and direct supervision of residents ++

Designing living units to facilitate good observation is integral to achieving effectiveness with a direct supervision treatment model, such as that used in SiS facilities. Research on adult correctional units and other types of treatment facilities has convincingly shown that design for good observation is associated with reductions in assaults, use of seclusion or isolation, rule violations, and increased perceived security. An important finding is that long corridors and corridor-dominated floor layouts hamper staff observation and are linked with higher rates of aggressive behavior and rule violations. The report proposes that floor layouts can be more effective in facilitating visibility throughout a living unit if corridors are short and occupy a relatively low proportion of total interior space. Other design approaches include providing windows or walls of damage-resistant glazing between communal spaces to facilitate observation.

Best practice design recommendations not supported by research evidence

The experience and knowledge of qualified professionals in areas such as juvenile rehabilitation and architectural practice make it plausible that the design suggestion will influence outcomes.

Single-level juvenile facilities, not multi-level •

Provide a timeout or cooling off space •

Avoid design that intensifies aggressive reactions to stressful information received by telephone •

SiS staff reported that placing a telephone booth/space in a living room or other shared space could worsen the problem of aggressive reactions triggered by "bad news," because residents would "get mad and act out in front of the other residents."

Non-institutional design •

MAIN REPORT

EVIDENCE-INFORMED DESIGN RECOMMENDATIONS FOR JUVENILE FACILITIES IN SWEDEN

1. Introduction

The Swedish National Board of Institutional Care (Statens institutionsstyrelse or SiS) is faced with the pressing need to provide compulsory care for increasing numbers of young people with psychosocial problems and for adults with substance abuse. Among other major challenges, SiS needs to provide more facilities and bed spaces, maintain and if possible increase the quality of treatment/rehabilitation, ensure safe environments for residents and staff, control costs, and recruit and retain quality personnel.

Several new SiS facilities will be constructed and aging buildings will be renovated. This wave of construction and refurbishment provides a very important opportunity to rethink the design of Swedish youth facilities, and create better buildings by use of the emerging field of evidence-based design (EBD). EBD has developed in recent decades as a fast-evolving interdisciplinary field that applies sound knowledge to help guide the design of different types of buildings to improve organizational performance, improve safety, facilitate effective and less stressful work, and help control costs (Hamilton & Watkins, 2009). Here it should be mentioned that SiS is charged with delivering knowledge-based treatment. Accordingly it makes compelling sense to take advantage of the best available knowledge to inform the design of youth facilities that will be used for decades and for which so much is at stake.

There is a substantial amount of quality EBD research relevant to general or somatic hospitals and other medical buildings, to the point that the design of nearly all hospitals in Sweden and other countries with advanced healthcare systems is strongly influenced by EBD knowledge and design concepts (Ulrich et al., 2008). These evidence-informed design approaches for hospitals have been shown to increase patient safety, clinical quality, patient and staff satisfaction, and reduce costs of delivering care (Ulrich, 2012; Ulrich et al., 2008; Berry et al., 2004; Sadler et al., 2011). A general conclusion supported by this research is that improving the design of healthcare buildings is integral to improving healthcare quality and controlling costs.

Unfortunately, compared to the large amount of design research available for general hospitals, few empirical studies have examined the link between the physical environment of youth detention/treatment facilities and outcomes such as aggressive behavior, perceived safety, recidivism, and resident and staff stress. There is a corresponding absence of reasoned and evidence-informed architectural theory to help guide the design youth facilities that are likely to improve safety and other outcomes, and effectively support treatment programs and staff work models.

Fortunately, there is a considerable body of research relevant to designing other types of detention and treatment facilities, particularly adult correctional facilities. Research on adult prisons includes several quality studies of American "new generation" detention facilities designed to support a staff model for supervision and treatment having some similarities with the staff model used in Swedish (SiS) juvenile facilities (a direct supervision and observation model). Other information pertinent to designing youth facilities comes from the growing number of studies on the influence of the

physical environment of compulsory care psychiatric facilities on aggressive behavior and treatment outcomes. Additionally, a great deal of indirectly relevant knowledge can be garnered from decades of research in environmental psychology, criminal justice, health psychology, and other fields concerning how different architectural design approaches affect crowding, stress, aggressive behavior, and health outcomes in settings as varied as urban apartments, university student housing, and commercial offices.

2. Objectives of report

This report focuses on architectural characteristics of residential units in Swedish (SiS) juvenile facilities and has the following main objectives:

- Identify empirical studies relevant to understanding the links between characteristics of the physical environment of juvenile facilities and resident stress, aggressive behavior, and treatment outcomes.

- Address the absence of evidence-grounded architectural theory for creating youth treatment/detention facilities by proposing a design model or theory for creating juvenile residential units with the goal of improving treatment and safety outcomes. The theory contends that aggressive behavior can be reduced and the quality of treatment/rehabilitation outcomes improved if SiS physical environments are designed with 1) several distinct evidence-grounded environmental features that reduce stressors such as crowding and noise, 2) and the architecture effectively supports good observation and the SiS direct supervision/treatment model calling for staff to be outside offices communicating directly with residents.

- Identify design recommendations informed by evidence and theory for creating SiS youth facilities that can be plausibly expected to improve safety and other outcomes, and effectively support SiS treatment and staffing protocols. Discuss each design recommendation and cite relevant research from juvenile and adult justice, environmental psychology, evidence-based healthcare design, psychiatry, and other fields.

- Achieve a balance in the content between, on the one hand, being scientifically responsible and grounded on evidence, and on the other, being practically useful for designing SiS youth facilities. A goal of the report is to communicate to a diverse audience ranging from SiS staff, managers, treatment and security personnel, to architects, researchers, and the public.

2.1. Focus on youth facility living units

The research literature review and later sections on design recommendations focus on characteristics of the physical environments of residential/living units in SiS juvenile

facilities (LVU and LSU). The focus on living areas is warranted, given that the vast majority of research relevant to designing the physical environments of juvenile facilities has been done on residential units, rather than on facility schools, recreation areas, grounds, or other spaces.

2.2. Aggressive behavior and rule violations in youth facilities mostly occur in living units

The outcomes receiving the most attention in empirical studies relevant to designing juvenile facilities have been aggressive behavior (including resident-resident assaults and resident-staff assaults) and other types of rule violations. Studies by American researchers have documented the incidence and location of aggressive incidents and other rule violations that occurred in several youth facilities in different U.S. states. A noteworthy finding has been that across all facilities the great majority of aggressive incidents and major rule violations occurred in the living or residential units. Comparatively few incidents occurred in schools, cafeterias, recreational spaces, facility grounds, or other areas. For example, Deitch and colleagues studied six juvenile facilities in Texas (five male facilities, one female) and found that at least two-thirds of assaults and major rule violations[1] took place in living units (Deitch, Madore, Vickery & Welch, 2013, p. 13). School rooms were a distant second.

Other research examined the location of 10,985 documented assaults in several juvenile correctional facilities in the U.S. state of Arizona (Vivian, Grimes, & Vasquez, 2012). Similar to the findings of Deitch et al. (2013), Vivian and colleagues reported that the majority of assaults occurred in dayrooms/lounges and corridors, followed by shared bedrooms (Vivian et al., 2012). Only 12% occurred in classrooms, 7% in facility grounds, and 7% during recreation. Importantly, when the researchers adjusted the assault data for the number of hours residents spent in each type of area, the time-adjusted assault incidence was significantly *increased* for lounges/dayrooms and corridors/hallways, and *decreased* for schools (Vivian et al., 2012, pp. 26-27). In summary, lounges/dayrooms and corridors stood out in both U.S. studies as the locations of most problem behaviors, while schools had relatively few assaults and other rule violations given the high number of hours residents spent in classrooms.

Swedish (SiS) youth units show similarities to U.S. units with respect to the percentage of incidents taking place in different areas of facilities, including the low incidence in schools. At the author's request, data for this report was obtained from the SiS reporting system for 2030 incidents that occurred in 2015. It should be noted there may

[1] 1 Rule violations studied for location and incidence by Deitch et al. (2013, p. 113) included, among other examples: assault causing bodily injury to a youth; assault causing bodily injury to staff; attempted escape; fighting that results in injury; fighting not resulting in injury; verbal threat of imminent bodily injury; extortion or blackmail; misuse of medication; possession of prohibited substances and paraphernalia; possession of a weapon; participating in a major disruption of facility operation; two or more failures to comply with a written reasonable request; and refusing a search. These and other types of major rule violations are described in the Texas Juvenile Justice Department, General Administrative Policy Manuel.

be reporting and accuracy issues in the figures because some SiS facilities actively submitted incident data while others did not (Reitan, 2017). In brief, approximately 70% of all reported incidents occurred in interior areas of SiS youth living units (25% in lounges, living rooms and activity rooms, 20% in resident rooms, 15% in corridors, 11% in kitchens/eating areas). Only 6% of incidents took place in schools and vocational training facilities. Comparatively few incidents occurred in meeting and treatment rooms, exercise spaces, facility grounds, and other areas.

2.3. Effects of design of living units carry over and impact school outcomes

The focus here on residential units is further justified by studies showing that the effects of negative conditions in the physical environment of youth living units carry over to other types of facility spaces and are expressed as worsened outcomes, particularly in schools. Studies by Ray and colleagues in the United States produced convincing evidence that crowding stress in youth residential detention units carries over into facility schools, and can be linked with lower grades, reduced staff control in classrooms, decreased cooperation, increased social disorganization within classrooms, and lower resident ratings of school staff quality (Ray & Wandersman, 1981; Ray, Wandersman, Ellisor, & Huntington, 1982). It should be mentioned that negative spillover effects of crowding and other stressful conditions in residential environments are by no means unique to juvenile facilities. As an example, university students assigned to apartments or dormitories with multi-bed rooms and large corridor group sizes, compared to those with smaller bedroom and corridor group sizes, evidence greater crowding stress and social withdrawal in educational and other settings outside their living units (Valins & Baum, 1973).

A noteworthy implication of these research findings is that designing SiS living units in evidence-informed ways to prevent crowding and other stress-producing environmental conditions is centrally important not only for reducing aggressive behavior and rule violations in the residential units, but also for advancing important goals in SiS schools, such as increasing teaching effectiveness and maintaining classrooms as comparatively safe and cooperative sanctuaries.

3. Methodology of research literature review

Starting points for identifying relevant research articles and reports were provided by an earlier review on juvenile residential/treatment facilities (Janssens & Laike, 2006), and by previous detailed systematic reviews on adult correctional facilities (Wener, 2012; Paulus, 1988), evidence-based design of general hospitals (Ulrich, 2012; Ulrich et al., 2008), and secure facilities for psychiatric patients (Ulrich, Bogren, Gardiner, & Lundin, 2018). To identify additional studies, including those published since the previous reviews, a modified Cochrane protocol for a systematic review was followed (Higgins and Green, 2008). The search scope was defined to prioritize juvenile treatment and detention facilities, but also include adult prisons, psychiatric hospitals,

general hospitals, and residential buildings. The *intervention* of main interest was interpreted as a change in one or more environmental factors pertinent to the design of SiS residential or detention facilities (such as single rooms, multi-bed rooms, noise, daylight, nature access, spatial density, social density, crowding, vandal-resistant furnishings, art). The priority populations were defined as facility residents and personnel. *Outcomes* were construed broadly to encompass: safety and security (for example, aggressive behavior, assault, physical injury, perceived safety, vandalism, rule violation, escape); resident outcomes (for example, stress, satisfaction, sleep quality, anger, depression, recidivism); staff outcomes (such as work satisfaction, job stress, retention, turnover, resident judgments of staff quality); and other outcomes such as facility construction costs.

More than 80 keywords and phrases were identified to guide searches of research electronic databases. As noted, the keywords ranged across a wide variety of physical environmental factors, and resident and staff outcomes. Searches used Google Scholar, PsycINFO, PubMed, and other online databases such as the library of the U.S. National Institute of Justice and National Institute of Corrections. Additionally, an extensive series of cross-searches was carried out using phrases and combinations of key words (such as assaults in juvenile correctional facilities, sightlines in juvenile correctional facilities, design to support direct supervision treatment models).

Consistent with Cochrane review protocol the reference lists of articles obtained from the keyword searches were then examined to identify additional relevant studies (Higgins and Green, 2008). This expansion step identified several relevant articles published since the appearance of the previous reviews. The productive result here from searching reference lists in research articles is similar to that reported in systematic reviews for other research topics where evidence is widely scattered, multi-disciplinary, and complex.

Research articles that met the following criteria were considered for inclusion in the report:

1. The research should be published in English or Swedish in a peer-reviewed research journal or report series.

2. The research should examine the influence of a single environmental characteristic, or a specified cluster of multiple environmental factors, on resident or staff outcomes.

3. Priority was given to identifying empirical studies carried out according to a structured design and methodology that is described in enough detail to enable another researcher to understand or duplicate what was done.

4. The research methods in empirical studies should be rigorous or sound (appropriate research design, measurements, and data analysis methods).

5. Reports identifying best practices (not evidence based) for designing juvenile facilities are included if they are based on the experience and knowledge of well-qualified professionals and/or a panel of experts.

Concerning the criteria for evaluating research quality, studies are considered to be most credible or sound if they were randomized or non-randomized controlled investigations (experiments and quasi-experiments). Articles are also included in the review and given weight if they were before-and-after comparisons with controls, repeated-measures studies of environmental interventions, or cross-sectional or correlational studies with attention to control variables. By far the largest category of studies identified consists of observational studies with or without control groups. Those with control groups are referenced more frequently and given more weight in the discussion in later sections of this report. The literature search also found several case studies and qualitative or descriptive studies without controls. Most were judged as lacking rigor and validity and therefore are not mentioned in the report. However, a small number of case studies, qualitative studies, and uncontrolled observational studies were selected for inclusion because they were carefully done and address an issue or outcome for which evidence from stronger methods is not available.

In scientific fields a randomized controlled study is considered the strongest research design for generating sound and credible empirical evidence. Randomized controlled experiments can be rigorous and practical when there is a single environmental factor change, or well-specified cluster of architectural changes, that can be randomly assigned to some residents or participants, while other participants are assigned to a control group that does not receive the intervention. Also, randomized controlled studies become much more practical and possible when non-environmental factors that could potentially influence the study results (in addition to the effects of the environmental intervention) can be well identified and standardized or controlled across the different groups of residents/participants. Non-environmental factors considered to influence treatment outcomes in juvenile facilities include, for example, the staff model for supervision and observation, and levels of staff training and experience.

It is not too surprising that the literature search found virtually no randomized studies linking specific design features of juvenile facilities to outcomes. This shortage is due partly to the fact that there are only a limited number of architectural or design interventions that involve changing one environmental factor (or a narrow and well-defined cluster of factors). Most design changes to physical environments involve and influence multiple environmental factors at the same time. This creates complexities and confounding factors that blur the independent effect of the specific environmental factor of main interest (Ulrich, 2012; Ulrich et al., 2008; Ulrich, Berry, Quan, & Parrish, 2010). Fortunately, the literature search identified several randomized studies and other well-controlled investigations on general hospitals, adult prisons, and other types of residential or treatment centers. Therefore, the strongest and most scientifically credible findings potentially relevant to designing youth facilities arguably come from studies on other types of treatment/residential settings.

It is also important to point out that several studies on adult prisons, juvenile facilities, and healthcare environments such as psychiatric hospitals have measured the influences of complex combinations of interventions involving changes to staff training and the treatment protocol, as well as architectural design changes (Jenkins, Dye, & Foy, 2015; Wener, Frazier, & Farbstein, 1987; Roush, 2002). These complex interventions create practical difficulties for carrying out randomized controlled studies in juvenile treatment or detention facilities. The practical obstacles can often be more easily overcome using other research designs that may be scientifically weaker than randomized experiments but nonetheless can yield quality evidence. As mentioned, the discussion in later sections gives more emphasis to findings obtained from studies with control groups, particularly the small number using quasi-experimental methods. However, most of the small amount of research on youth facilities is not well controlled, which underscores the need for improvement in conceiving future studies so that the independent role of specific environmental changes, or a well-defined cluster of design interventions, can be better understood.

3.1. Other information sources for the report

Although the report material is derived mainly from the research literature search, it also reflects information received from three workshops attended by scores of SiS staff. Two workshops took place at Chalmers University in Gothenburg (September 15 and October 20, 2016). The third was held at a conference of SiS managers and staff in Uppsala on December 1, 2016.

Additionally, the report includes much information gained from tours by the author and other Chalmers CVA researchers of SiS facilities at nine locations in Skåne, Västra Götaland, and Stockholm county.[2] Visits and discussions with staff occurred at seven SiS locations having youth residential units. These included residential units for males and units for females. The latter included a treatment facility for residents with self-harm problems. One facility with higher security for juveniles (males) was visited. Additionally, two other SiS locations were visited having facilities for adults with substance abuse problems. Although desirable, a literature review on adult SiS facilities was deemed beyond the scope of this report.

3.2. Three-level rating system of evidence strength

A three-level rating system is used throughout the report to assist readers from different fields in understanding the strength of the research evidence underpinning each design recommendation. The rating system is similar to those used in previous systematic reviews of research in evidence-based healthcare design (Ulrich et al., 2008; Ulrich, 2012). It is also similar to the system used in the *New York City Design*

[2] The author would like to thank the many SiS staff that attended workshops and/or helpfully guided Chalmers CVA researchers during facility tours. They provided insightful comments and suggestions, patiently answered questions and provided information, and were always graciously cooperative.

Guidelines for communities and office buildings to promote physical activity and health (New York City, 2010). The three level rating/symbol system is described below:

++ ***Strong evidence***

Indicates there is a pattern of evidence from multiple rigorous studies supporting the relationship between the design feature and an outcome. The strength of the evidence suggests that alternative hypotheses or explanations are unlikely or can be discarded.

+ ***Emerging evidence***

Indicates that a relationship between the design feature and an outcome is supported by limited research evidence. Existing studies give reason to believe that the design intervention will affect the outcome, but the evidence is not yet definitive.

• ***Best practice***

Indicates that a relationship between the design feature and an outcome is not yet directly supported by research evidence. However, experience and knowledge of well-qualified professionals in areas such as juvenile rehabilitation and architectural practice make it plausible that the design feature can influence an outcome.

4. SiS youth supervision and treatment model

As background for later sections that discuss research concerning the physical environment of facilities, it is first important to consider the major objectives and features of the supervision and treatment model used in SiS youth residential units. A requirement for designing successful buildings is to ensure there is a good fit between the architecture and the supervision/treatment model. Thus an understanding of the SiS model is a necessary prerequisite for using an evidence-based approach to tailor facility design to effectively support the supervision model and the needs of both residents and staff.

The following information concerning the supervision model was obtained from the SiS/Chalmers CVA workshops, facility tours, and discussions and correspondence with SiS staff and managers. It provides an important lens through which to interpret the relevance of research discussed in later sections.

- Rehabilitation, not punishment, is the key objective or purpose of SiS juvenile facilities. The main role of SiS personnel is to serve as rehabilitation and treatment assistants or counselors, not as security guards. Most youth residents come from social services, not the legal system. Some are placed in SiS facilities primarily because of antisocial behavior, not necessarily criminality. Residents can have problems in many life areas, for example, poor mental health, substance abuse, or self-harm.

- SiS youth facilities use a direct supervision and observation model (Wener, 2012) that encourages staff to be outside their offices and directly involved with residents, often interacting with residents on an individualized basis. Most staff interactions with residents are direct, not through glass or mediated by partitions. A key aspect of the supervision and observation model is that personnel are trained to be proactive. Through direct and frequent contact with residents, staff can get to know residents and recognize and respond to problems or troubles before they escalate into aggressive behavior or other major rule violations.

- The direct supervision model, in combination with the emphasis on rehabilitation, requires that residential unit group sizes be small (about 8 residents), and the ratio of staff to residents must be moderately high.

- The SiS model for supervision and observation of residents requires that staff move about in the interior spaces of a living unit, while maintaining good observation over communal or activity spaces and other unit areas. Thus it is essential that the design and floor planning of living units be effective in facilitating good observation by staff and supporting the supervision model in which staff interaction with residents is direct, often on an individualized basis.

- Most residents can move freely about the communal areas of living units, except at night or when in school. Some residents come from the legal system, rather than being placed by municipal social services, and security may be stricter for them.

5. Conceptual model for designing youth living units to improve outcomes

As mentioned, one main aim of the report is to propose a conceptual model to address the absence of reasoned architectural theory for informing the design of youth living units that are likely to improve safety and treatment outcomes. A major consideration in developing the model was to identify design features that are sufficiently well defined and described to enable practical use by architects, managers, and staff, and replication or testing by researchers. For a design feature to be included in the model, there should be credible research evidence suggesting that changes in the environmental factor are linked with measurable changes in stress, aggressive behavior, and/or other outcomes. The design model should be based on plausible and logically consistent reasoning, and capable of generating testable predictions.

The design model or theory described below provides an organized framework for identifying relevant studies from the literature review, and explaining why specific environmental features and design recommendations discussed in later sections can be reasonably expected to influence outcomes in SiS youth living units. Major parts of the design model draw heavily on previous work by the author and colleagues concerning the design of improved psychiatric facilities that reduce patient stress and aggressive behavior (Ulrich et al., 2018; Ulrich et al., 2012). Compared to the design model for

psychiatry, the model proposed here has been revised and expanded to apply to youth facilities. Examples of several changes tailored to youth facilities include highlighting the importance on small resident group size in living units, and placing greater emphasis on design measures to support good staff observation and a direct supervision model.

5.1. Two Key Propositions Underlying the Design Model

5.1.1. Proposition 1: Youth living units designed with several stress-reducing environmental features will lessen aggressive behavior and improve treatment outcomes.

The model proposes that environmental and psychosocial stressors experienced by residents in SiS living units affect levels of aggressive behavior, rule violations, and the quality of treatment/rehabilitation outcomes. Based on decades of research in environmental psychology and other fields, the model or design theory contends that the physical environment of living units strongly and directly influences resident stress. A poorly designed facility that worsens crowding, is noisy, and has other stressful features can intensify stress during confinement and rehabilitation, thereby worsening aggressive behavior and working against the quality of treatment outcomes (Ulrich et al., 2018).

The proposition that stress triggers and worsens aggression and other negative outcomes is reflected in explanatory models of aggressive behavior in psychiatry. Some models developed for psychiatric treatment units have included the physical environment as a variable influencing stress (Nijman, à Campo, Ravelli, & Merckelbach, 1999; Nijman, 2002; Kumar & Ng, 2001). The premise that stressful events trigger aggression and violence in persons with mental health problems received convincing support from a study of individuals born in Sweden who were diagnosed either with psychosis or had no psychiatric diagnosis and served as controls (Sariasian, Lichtenstein, Larsson, & Faze, 2016). Findings showed that exposure to major stressors significantly increased risk for patients with a history of psychosis to commit aggressive acts during the first week following exposure.

It is also notable that a randomized controlled study of volunteers with no history of mental health issues or antisocial behavior produced strong evidence that stress triggers and fosters anger reactions, particularly in higher trait anger individuals (Kweon, Ulrich, Walker, & Tassinary, 2008).

Figure 1 outlines the proposed conceptual model for designing youth facilities to reduce stress and aggressive behavior and improve treatment outcomes. The lines and arrows in the figure indicate posited relationships among the main environmental and outcome variables (see box labels). Beginning with the left-most boxes, the model posits that the stress level of a youth with a history of antisocial behavior is intensified by stressors associated with compulsory admission to a juvenile facility (such as being locked up).

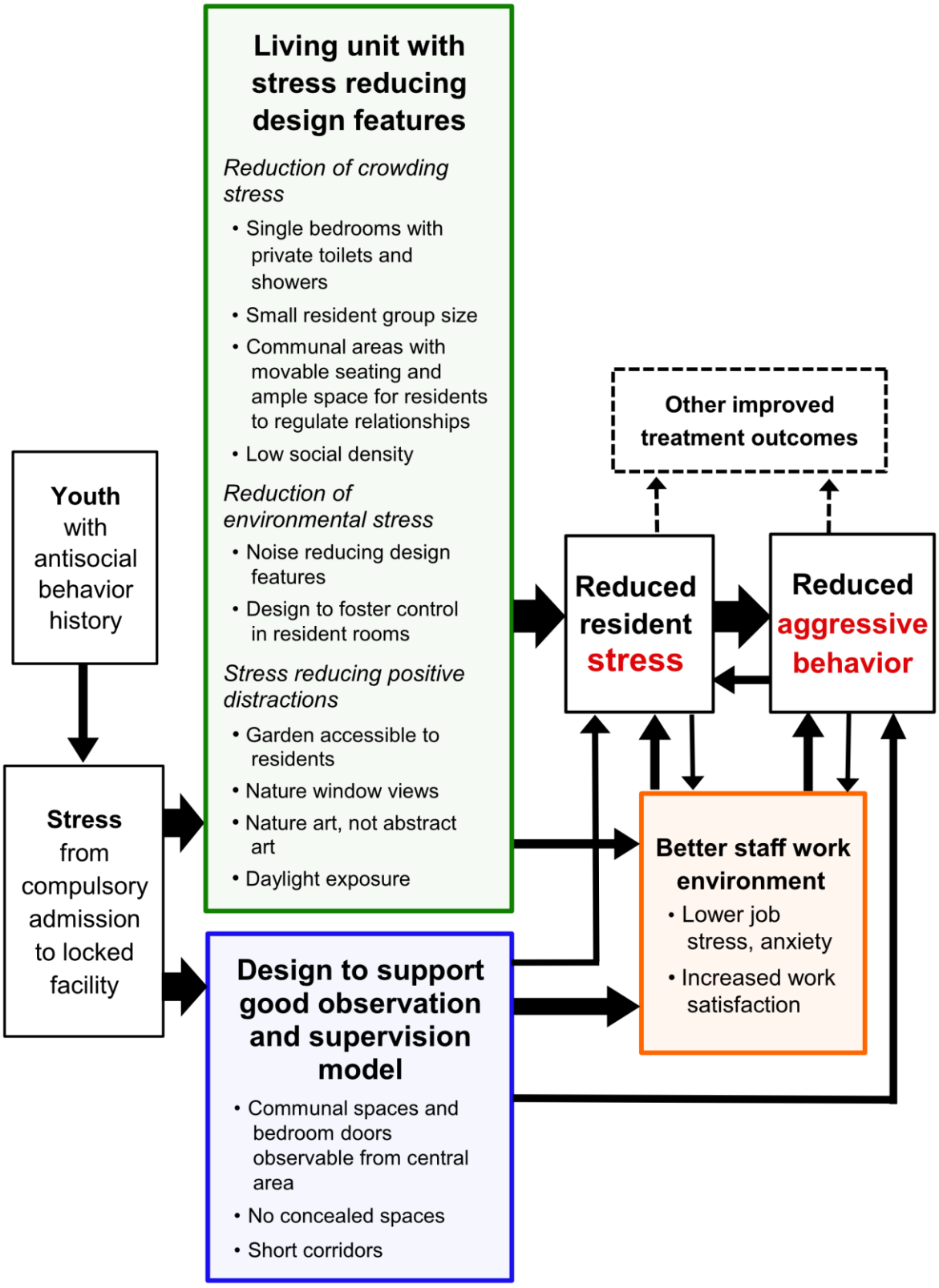

Figure 1. Conceptual model for designing youth living units to reduce resident stress and aggressive behavior, and improve treatment outcomes and the staff work environment.

Moving to the right in Figure 1 to the green box labeled "Living unit with stress reducing design features," the model proposes that the youth's stress will be lessened after admission–in contrast to intensified–if the residential unit has been deliberately designed with several evidence-grounded stress-reducing environmental features (Ulrich et al., 2018; Ulrich et al., 2012). Most of the design features in the green box are gleaned from research in environmental psychology, evidence-based design of somatic and psychiatric hospitals, and criminal justice and correctional facilities. The green box identifies ten specific design characteristics for juvenile residential units, and groups them into three conceptual categories: crowding stress reduction (four design features); environmental stress reduction (two design features); and stress reduction through positive distraction (four features). The design model further contends that implementing several of the design features in a living unit will be more effective in reducing stress than only one or two of the features (Ulrich et al., 2018). Later sections of the report discuss each of the ten stress-reducing design characteristics and describe examples of relevant research.

As shown in Figure 1, the model posits that a youth living unit designed with the stress-reducing features (green box) will effectively lessen resident stress, thereby leading to reduced aggressive behavior and improved treatment quality (Ulrich et al., 2018). This can potentially be reflected in a range of different outcome improvements, for example, reduced verbal aggression, vandalism, physical violence, physical injury, use of isolation, and increased resident satisfaction and perceived security.

The stress-reducing environmental features (green box) are also considered to directly and positively affect personnel, for example, by reducing work-related stress and fostering higher work satisfaction and retention. (See orange box in Figure 1 labeled "Better staff work environment".) Diminished resident aggressive behavior and stress are expected to feed back positively on personnel, further lessening staff stress and fostering better supervision and treatment that additionally advance treatment outcomes. There conceptual arguments are consistent with research on locked juvenile facilities showing that reduced aggressive behavior is associated with decreased staff stress (Wells, Minor, Angel, Matz, & Amato, 2009).

5.1.2. Proposition 2: Living units designed to enable good staff observation and support a direct supervision treatment model will increase safety and treatment quality.

Good visibility or observation supports staff capability to communicate effectively with residents and anticipate aggressive behavior at an earlier stage (Jenkins et al., 2015; Ulrich et al., 2018). Further, it may enable residents to feel more secure and less stressed, and foster staff sense of security. (See blue box in Figure 1 labeled "Living unit designed to support good observation and direct supervision".)

Studies of adult correctional units and other types of treatment facilities have convincingly shown that design for good observation is linked with significantly reduced aggressive behavior and other violations (Nelson, 1983b; Nelson & O'Toole, 1983;

Senese, 1997; Wener, 2012; Ulrich et al., 2012; van der Schaaf, et al., 2013; Jenkins et al., 2015).

As shown in Figure 1, the model proposes that design for effective observation and supervision (blue box) plays an important role in reducing aggressive behavior and improving treatment outcomes, and also fosters a better, less stressful work environment for staff. (See orange box in Figure 1 labeled "Better staff work environment".)

Studies of adult correctional facilities and psychiatric units have demonstrated that floor layouts with long corridors often have poor observation characteristics and hamper supervision of residents involving direct staff contact and communication in living areas outside staff offices or work stations (Nelson & O'Toole, 1983; Wener et al., 1987; Tartaro & Levy, 2007; Ulrich et al., 2018). Compared to corridor-dominated designs, floor plans can be more effective in facilitating visibility throughout a living unit, and supporting a direct supervision/communication model, if corridors are short and occupy a low proportion of total interior space (Ulrich et al., 2018). (See orange box in Figure 1 labeled "Better staff work environment.")

Research evidence discussed below suggests that design priority should be given to ensuring ample space to central areas or communal rooms, not to corridors. A later section (7.1) discusses in more detail design approaches recommended as best practice for promoting good observation in youth living units, such as providing walls of damage-resistant glazing between communal spaces and ensuring there are no concealed spaces (Roush & McMillen, 2000).

6. Design features that reduce stress and aggressive behavior in youth living units

It will be recalled the design model proposes that one key way the architecture of youth facilities can potentially reduce aggressive behavior and improve other outcomes is by reducing resident stress. As shown in Figure 1 one major part of the model identifies a total of ten evidence-grounded stress-reducing design features (green box), and groups them into three conceptual categories: reduction of crowding stress (four design features); reduction of environmental stress (two features); and stress reduction through positive distraction (four features). These conceptual categories and ten design features are listed immediately below. Subsequent pages discuss each of the stress-reducing design characteristics and review relevant research. Later sections of the report discuss design approaches for youth living units to enable good staff observation and support a direct supervision/treatment model.

Reduction of crowding stress in living units

Single bedrooms with private toilets and showers **++**

Small resident group size in living units **++**

Communal areas with movable seating and ample space for resident to regulate relationships **++**

Low social density **++**

Reduction of environmental stress

Noise reducing design **+**

Design to foster control in resident rooms **+**

Stress reduction through positive distraction

Nature space or garden accessible by residents **++**

Nature window views **+**

Nature art, not abstract art **+**

Daylight exposure **+**

6.1. Design features that reduce crowding stress in living units

6.1.1. Single bedrooms with private toilets and showers ++

Providing single bedrooms with private toilets and showers may be the single most important design intervention for enabling privacy access and reducing crowding stress and aggressive behavior in youth living units. This recommendation is supported by strong evidence from numerous quality studies on juvenile units, adult correctional facilities, apartments, and treatment environments such as psychiatric and somatic hospitals. Research has consistently shown that the number of persons sharing a bedroom or cell correlates with higher crowding stress, elevated physiological stress, more aggressive behavior, reduced privacy, increased illness complaints, and social withdrawal (Ittelson, Proshansky, & Rivlin, 1972; Baron, Mandel, Adams, & Griffen, 1976; Baum & Valins, 1977; D'Atri, Fitzgerald, Kasl, & Ostfeld, 1981; Ray & Wandersman, 1981; Cox, Paulus, & McCain, 1984; Ruback, Carr, & Hopper, 1986; Paulus, 1988; Schaeffer, Baum, Paulus, & Gaes, 1988). These findings hold when researchers control for or standardize spatial density (the amount of space per person) in bedrooms, cells, or dormitories. (Figures 2 and 3.)

In addition to reducing crowding stress, single rooms can help mitigate sleep problems prevalent among adolescents (Deitch et al., 2013). National surveys in the U.S. report that youth in detention/treatment facilities have even more sleeping problems than youth in the general population. Single occupancy rooms are quieter and more private than multi-occupancy sleeping rooms and therefore better suited to supporting the sleep needs of juvenile residents (Deitch et al., 2013; Ulrich et al., 2008). It is important to mention that research in juvenile detention facilities has shown there is a significant negative relationship between sleep quantity and quality on the one hand, and aggressive behavior, hostility, and impulsivity on the other (Ireland & Culpin, 2006). In

particular, poor sleep quality in treatment/detention facilities worsens hostility in adolescent males (Ireland & Culpin, 2006). This work implies that single rooms may help to reduce aggressive behavior and hostility in SiS living units by reducing sleeping problems.

Various authors (most in the United States) have published lists of design best practices for juvenile facilities. These reports are based mainly on the knowledge and experience of well-qualified professionals and/or expert panels, not research evidence. Nonetheless it is notable that the reports are unanimous in recommending single rooms with private toilets as best practice design (Rouse & McMillan, 2000; McMillen, 2005; Deitch et al., 2013; Moos, 1975; Farbstein & Wener, 1993).

Figure 2. Single bedroom in a SiS youth facility. (Photo by R. Ulrich)

Figure 3. Older juvenile living units often have shared toilets and showers. Staff reported during workshops and tours they preferred private toilets and showers, not shared. During tours of different SiS juvenile facilities staff reported to the author that conflicts among residents occurred in association with shared toilets and showers. (Photo by R. Ulrich)

6.1.2. Small resident group size in living units ++

Considerable empirical evidence supports the importance of designing juvenile living units with small group sizes to improve several outcomes (for survey of studies see Roush, 2002). Also, reports describing best practices for juvenile facilities universally and strongly recommend small resident group sizes in residential units (Moos, 1975; California Youth Authority, 1980; Rouse & McMillan, 2000; McMillen, 2005; Deitch et al., 2013). An influential researcher on juvenile facilities, Rudolph Moos, concluded that small group size in a living unit is an essential requirement for success (Moos, 1975).

One important reason for small resident groups is to make it possible for staff to work with youth on a more individualized basis (Roush & McMillen, 2000). This usually requires a higher proportion of staff to residents in juvenile units, compared to the ratios of staff to adult inmates in correctional facilities (Roush & McMillen, 2000; Roush, 2002; Wener, 2012). Different investigators have independently compiled evidence and arguments to propose a staff/resident ratio of about 1:8 for juvenile facilities, and likewise have recommended that youth living units be designed for about

8 residents, and not more than 12 (Parent et al., 1994; California Youth Authority, 1971, 1980; Roush, 2002; Deitch et al., 2013).

Research evidence suggests that small group sizes in juvenile living units are associated with more individualized relationships between staff and residents, more staff time available for each resident, less social distance between staff and residents, and more positive interaction and friendship formation among residents (California Youth Authority, 1971, 1980; Jesness, 1972; Moos, 1975; Deitch et al., 2013).

Another strong justification for small group sizes in residential units comes from research on crowding stress and aggressive behavior in juvenile facilities and other residential/treatment settings. Smaller group sizes in living units are associated with less crowding stress than units with larger group sizes, even when spatial density (space per resident) is held constant (Valins & Baum, 1973; Baum & Davis, 1980; Baum & Paulus, 1987). Small unit group sizes in youth living units may foster sense of control and help prevent crowding stress by enabling residents to more easily regulate their relationships with others in shared spaces such as dayrooms, activity rooms, eating areas, and corridors. Well-controlled studies in California juvenile facilities found that small living groups reduced crowding stress and assaults among residents, and lessened perceived insecurity (California Youth Authority, 1971, 1980). Limited evidence raises the possibility that smaller living units in juvenile facilities may be linked with lower rates of parole violations during the first 15 months following release from detention (Jesness, 1972).

6.1.3. Communal areas with choices of semi-movable seating and ample space to regulate relationships ++

Design to reduce crowding stress requires more than providing small unit group sizes and single bedrooms with private bathrooms. The design model proposes that it is also important to have communal or shared living areas with choices of semi-movable seating (not fixed) and ample space to enable residents to regulate personal space and interactions with others (Ulrich et al., 2018). One important way persons regulate interactions is by actively adjusting and using the space immediately around them -- by moving closer to or farther away, and altering orientation relative to others (Sommer, 1969; Altman, 1975). Persons are quite sensitive with respect to maintaining appropriate interpersonal distances and respond with stress, anxiety, and often anger when others intrude into their personal space (Felipe & Sommer, 1966; Sommer, 1969; Altman, 1975; Fagan-Pryor, Haber et al., 2003).

An important research finding having much relevance for designing youth living units is that juveniles, adult inmates, and other persons with a history of aggressive or antisocial behavior require significantly greater personal space distances than those with no history of such behavior (Kinzel, 1970; Hildreth, Derogatis, & Mccusker, 1971; Walkey and Gilmour, 1984). Also, persons with an aggressive history are more reactive to personal space intrusions. This implies the importance of providing ample space in lounges and other shared rooms in SiS living facilities to support the greater personal space distances that many residents presumably need. Semi-movable and movable

Figure 4. Flexible groupings of comfortable movable and semi-movable seating in a communal room at Östra psychiatric hospital, Gothenburg. Half-wall partitions of break-resistant glass enable staff moving in the space to observe bedroom doors. The separation and architectural definition of the seating sub-areas prevent a dominant or predatory individual from dominating others in the communal area. (Source: Ulrich et al., 2018)

Figures 5 and 6. Flexible groupings of movable and semi-movable seating in communal rooms at Rågarden psychiatric hospital, a high security adult forensic facility in Sweden. Movable chairs make it easier for persons to regulate personal space and interactions with others by moving closer to them or farther away, and altering orientation. Movable in contrast to fixed chairs may reduce crowding stress and aggressive behavior in communal spaces and promote positive interpersonal interaction. (Photo: Hans Wretling, architecture: White arkitekter)

seating arrangements facilitate personal space regulation, sense of control, promote positive interpersonal interaction, and can reduce crowding stress and aggressive behavior in communal spaces (Sommer & Ross, 1958; Holahan, 1972; Holahan & Saegert, 1973; Sommer, 1969, 1974; Baldwin, 1985). (Figures 4-6.)

In comparison to communal space with movable seating and ample space to regulate relationship, a combination of fixed seating, restricted space, and lack of seating alternatives can be expected to hamper regulation of relationships, increase the frequency of personal space intrusions, thereby producing crowding stress and triggering aggressive behavior. In this regard, the placement of fixed seats facing each other at inappropriately close interpersonal distances is a problematic configuration that can increase crowding stress and trigger aggressive incidents (Figure 7).

Large immovable sofas and fixed chair groupings can have the added undesirable effect of making it easier for dominant or predatory residents to engage in territorial behavior and dominate other residents in a communal space. Studies of spatial behavior in juvenile living units for males (Sundstrom & Altman, 1972) and females (Deutsch, Esser, & Sossin, 1978) suggest that residents high in dominance are more territorial, and tend to more consistently occupy the same "more desirable" chair or area in communal space, than low dominance individuals. (Figure 8.)

Figure 7. One of several U-shaped groupings of immovable seating observed during SiS facility tours. These arrangements can force residents to sit face-to-face at inappropriately close personal distances, possibly fostering incidents. Several studies have found that persons with a history of aggressive behavior require significantly greater personal space distances than those with no history of aggressive or antisocial behavior. (Photo by R. Ulrich)

Figure 8. Three long immovable sofas arranged along the walls of a living room for female youth. Staff reported that the arrangement of sofas could make it easier for a dominant resident, by consistently occupying the center sofa, to engage in territorial behavior and dominate others in the communal space. (Photo by R. Ulrich)

The design model posits that the overall incidence of aggressive behavior or other rule violations in youth living units may be lower if semi-movable and movable seating is included in the design feature bundle to more effectively reduce crowding stress. Although fixed seating may lessen risk that specific "throwable" chairs are used in violent acts in high-risk spaces such as intake areas, controlled studies are lacking to clarify whether fixed seating reduces overall aggressive behavior in juvenile facilities or adult prisons and psychiatric hospitals. Most reports describing best practices for designing juvenile facilities recommend non-institutional furnishings including semi-movable comfortable chairs and normalized features such as art and carpeting (McMillen, 2005; Wener, 2012; Deitch et al., 2013). (See figures 4-6.)

It is should be pointed out that studies of newer generation American direct supervision adult correctional facilities have produced no evidence that semi-movable or regular chairs are used as weapons (Tartaro & Levy, 2007). To the contrary, these studies suggest that semi-movable furniture and normalized decor are associated with reductions in furniture damage, other vandalism, and aggressive behavior more generally (Nelson, 1988; Farbstein & Weiner, 1989; Wener et al., 1985, 1987; Williams et al., 1989; Senese et al., 1997; Tartaro & Levy, 2007). A well-conducted cross-sectional study of 199 locked psychiatric units in the Netherlands found that costly violence-proof design features (doors, ceilings, walls, toilets, sinks) were linked with significantly *higher* levels of ward aggressive behavior and use of isolation (van der Schaaf et al., 2013).

Information from facility tours and workshops. Staff in some facilities reported that aggressive incidents or conflicts sometimes occurred when residents sat on a long fixed sofa in front of a TV. ("The boys jab elbows in each other's ribs.") During facility tours the author observed several large U-shaped groupings of fixed sofas or chairs that forced residents to sit facing each other at inappropriately close personal distances. These furniture arrangements can be expected to hinder residents in regulating their distances and orientations with respect to others. Staff reported that aggressive incidents occurred in these U-shaped groupings of immovable furniture (Figure 7).

6.1.4. Low social density (many fewer residents than rooms in a living unit) ++

Crowding research in environmental psychology, criminal justice, and other fields has long distinguished two types of density related to building design, *spatial* and *social*. Spatial density refers to the amount of space per person in a physical environment. Social density by contrast is defined as the number of persons per room in an environment such as a juvenile living unit, adult correctional facility, apartment complex, or mental health ward. Crowding research has found that both spatial and social density can influence crowding stress, but social density consistently has greater effects on stress and aggressive behavior across varied types of residential, treatment, and detention environments (Baum & Valins, 1979; Ray & Wandersman, 1981; Ray et al., 1982; Baum & Paulus, 1987; Wener & Keys, 1988; Schaeffer et al., 1988; Roush, 1999; Evans, 2003).

The design model contends that social density is a broad indicator of the extent to which the architectural design of juvenile living units facilitates or hampers residents' ability, by *moving between different rooms*, to regulate relationships and room group size, avoid unwanted contacts, access privacy, and avoid stressors such as noise (Ulrich et al., 2018). Living unit social density is defined here as the number of residents (assuming occupancy of 100% designed capacity) divided by the total number of rooms in the unit accessible to residents – that is, the number of residents per room. Rooms included in the definition proposed here for youth living units are private and shared bedrooms, private and shared toilets and showers, lounges, living rooms, and other communal spaces such as activity rooms and kitchens. If a living unit has an outdoor space or garden, the model counts it as a communal space (or room) in calculating social density only if it contains seating and is accessible to residents without staff escort (Ulrich et al., 2018).

It is important to mention the definition does not consider corridors to be rooms and excludes these spaces in calculating the social density of living units. Corridors are regarded as movement paths with narrow dimensions that can exacerbate personal space intrusions and trigger aggressive behavior (Roush, 2002; Lanza, Kayne, Hicks, & Milner, 1993; Ulrich et al., 2018). Youth facilities with long corridors "require residents to interact with too many others," causing crowding stress (Roush, 2002, p. 4). The discussion previously described data from Swedish and American youth facilities showing that corridors in youth living units in both countries stand out as the locations

for many aggressive incidents (Vivian et al., 2007; Deitch et al., 2013; Reitan, 2017). Another drawback is that fire codes usually prevent placement of seating and other furniture in corridors of locked treatment/residential facilities. (Figure 9.)

> ***Information from facility tours and staff workshops.*** Several staff reported independently that aggressive incidents often occurred in corridors or hallways where the residents "can't avoid persons they don't like." Staff said they preferred having short corridors, not long. (Figure 9.)

Consistent with much evidence showing that social density has reliably significant effects on crowding stress and aggressive behavior, the design model proposes that youth living units designed in ways that ensure lower social densities (many fewer residents than rooms) should tend to mitigate crowding stress and lessen aggressive behavior. Even if bed occupancy reaches 100% of designed capacity, a well-designed unit with single bedrooms, private bathrooms, several communal rooms, and a garden will maintain a low social density of <0.5 resident per room, indicating the physical environment will continue to make it possible for residents to regulate relationships and avoid unwanted contacts by moving between rooms (Ulrich et al., 2018). However, residential units with multi-bed rooms, shared toilets and showers, and few communal spaces can have social densities of >1.0 resident per room when bed occupancy is high, signaling the physical environment raises obstacles to accessing privacy, regulating relationships, and avoiding stressors.

Figure 9. Most SiS living units visited by the author and other Chalmers University researchers had prominent corridors. Some unit floor plans were dominated by long corridors or hallways. Studies on correctional facilities and other types of locked treatment settings have reported that corridor-dominated floor layouts hinder observation and are linked with increased rates of aggressive behavior and rule violations (Sections 7.1 & 7.2). The design model proposed in the report does not consider corridors to be rooms, and excludes them in calculating social density. Fire codes often prevent placement of seating and other furniture in corridors of locked treatment facilities. (Photo by R. Ulrich)

A considerable body of quality research has documented negative impacts on outcomes of very high occupancy rates (exceeding 100%) in juvenile facilities, adult prisons, and other treatment/rehabilitation facilities such as psychiatric hospitals (e.g., Nacci, Teitelbaum, & Prather, 1977; Paulus, 1988; Wener & Keys, 1988; Virtanen et al., 2011). Compared to adult units, the negative consequences of excessive occupancy may be even greater in living units for juveniles and young adult offenders (Nacci et al.,

1977; Roush, 1999). "Overcrowding" in juvenile facilities -- defined as occupancy rates exceeding designed capacity -- is associated with increased incidence of resident-on-staff assaults, isolation room confinements, rule violations, higher perceived crowding stress, decreased perceived safety, and lower ratings of staff quality (Ray & Wandersman, 1981; Ray et al., 1982; Parent et al., 1994; Roush, 1999). Recall that studies by Ray and colleagues found that impacts of overcrowding in youth living units (occupancy rates above 100%) carry over into schools as worsened outcomes, for example, poorer grades and increased social disorganization in classrooms (Ray & Wandersman, 1981; Ray et al., 1982).

It should be emphasized that these and other serious negative effects of overcrowding or very high occupancy are linked primarily to increased social density, less so to higher spatial density. The findings of Ray and colleagues are consistent with those from other well-controlled studies (e.g., Baum & Valins, 1979) showing that social density plays a more powerful role than spatial density in producing crowding stress and other detrimental effects on residents (Ray et al., 1982). To paraphrase Baum & Valins' conclusion (1979, p. 148), "increased numbers of people [social density] have greater impact" than reduced space per person.

An important implication of the design model and this discussion for juvenile facility management, and for resident and staff safety, and is that rising occupancy rates are expected to markedly worsen crowding stress and aggressive behavior in poorly designed units having high social density design features such as multi-bed rooms, shared bathrooms, few communal spaces, and prominent corridors (Ulrich et al., 2018). However, escalating bed occupancy rates may be more weakly associated with increased aggressive behavior in well-designed residential units having low social density and other stress-reducing environmental characteristics.

6.2. Design features to reduce environmental stress

6.2.1. Noise reducing design +

It is somewhat surprising that research is lacking on the effects of noise on treatment outcomes in juvenile living units, given strong evidence from randomized controlled studies of non-resident volunteers showing that exposure to uncontrollable or unpredictable noise robustly increases stress and worsens aggressive behavior (Geen & O'Neal, 1969; O'Neal & McDonald, 1976; Donnerstein & Wilson, 1976; Geen, 1978; Geen & McCown, 1984). For example, participants presented with an anger-provoking situation in a laboratory deliver more frequent and intense electric shocks to others in the room if they are exposed to unpredictable noise (Donnerstein & Wilson, 1976). These studies show that noise is a stressor that both triggers aggression and worsens retaliatory aggression.

Although there is a shortage of noise studies on youth living units, there is much evidence that noise in other treatment/rehabilitation settings is a pervasive environmental stressor that worsens treatment outcomes and negatively impacts staff. In environments such as general hospitals, noise-reducing design features lower

psychological and physiological stress in patients, increase satisfaction, and improve other medical outcomes (Hagerman et al., 2005; Ulrich et al., 2008). Regarding medical workers, design to reduce noise lessens stress and perceived work demands, increases speech intelligibility, and improves communication quality with patients and work colleagues (Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005; Topf & Dillon, 1988; Ryherd, Okcu, Ackerman, Zimring, & Waye, 2012).

An earlier section (6.1.1) mentioned there is a significant relationship between loss of sleep (low quantity and quality) and increased aggressive behavior, hostility, and impulsivity among youth in detention facilities (Ireland & Culpin, 2006). This finding underscores the importance of implementing noise reducing design features in SiS living units to minimize sleep disruptions caused by noise.

Design measures found effective for reducing noise and enhancing acoustic privacy in other treatment facilities include, among others, providing single-bed rooms with walls and doors that block noise, sound-absorbing ceiling panels and other environmental surfaces that diminish echoing and propagation of noise, and insulating noise sources or using partitions to buffer them (MacLeod, Dunn, Busch-Vishniac, West, 2007; Ulrich et al., 2008).

> ***Author observation from facility tours about noise.*** *The* author has research experience concerning negative impacts of noise and poor acoustics in hospitals and work environments. During tours of SiS youth facilities, it was evident that many living units had corridors/hallways, living rooms, and activity spaces with poor acoustics stemming in part from lack of sound-absorbing environmental surfaces. Some corridors had hard sound-reflecting ceiling surfaces such as concrete that produced echoing and propagated noise throughout the spaces. (Figure 9.) By contrast, classrooms in SiS youth facilities consistently had sound-absorbing surfaces and good acoustics. In the author's opinion, there is need for improvement with respect to design measures for reducing noise in SiS living units. For example, installation of sound-absorbing panels or surfaces could be done at reasonable cost in old as well as new facilities.

6.2.2. Design to foster control in resident rooms +

Evidence-based design theory holds that one important way design can reduce stress is by fostering sense of control over physical surroundings (Ulrich, 1991; Andrade & Devlin, 2015). Exposure to environmental conditions not under personal control can be stressful; for example, television played uncontrollably in a healthcare waiting room can worsen patient stress (Ulrich, Simons, & Miles, 2003). Although some of the design features discussed previously enhance control (noise reduction, single rooms for privacy), the focus here is on design elements within resident rooms (Ulrich, 1991; Ulrich et al., 2018). The design model proposes that design features that enable

residents to control or personalize their rooms will support stress coping and help diminish aggressive behavior.

Examples of features presumed to enhance control in resident bedrooms and thereby reduce stress include controllable lighting and ventilation, and personalization opportunities such as pictures (Ulrich, 1991; Ulrich et al., 2018; Wener & Farbstein, 1993; Andrade & Devlin, 2015). Recent qualitative research on Swedish adolescent male offenders suggested that "disempowerment" or lack of control is a prevalent perception and stressor with respect to the physical environment of compulsory care facilities (James & Olausson, 2018). The Swedish youth identified several design characteristics of their bedrooms as intensifying their sense of "being disempowered." Examples included locked windows, window bars, and immovable lamps and beds (James and Olausson, 2018). It is notable that a study of psychiatric wards in the Netherlands found that control-related design features in patient rooms were associated with significantly reduced use of isolation room confinements (van der Schaaf et al., 2013). However, other research on hospital patient rooms raises the possibility that control features, if complicated and difficult to operate, may erode control and not reduce stress (for example, a complicated remote control for temperature and lighting) (Andrade & Devlin, 2015).

Design features to enable control are provided in the cells for adult inmates in newer generation direct-supervision prisons in the U.S. and elsewhere. These features, which often enable control of lighting, heating, and air-conditioning in cells, are implemented as part of a combination of other architectural and operational changes that have been linked with reduced stress, assaults, and vandalism (Nelson & O'Toole, 1983; Wener & Farbstein, 1993; Wener, 1996).

6.3. Design features to reduce stress through positive distraction

6.3.1. Nature space or garden accessible to residents ++

The design model proposes that providing a nature space or garden accessible to residents can reduce stress by providing nature views, a pleasant place to seek privacy or socialize, and fostering sense of control (Ulrich, 1999; Ulrich et al., 2008; Marcus & Sachs, 2014). Importantly, several controlled studies have found that simply viewing nature (trees, plants, or water) for a few minutes -- but not most built environments lacking nature -- can produce rapid and significant psychological and physiological reduction of stress (Brown, Barton, & Gladwell, 2013; Zijlstra, Hagedoorn, Krijnen, Van der Schans, & Moback, 2017; Ulrich, 1979; Ulrich et al., 1991; Hartig, Evans, Jamner, Davis & Gärling, 2003; Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998). Physiological restoration from stress is evident, for example, in reduced blood pressure, sympathetic nervous system activity, and diminished levels of cortisol, a stress hormone. These and other beneficial physiological changes are accompanied by reduced levels of psychological stress symptoms, including anger, anxiety, sadness, and fatigue (Ulrich et al., 1991). Although a window view of nature

can reduce stress (see section 6.3.2), physical access to a nature space or garden appears more effective in fostering restoration (Largo-Wight et al., 2011; Lottrup, Grahn & Stigsdotter, 2013).

A strong controlled study by Cordoza and colleagues found that nurses working in hospital intensive care units had significantly reduced work-related stress and burnout scores when they had a daily work break for six weeks in a garden in contrast to indoor staff break rooms (Cordoza et al., 2018). The researchers also reported that taking only a single garden break (average 24 minutes) was more effective than one indoor break of similar duration in reducing immediate stress-related feelings such as anger and tiredness. Other studies in hospitals and workplaces have similarly found that patients, medical staff, and office employees using gardens report reduced stress and improved emotional well-being (Marcus & Barnes, 1995; Whitehouse et al., 2001; Sherman et al., 2005). Walking in nature areas, compared to built environments lacking nature, is more effective in reducing stress and improving mood for persons with negative emotional states or mental health problems (Roe & Aspinall, 2011; Berman et al., 2012).

Studies strongly suggest that gardens designed in informal natural styles with prominent vegetation are more effective in reducing stress than structured or geometric gardens with prominent concrete or other hardscape (Shukor, 2012; Marcus and Sachs, 2014; Twedt, Rainey, & Proffitt, 2016). However, locked and inaccessible nature spaces or gardens in secure treatment facilities can decrease sense of control in residents and thus may worsen their stress (Ulrich et al., 2018; van der Schaaf et al., 2013).

Figure 10. A nature space easily accessible by residents and staff from a communal room in a single-story SiS living unit for adolescent males. The space contains lightweight movable seating. The design of the security fence appears less penal and institutional than a galvanized metal fence topped with razor wire. (Photo by R. Ulrich)

Research on gardens and outdoor smoking spaces in psychiatric hospitals and adult correctional facilities supports the advisability of building single-story facilities (two stories at most) rather than multi-story buildings (Ulrich et al., 2018). Single-story buildings can enable residents of youth facilities to access a secure outdoor space without time-consuming escort by staff through stairways or hallways. (Figure 10.) Living units can be designed that enable staff to maintain good observation of the outdoor space and resident users from interior areas of the living unit. Wener et al. (1986) reported

problems of deprivation of nature contact and monotony in U.S. high-rise adult jails lacking ground-level outdoor spaces. Providing one large rooftop outdoor space has proved to be inadequate for multi-story adult prisons (Wener et al., 1986).

Figure 11. A nature space accessible by residents and staff from a communal room in a SiS living unit for adult women. The fence is deliberately designed to appear non-institutional rather than stark and punitive. (Photo by R. Ulrich)

Figure 12. Portion of a ward courtyard garden in Östra adult psychiatric hospital, Gothenburg. An unlocked door in the communal area of each ward opens onto a secure courtyard garden with prominent nature including flowers. Patients can enter the garden without the need for time-consuming staff escort. Staff can observe the garden and patients from the ward interior. (Source: Ulrich et al., 2018. Photo by R. Ulrich)

The design of certain secure Swedish psychiatric facilities well illustrates how single-story architecture can solve the problems of resident access, staff observation, and work difficulties associated with outdoor spaces in multi-story treatment/living facilities. Each ward in Östra psychiatric hospital has an unlocked door that opens directly to a secure courtyard garden with seating choices and abundant vegetation (Figure 12). Patients can easily access the garden without staff escort, and staff can observe the garden and patients from the ward interior. Clinical staff reported that patients heavily use the ward gardens at Östra in all seasons (Ulrich et al., 2018). As another example, Rågården forensic hospital (located near Gothenburg) is among the highest security psychiatric facilities in Scandinavia, yet the single-story design enables each patient unit/ward to have ground level access to a pleasant yet secure courtyard garden having a separate smoking area. Patients can enter the garden through a door (unlocked during daytime) from a communal area in the living unit/ward. Staff escort is not required, and staff from within the ward can observe patients in the garden.

Information from facility tours and staff workshops. Staff reported that smoking must occur outdoors in SiS facilities and that supervision of resident smoking was difficult and time-consuming, especially in multi-story facilities. Several suggested that living units should be designed with a calming outdoor space, ideally separated from a smoking area. Other staff reported work difficulties and inefficiencies associated with the need to provide time-consuming escort of residents who smoke to a ground-level space (up to eight times per day) from living units located on the second and third floors of a facility (formerly an adult prison). Maintaining observation required staff to be with residents who were smoking in the outdoor space, interrupting the continuity of staffing in residential unit interiors.

6.3.2. Nature window views +

Window views displaying nature and depth are consistently preferred over window views of built, low-depth, or visually impoverished environments (Markus, 1967; Verderber, 1986). The previous section cited several strong studies showing that simply viewing nature for a few minutes reduces physiological stress and diminishes anger, anxiety, and other negative emotions (e.g., Ulrich, 1979; Ulrich et al., 1991; Kweon et al., 2008; Joye, 2007; Gladwell et al., 2012).

Although even brief views of nature can foster stress recovery, the potential benefits of window views of trees, grass, and other nature can be greatest -- and extend to influences on treatment and health-related outcomes -- when persons experience considerable stress and are required to spend long periods in a confined setting (Ulrich, 1979). Such situations include confined treatment facilities, prisons, hospitals, and certain high-stress work environments. Moore (1982) examined the need for healthcare services by adult prison inmates whose cells looked out onto the prison yard and those who had a view of nearby forests and farmlands. He reported that inmates with the natural window view had a lower rate of illness complaints and use of healthcare services. Ulrich (1984) found that hospital patients recovering from abdominal surgery had better emotional well-being, endured fewer stress-related minor complications such as persistent headache, required far fewer narcotic pain drugs, and had shorter hospital stays, and if they had bedside windows with a nature view (trees) than if their windows overlooked a brick wall. Raanaas and colleagues (2011) studied patients in a Norwegian residential rehabilitation center and reported that those with panoramic views to natural surroundings, in contrast to partially blocked or blocked window views of nature, reported greater improvement in mental health during their stays. Other research on nurses in general hospitals and office workers suggests that those having daily exposure to a nature window view in their work areas report lower work-related stress and higher satisfaction than employees having a built environment view or no window (Leather, Pyrgas, Beale, & Lawrence, 1998; Pati, Harvey, & Barach, 2008; Lottrup, Stigsdotter, Meilby, & Claudi, 2015).

6.3.3. Nature art, not abstract art +

A growing body of evidence suggests that representational nature art should be considered for stressed individuals in confined and/or locked environments, while abstract artwork and emotionally negative pictures should be displayed with caution. Studies of art preferences of the general public, of persons working in confined and isolated environments, and stressed hospital patients have consistently found that the great majority of persons across diverse cultures prefer realistic nature art but most dislike images that are abstract, surreal, ambiguous, or display emotionally negative subject matter (Kettlewell, 1988; Carpman & Grant, 1993; Ulrich & Gilpin, 2003; Nanda, Eisen, & Baladandayuthapani, 2008).

Figure 13. On the basis of research showing that realistic nature pictures can help calm acutely stressed persons, nature scenes often are installed in windowless procedure rooms in hospitals and medical clinics to reduce patient stress. Figure 13 shows an "evidence-based" ceiling-mounted nature scene intended to calm patients as they awaken from anesthesia following surgery in a general hospital in San Francisco. (Photo by R. Ulrich)

Findings suggest that looking at nature art or pictures for only a few minutes can produce significant reduction of stress, even for persons experiencing acute stress. (Figure 13). Heerwagen (1990) found that stress in a hospital dental clinic (for persons fearful of dental treatment) was appreciably lower on days when a large nature mural was hung on the wall of the waiting room, in contrast with days when the wall was blank. A study focusing on stressed blood donors found that participants had lower pulse rates and blood pressure when a television in the waiting room displayed a nature video, compared with when the television displayed either a videotape of urban areas and buildings or daytime television programs (Ulrich, Simons, & Miles, 2003). Clearwater and Coss (1991) studied scientists in Antarctica who worked for one year in confined and isolated research stations. The researchers found that nature landscape pictures, particularly those with high depth of field, were more effective that other types of art subject matter or picture content in fostering relaxation and sustaining liking and interest throughout the year of confined work. Spatially open nature landscapes proved superior to pictures depicting, for example, wild animals or humans in action (Clearwater & Coss, 1991). In a second study Clearwater and Coss (1991) displayed a collection of ninety-five pictures of sixteenth-to-twentieth century paintings to volunteers confined in a realistic mock-up of the International Space Station at a NASA facility. Similar to the findings of the first study, persons confined in

the space station environment responded most positively to natural landscapes with high depth of field.

It will be recalled that a key premise of the design model is that stress triggers and worsens anger reactions. It follows from this that nature pictures which reduce stress also can be expected to foster reduced anger and aggressive behavior. A randomized controlled study of 210 volunteers produced strong evidence that stress triggers and fosters anger reactions, and that nature pictures can lessen anger by lessening stress (Kweon, Ulrich, Walker, & Tassinary, 2008). Participants in the study performed anger-provoking computer tasks while assigned to different office conditions having either nature pictures, abstract pictures, a mix of abstract and nature pictures, or no pictures hanging on the walls. Mediation analysis indicated that increased proportions of nature posters diminished anger in male participants by reducing stress levels. (Figure 14.) Both stress and anger among males were highest when no pictures were present (Kweon et al., 2008). Nature pictures significantly reduced stress in female participants but not anger. (Females in the study were lower in trait or dispositional anger than males.)

Figure 14. One of the nature pictures on an office wall that reduced both stress and anger in male participants (aged 18-24) when they performed anger-provoking tasks (Kweon et al., 2008). Nature pictures reduced stress in females but not anger. The picture is a copy of "A River through the Woods" by Zacho. (Photo by R. Ulrich)

Figure 15. An interior sunroom in a SiS juvenile residential unit. At the initiative of staff, the calming nature mural was installed and carpets provided to lessen noise. The room partition has sound-absorbing surfaces and divides the limited space into sub-areas with movable seating that facilitate regulation of relationships. The separation of sub-areas makes it more difficult for a dominant individual to dominate other residents in the space. There are observation windows on the left (visible) and right-hand wall (not visible). The entry door enables further observation. (Photo by R. Ulrich)

A well-controlled investigation of psychiatric patients in a locked ward found that placing a realistic nature poster in a dayroom was significantly more effective in reducing injections for aggressive behavior than abstract art or a control condition of no art (Nanda, Eisen, Zadeh, & Owen, 2011). A retrospective study of patient responses to pictures was carried out in a Swedish psychiatric ward extensively furnished with wall-mounted paintings and prints (Ulrich, 1991, 2009). Patients reported having positive feelings and associations with respect to nature pictures. (Figure 16.) By contrast, several individuals expressed negative emotional reactions to abstract artworks in which the content was ambiguous and could be interpreted in multiple ways. Moreover, archival data showed that several patients had physically attacked seven of the abstract paintings and prints, but none of the nature artworks (Ulrich, 1991, 2009). (Figures 17-18.)

Figure 16 (left). Example of nature artwork in a Swedish psychiatric hospital that elicited positive feelings and associations in adult patients (Ulrich, 1991).

Figures 17 and 18 (below). Examples of abstract artworks in a Swedish psychiatric hospital that were physically attacked by adult patients considered not prone to aggressive behavior or violence (Ulrich, 1991).

Research in neuroscience and visual perception has provided additional support for the recommendation that nature art should be provided for confined living units, while many abstract artworks and scenes lacking nature should be avoided (Ulrich et al., 2018). This research is consistent with the idea that the human visual system evolved to efficiently process natural scenes and images of human faces, and that images with

"unnatural" characteristics can be taxing and physiologically stressful to the visual system and brain (Fernandez & Wilkins, 2008). Many abstract artworks and scenes of built environments elicit dislike or aversive reactions in part because they display high contrast elements (or contrasting elements with unnatural spacing and patterning) to which the visual system is negatively sensitive (Fernandez & Wilkins, 2008; Párraga, Troscianko, & Tolhurst, 2000).

Although the great majority of nature images are liked and can reduce stress, researchers in psychology and psychiatry have identified a small number of specific nature features that humans across different cultures respond to with stress, fear, and avoidance. These natural elements and situations have signaled threats or dangers throughout millions of years of evolution; this long history has left its mark on modern humans as a partly innate or genetic proneness to respond with stress and fear (Öhman, 1986; Ulrich, 1993; Coss, 2003). Examples of negative stimuli include snakes and spiders, reptilian-like scale patterns, nearby large animals staring directly at the viewer, pointed or piercing forms, shadowy enclosed spaces, and angry or fearful human faces (Öhman, 1968; Coss, 2003; Ulrich, 1993). Evidence suggesting that fear and defense responses to these features have a partly genetic underpinning underscores the importance of excluding art or pictures containing such phenomena from shared spaces in youth treatment/detention facilities (Ulrich & Gilpin, 2003).

A conclusion supported by research in this section is that providing visual artwork or pictures in confined youth residential units is no mere luxury or unimportant embellishment. To the contrary, findings increasingly support the notion that the evidence-informed selection of emotionally appropriate art for communal spaces and therapy rooms in juvenile living units may contribute an important design dimension that can lessen resident stress and possibly reduce aggressive behavior.

6.3.4. Daylight exposure +

Reports describing best practices for juvenile facilities have recommended design to foster exposure to daylight (McMillen, 2005; Deitch et al., 2013). Similarly, best practices for designing psychiatric facilities traditionally have endorsed architectural measures such as large windows and atriums that increase daylight indoors (Karlin & Zeiss, 2006; Connellan et al., 2013; Shepley & Pasha, 2013). Regarding psychiatric patients and daylight, two empirical studies have reported that assigning psychiatric patients with serious depression to rooms with higher daylight can reduce depression and shorten stays compared to placing similar patients in rooms that receive less light or are always in shade (Beauchemin & Hays, 1996; Benedetti, Colombo, Barbini, Campori, & Smeraldi, 2001). Research on Alzheimer's patients suggests that levels of agitation and aggressive behavior may be lower in facilities having higher interior light exposure compared to buildings with less light (Sloane, Mitchell, Preisser, Phillips, Commander, & Burker, 1998). Regarding staff, hospital nurses with higher access to daylight in work areas, compared to those working in spaces far from windows, report less work stress, better health status, and higher satisfaction (Alimoglu & Donmez, 2005; Mroczek, Mikitarian, Vieira, & Rotrius, 2005). Providing windows to ensure

daylight exposure to office workers is among a combination of design factors (such as reduced noise) linked to lower levels of physiological stress (Thayer et al., 2010).

It appears that no well-controlled empirical study has yet investigated whether daylight levels influence stress, aggressive behavior, and treatment outcomes of juveniles in living units. Building codes and regulations rightly require that architects provide daylight in youth facilities; however, credible research support for providing daylight exposure to improve outcomes currently is not as strong as the evidence favoring, for example, nature or garden exposure.

7. Conceptual model for designing youth living units: part two

An earlier section (5.) described an evidence-informed conceptual model for designing SiS youth living units to foster improved treatment and rehabilitation outcomes. In addition to proposing that facilities should be designed with several stress-reducing features (as discussed in previous sections), a second proposition of the model holds that living units should be designed to enable good staff observation and support a direct supervision treatment model (section 5.1.2). Achieving a good fit between facility design and the supervision/treatment model is a key requirement for effective youth living units.

SiS youth facilities use a direct supervision/observation model that strongly encourages staff to be outside their offices and directly involved with residents, often interacting with them on an individualized basis. (Section 4.) An important aspect of the supervision model is that personnel are trained to be proactive. Through direct interaction with residents (not through glass or behind partitions), staff can get to know residents and proactively respond to problems before they escalate into aggressive behavior or other rule violations. The design model contends that designing SiS living units for good observation will support staff capability to communicate effectively with residents and anticipate aggressive behavior or other troubles at an earlier stage (Jenkins et al., 2015; Ulrich et al., 2018). Additionally, design features for good observation may enable both residents and staff to feel more secure and less stressed (Ulrich et al., 2018). (Figures 4, 19-20.)

7.1. Design that supports good observation and direct supervision of residents ++

Design to facilitate staff observation is recommended by qualified professionals as best practice for juvenile facilities (Roush & McMillen, 2000), psychiatric wards (Shepley & Pasha, 2013), and adult prisons (e.g., Nelson & O'Toole, 1983; Wener, 2012). Regarding youth facilities, Roush & McMillen have written: "Housing and activity spaces should be arranged in a way that promotes a high degree of visibility for staff within and outside those areas. Juveniles should not be able to conceal themselves in corners or rooms that are not directly supervised" (2000, p. 12). They recommend

providing windows or walls of damage-resistant glazing between communal spaces to facilitate observation in living units (Roush & McMillen, 2000). (Figures 4, 19-20.)

Figure 19. Observation window between two communal rooms in a SiS facility for adult males. The break-resistant glass blocks noise travel between the spaces. The window enables staff in one room to observe a large portion of the other, but might permit residents to conceal themselves in room corners. (Photo by R. Ulrich)

Although design for good observation/visibility is recommended by qualified professionals as best practice, it appears that no quality research on juvenile facilities has examined the link between specific design features and measurements of observation quality. Studies are also lacking for youth units on the possible association between well-defined design approaches for achieving observation and outcomes such as aggressive behavior. In contrast to the shortage of research on juvenile facilities, studies on psychiatric wards (Ulrich et al., 2018; van der Schaaf, et al., 2013; Jenkins et al., 2015) and adult correctional units have convincingly shown that design for good observation is associated with reductions in assaults, use of isolation, fewer rule violations, and increased perceived security (Nelson, 1983b; Nelson & O'Toole, 1983; Senese, 1997; Wener et al., 1987; Wener, 2012). An important finding from studies of correctional facilities is that floor layouts with long corridors seriously hamper staff observation and are linked with significantly higher rates of aggressive behavior and rule violations. (Figure 21.)

Studies on observation and outcomes in psychiatric wards have compared visibility in different facilities using ratings such as "clear lines of sight" and "all areas of the unit visible from a central area" (Jenkins et al., 2015; Ulrich et al., 2018). One study that examined the influences of design on aggressive behavior in three Swedish psychiatric hospitals identified Östra hospital in Gothenburg as having wards with a combination of good observation and several stress-reducing design features such as single rooms, movable seating, and a garden (Ulrich et al., 2012, 2018). It is important to point out that Östra hospital and other Swedish psychiatric facilities use a direct supervision treatment model that is similar to the SiS model in calling for staff to be outside offices observing and communicating directly (not through glass) with residents.

Figure 20. A game room in a SiS youth living unit. Several window-like wall openings enable staff to observe the game room from the adjacent living room, and vice-versa. However, the unglazed observation openings enable noise to propagate throughout both large rooms. (Photo by R. Ulrich)

Figure 21. Portion of a ward in an older Swedish psychiatric hospital showing a corridor-dominated floor layout that obstructs staff visibility of seating areas and activity rooms accessed from the corridor, but enables observation of bedroom doors and doors of shared toilets and showers in the corridor. (Source: Ulrich et al., 2018)

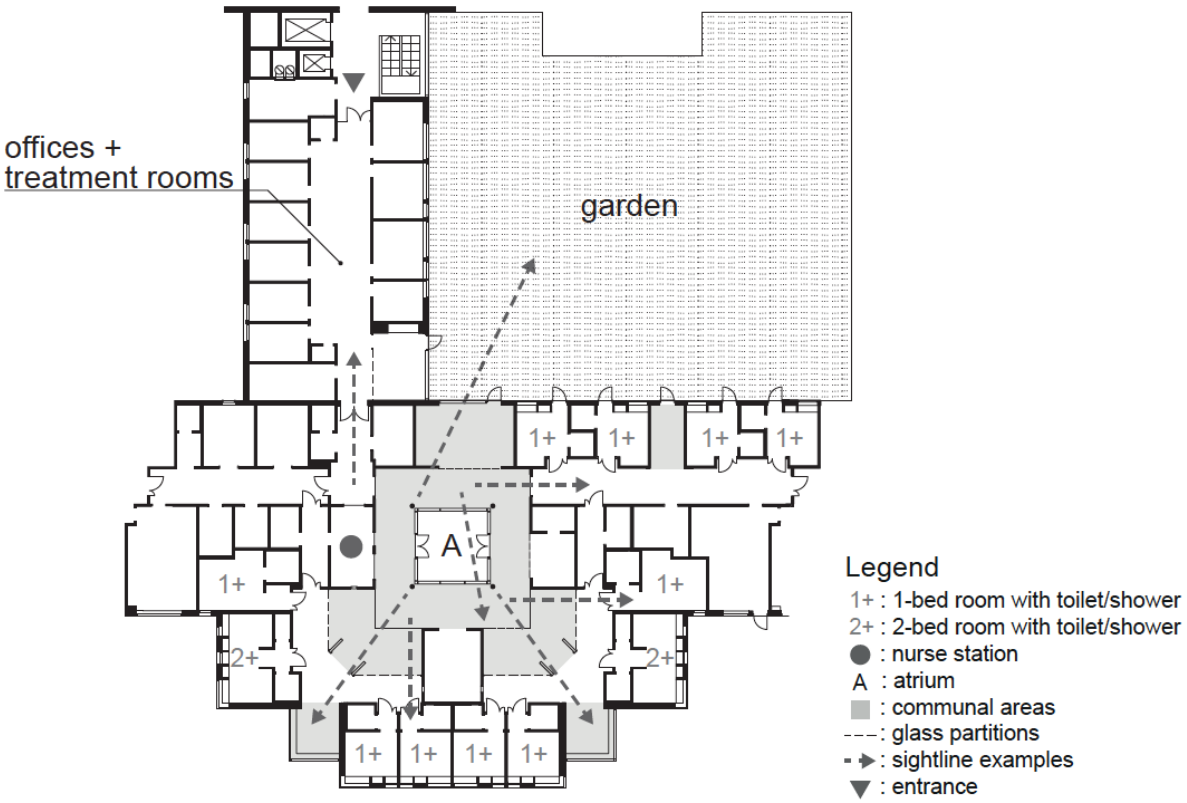

Figure 22. One ward in Östra psychiatric hospital in Gothenburg. The floor layout arranges most patient rooms around a central communal area having an atrium to increase daylight. Staff moving within the central area can observe all communal spaces and bedroom doors. (See arrows showing sightline examples from different points in the central area.). Observation is facilitated by half-wall partitions of break-resistant glass and the transparency of walls enclosing the atrium. An unlocked door in the central area opens directly onto a secure courtyard garden (Figure 12). (Source: Ulrich et al., 2018.)

Data on two clinical markers of aggressive behavior, compulsory injections and physical restraints, was compiled for Östra and compared with data from two other hospitals that had poor observation characteristics and lacked stress reducing design features (Ulrich et al., 2012, 2018). The two comparison hospitals had corridor-dominated floor plans that blocked observation of communal areas. Despite wide differences in observation quality and other design features, the three hospitals were similar with respect to the types of patients and acuity levels, treatment protocols, staffing ratios, bed occupancy rates, and ward patient group sizes. The data showed that the proportion of patients requiring compulsory injections was significantly lower in Östra compared to the older hospital it replaced. By contrast, the proportion of patients given compulsory injections increased in another comparison or control hospital that did not undergo architectural change during the same period of the study. Regarding physical restraints, the average number decreased by 50% in Östra compared to the old hospital it replaced (Ulrich et al., 2018). The findings strongly suggest that aggressive behavior was reduced in the newer hospital having good observation and several stress reducing design features (Östra) but not in the old and control hospitals with wards having poor observation and a lack of stress reducing features. (Figure 21.)

In the author's opinion, Rågården forensic psychiatric hospital (a high security facility outside Göteborg) has wards designed to facilitate effective and comprehensive observation over shared spaces, yet the visibility is not intrusive or intimidating for patients. Rågården wards have large communal areas with radiating short corridors containing a total of nine single-bed rooms. The floor plan and clear sight lines enable staff moving about in the communal areas to view bedroom doors and corridors while maintaining observation over the shared spaces. The floor layout appears well suited to support the direct supervision treatment model, which requires staff to be outside offices in the communal spaces observing patients and communicating with them on an individual basis.

7.2. Research on observation, direct supervision, and outcomes in U.S. federal correctional facilities

The largest body of quality research on design to support good observation and direct supervision has been done on adult correctional facilities in the U.S. federal system. One reason these studies are noteworthy is because most examine the effects of a combination of changes in observation characteristics and supervision models on varied outcomes -- from assaults and vandalism to staff safety and work satisfaction. Several of the studies are relevant to this section of the report because they evaluate the influences of different floor plans and architectural layouts on observation quality and supervision effectiveness. Although the studies provide revealing insights concerning the influences of different observation characteristics, it should be kept in mind there are differences between U.S. federal correctional facilities for adults and SiS treatment facilities. One obvious difference is that inmates in adult facilities are older than residents in juvenile units. Another is that the group size of an adult prison unit in the U.S. federal system is approximately 40-45 persons. By contrast, the group

size for SiS living units is about 7-9 youths. Apart from differences, there are similarities as well between juvenile units and U.S. federal correctional facilities. One is that aggressive behavior is a prevalent problem in both types of facilities.

The research literature on U.S. federal prison design is sizable, running to scores of empirically based articles, reports, and books. A comprehensive review of the studies and findings is beyond the scope of this report. Several reports have examined the influences on outcomes of different generations or types of federal adult prisons. The discussion that follows describes the architectural characteristics and supervision models for three major facility generations or types, and summarizes findings concerning the impacts on outcomes. It will be apparent that the first and second generations of U.S. facilities are widely different than SiS youth living units with respect to architecture and the supervision/rehabilitation models. Nonetheless, it is relevant to describe them because the effects of these facility types on outcomes are exceptionally well documented, and provide valuable insights concerning the link between design for observation and the effectiveness of different supervision models. The newer third generation of adult correctional facilities uses a direct supervision model with clear similarities to that used in SiS juvenile living units. Staff in third generation U.S. facilities is located outside workstations where they directly observe, supervise, and interact on an individualized basis with inmates

Numerous researchers have contributed to the body of knowledge on U.S. federal correctional facilities. Much of the discussion below draws on reports and studies by W. R. Nelson and colleagues (Nelson, 1983a; Nelson, 1983b; Nelson, 1988; Nelson & O'Toole, 1983) and R. Wener and colleagues (Wener & Olson, 1980; Wener et al., 1987; Wener & Keys, 1988; Farbstein & Wener, 1989; Wener 2006, 2012).

7.2.1. First-generation U.S. federal correctional facilities with remote observation and corridor-dominated layouts

These older correctional facilities (also called linear jails with remote surveillance) had two-bed cells arranged along lengthy corridors with no interior activity spaces. The main objectives of confinement were punishment and keeping society safe, not rehabilitation. There were few staff in relation to inmates, and they were separated from inmates in fortress-like observation stations located at corridor intersections. Staff interaction with inmates was minimal and physically separated by cell bars or glass. Observation was intermittent and poor. Staff/officers could observe down the corridors but not into cells. Surveillance of cells required officers to leave their fortresses periodically and walk down long corridors. Cells provided inmates with no visual or auditory privacy with respect to other inmates; noise levels were high.

Outcomes in first-generation prisons were unacceptably bad. Despite being very costly to build and maintain per square meter, these environments were unsafe for prisoners and officers, having high levels of inmate-inmate assaults, and inmate-staff assaults. The corridor-dominated layouts and poor observation fostered gang and criminal behavior. Levels of vandalism and graffiti were high. Inmates had very high rates of parole violations and re-conviction (recidivism) following release.

7.2.2. Second-generation U.S. federal correctional facilities with indirect supervision

Many facilities of this type (also called podular facilities with indirect supervision) were built starting in the 1960s, and most remain in service. They represent an attempt to remedy through architectural changes major problems associated with first generation jails, such as poor observation and high violence levels. The purpose of confinement in these facilities is expanded beyond punishment and keeping society safe to include rehabilitation.

In a radical departure from earlier generation facility design, *corridors are eliminated in inmate units to improve observation and safety,* and cells are arranged around a rectangular or triangular pod with a communal or activity space at the center (see Wener, 2012). Staff is located behind break-resistant glass in observation rooms adjacent to the communal area, enabling good observation of the communal space and cell doors. Cells provide some visual privacy and have exterior windows for daylight. Compared to first-generation facilities, the ratio of staff to inmates is somewhat higher.

However, staff in second-generation U.S. federal facilities still have minimal direct or personal contact with inmates. Staff is separated from inmates by thick glass and communicates with them by intercom or public address system. The indirect staff supervision model is reactive rather than proactive. In other words, the supervision model (and staff training) focus mainly on reacting to inmate problems rather than anticipating and preventing them. Costly vandal-resistant building systems and furnishings are used throughout. "Cells are equipped with vandal-proof cast aluminum toilets and bowls, steel or concrete beds, and security doors and hardware" (Nelson, 1983, p. 38).

Outcomes in second-generation prisons are improved compared to first-generation facilities, but remain unsatisfactory. Staff safety is better, and violence among inmates reduced. However, vandalism remains prevalent and rates of parole violations and recidivism following release are high. The facilities are very costly to build per square meter due to the extensive use of security systems and technology, and vandal-resistant building systems and furnishings.

7.2.3. Third-generation U.S. federal correctional facilities with direct supervision and observation

Many facilities of this type have been built since the late 1970s. The purposes of confinement in these units are rehabilitation and protection of society, not punishment. Similar to second-generation facilities, inmate *units have no corridors in order to provide clear sightlines for staff.* Another similarity is that cells (single-bed with toilet) are arranged around the periphery of a rectangular or triangular pod having a large communal space at the center. In sharp contrast to second-generation facilities, third-generation units have multiple large dayrooms and activity spaces. Inmates can roam freely within the shared living areas, except at night. Inmates can turn lights on and off in cells, and often can control ventilation. Cell doors provide visual and acoustic privacy. In a major change from previous generations of facilities, furnishings and

interior design are normalized, colors are non-institutional, and regular fixtures (in contrast to costly vandal resistant) are installed. Comfortable regular or commercial grade furniture is provided.

Compared to first and second generation facilities, by far the most important change is that third-generation units are designed to support a direct supervision rehabilitation model. Unlike first and second generation prisons, there are no staff fortresses or glassed-in observation stations. Staff receives more training and is required to be outside offices moving within the communal and activity spaces, observing and communicating directly (not through glass) with inmates. Sightlines for staff moving within the shared spaces are superior to those from the glassed-in observation stations in first and second generation facilities (Tartaro & Levy, 2007). Similar to SiS facilities, the U.S. federal prison direct supervision/observation model is deliberately proactive, not reactive. Staff is trained to prevent negative behavior before it occurs. "Officers in constant and direct contact with inmates get to know them and can recognize and respond to trouble before it escalates into violence" (Wener et al., 1987, p. 2).

Several studies have found that outcomes in third-generation facilities are significantly better than those in second-generation units, and far superior to outcomes in first-generation corridor-based facilities with poor observation. Nelson & O'Toole (1983) reported that six older generation remote supervision jails with long corridors had assault rates that were 15 times higher on average during a two-year period than in a sample of five third-generation direct supervision facilities. Other U.S. studies have found that direct supervision correctional facilities reduce the incidence of assaults by more than 50% compared to second-generation units with indirect supervision. In addition to steep drops in aggressive behavior and rule violations, third-generation direct supervision prisons with no corridors have fewer escapes and far less vandalism and graffiti. Inmates and staff report feeling safer, and staff is more satisfied with their jobs. Limited evidence suggests that newer generation direct supervision facilities reduce recidivism or re-arrest following release. Another notable finding is that third-generation DS facilities have lower construction costs per square meter than first and second-generation prisons (Nelson, 1988).

7.3. Implications of research on U.S. federal correctional facilities for designing juvenile units

To briefly summarize, several quality studies on U.S. adult facilities support the conclusion that direct supervision and observation models are associated with substantially better outcomes than indirect (remote) supervision models. (As previously noted, SiS youth units use a direct supervision model.) The U.S. studies reinforce the conclusion that designing units to facilitate good observation is integral to achieving effectiveness with a direct supervision treatment model. The research powerfully underscores the importance of design that enables good observation by staff moving within communal or activity spaces, while maintaining surveillance of cell or bedroom doors.

The studies have consistently reported that floor layouts with long corridors seriously hinder staff observation, and are linked with higher rates of aggressive behavior and rule violations. As a result of this evidence newer generation U.S. federal correctional facilities are *designed with no corridors* in inmate areas. Floor layouts in these units arrange single-bed cells or bedrooms around large central shared areas. These central area layouts are effective in creating good sightlines for staff moving within the unit, and supporting staff supervision of residents requiring direct and frequent communication outside offices.

A variant of a central area design is to have short corridors with bedrooms radiating from large communal spaces. (Figure 21 shows an example of a Swedish psychiatric facility with short corridors radiating from central areas.) This type of floor layout (with short corridors) may be more suitable for units having smaller resident or patient group sizes such as youth living units (7-9 persons) and psychiatric wards (about 12-16 persons). By contrast, the group size in U.S. adult direct supervision prison units is larger, roughly 40-45 persons. The U.S. studies suggest that residents/inmates are receptive to, and feel safer, being under close but unobtrusive observation in shared spaces as long as they can access privacy in their bedrooms or cells.

8. Best practice design recommendations not supported by research evidence

The design recommendations discussed in previous sections -- and included in the design model (Figure 1) -- were supported by research evidence, in some cases by strong evidence from multiple studies. The design suggestions and features identified in this section are not yet directly supported by research. Most of the recommendations are based on the experience and knowledge of well-qualified professionals in areas such as juvenile justice and architectural practice, making it plausible that the design feature will influence outcomes.

8.1. Single-level facilities, not multi-level ●

Roush and McMillen (2000) make several arguments favoring single-level over multi-level juvenile facilities. They contend that single-level facilities can "permit easier access to and better supervision of sleeping rooms," while multi-level facilities "pose significant operational challenges" including "potential difficulties with vertical circulation, resident access, emergency egress, room supervision, compliance with accessibility requirements [for persons with movement difficulties], and the potential for behavior problems" (Roush & McMillen, 200, pp. 13-14). Other authors have identified problems with multi-level buildings such as blind spots and concealment opportunities associated with stairwells.

An earlier section described research on psychiatric hospitals and correctional facilities that supports building single-level rather than multi-level facilities to facilitate access to a garden or nature space and outdoor smoking area. (Figures 10-12.) As mentioned,

single-level structures can be designed to enable residents to access a secure adjacent outdoor space without time-consuming escort by busy staff through stairways. (Section 6.3.1) It was also noted that SiS staff reported during workshops and facility tours that supervision of resident smoking was time-consuming, and multi-level facilities worsened the difficulty and inefficiency associated with the need to escort residents who smoke to a ground-level smoking space up to eight times per day.

8.2. Provide a timeout or cooling-off space ●

Two reports by qualified professionals on best practices for design juvenile living units recommended providing a time-out or de-escalation space (Roush & McMillen, 2000; Deitch et al., 2013). The purpose of the space is to permit staff to temporarily separate residents who are exhibiting disruptive behavior (Roush & McMillen, 2000, p. 13). Staff can communicate directly with the resident in the space to de-escalate the behavior, and the interaction does not take place in the presence of other residents. The space can be indoors or outdoors. (While touring a SiS facility, the author witnessed a resident begin to argue aggressively and loudly. Staff escorted the resident to a nearby outdoor space with no other residents present, seated him and talked to de-escalate the situation.)

8.3. Avoid design that worsens aggressive reactions when residents receive stressful information ●

Studies of adult correctional facilities, juvenile facilities, and psychiatric hospitals have identified the communication of "bad" news by staff to residents or patients as a major trigger of aggressive behavior (for example, turning down demands, limiting privileges) (Fagan-Pryor, 2003). Consistent with this research, numerous SiS staff stated during workshops and tours that aggressive behavior frequently occurred when a resident received negative news, often from a social worker. Staff reported that placing a telephone booth/space in a living room or other shared space worsened the problem of aggressive reactions, because upon receiving bad news residents would "get mad and act out in front of the other residents" (swearing, throwing books, overturning a table). Staff in these units agreed that having a telephone booth in a living room or other shared space created a public forum or communal stage that intensified aggression on the occasions when bad news was received.

In the opinion of some staff that spoke with the author, telephone booths should be removed from communal areas in some existing SiS facilities, and not installed in new living units. They suggested that it could be better if clients had their conversations with social workers take place in the privacy of their single bedrooms (via mobile phone on temporary loan). They believed that when residents received bad news in private they were less reactive and aggressive, which mitigated the problem of acting out disruptively in front of other residents in communal areas such as living rooms.

8.4. Non-institutional design

Non-institutional or home-like decor has been widely recommended as best practice for psychiatric hospitals, somatic hospitals, prisons, juvenile detention facilities, and Alzheimer's units (Wener, 2012; Karlin & Zeiss, 2006; Shepley et al., 2016; Day, Carreon, & Stump, 2000). Although frequently advocated, the concept remains vaguely defined and elusive to pin down, making it difficult for architects to clearly understand design approaches and for researchers to replicate studies. The ambiguity of the concept also raises obstacles to discerning plausible links to stress or other outcomes.

Research evidence concerning possible influences of non-institutional or home-like design on stress, aggressive behavior, satisfaction, or other outcomes is sparse and conflicting (Ulrich et al., 2018). It appears there is a lack of sound empirical research on juvenile living units that has investigated whether non-institutional characteristics influence treatment outcomes. Limited evidence has linked home-like characteristics in Alzheimer's facilities with reduced agitation and aggression (Day et al., 2000). However, a well-controlled prospective study in a Norwegian psychiatric hospital found that decorating an isolation room in an embellished home-like versus unembellished institutional manner did not reduce aggressive behavior or symptoms of psychopathology (Vaaler, Morken, & Linaker, 2005).

Design measures mentioned by designers and researchers for achieving non-institutional characteristics in treatment/rehabilitation facilities have tended to emphasize interior decoration and visual embellishment (Vaaler et al., 2005). In the author's opinion it seems justified to suggest that the design model described in this report implies a starting point for re-conceptualizing non-institutional or home-like design for youth living units in a way that is less vague and might identify more well-defined design approaches that can be plausibly linked to outcomes. Perhaps it could be fruitful in future SiS construction and renovation projects to rethink non-institutional design as a concept that may have multiple environmental attributes and be broader and more complex than interior decoration or visual embellishment. It is reasonable to propose that designing youth living units with the stress-reducing environmental features identified in the design model would provide some important aspects of a more home-like and calming environment, one that is interpreted more broadly than interior decoration to also include, for example, single bedrooms with privacy and features to enable control, choices of comfortable seating in spacious rooms, low noise levels, and positive distractions such as nature art, daylight, and access to a pleasant nature space.

9. Summary and implications

- Few empirical studies have examined the link between the physical environment of youth facilities and resident outcomes. Most of the limited amount of research has methodological shortcomings. Fortunately there is a considerable body of quality research relevant to designing other types of treatment, detention, and residential facilities. The most scientifically credible findings potentially relevant to designing youth facilities come from studies on other types of treatment and residential settings. (Section 3.)

- The report proposes a logically consistent and evidence-informed conceptual model for designing youth facilities to improve treatment and safety outcomes. The design model contends that stress and aggressive behavior can be reduced and the quality of treatment/rehabilitation outcomes improved if juvenile environments are designed with 1) several evidence-grounded environmental features that reduce stressors such as crowding and noise, 2) and the architecture effectively supports good observation and the SiS direct supervision/treatment model calling for staff to be outside offices interacting directly with residents, often on an individualized basis. Achieving a good fit between facility design and the supervision/treatment model is a key requirement for effective youth living units. (Sections 5., 5.1.1 & 5.1.2)

- Providing single bedrooms with private toilets and showers may be the single most important design intervention for enabling privacy access, reducing crowding stress and aggressive behavior, and fostering better sleep quality in youth living units. This recommendation is supported by strong evidence. (Section 6.1.1)

- The report defines living unit *social density* as the number of residents divided by the total number of rooms in the unit accessible to residents – that is, the number of residents per room. Much research on varied types of treatment, correctional, and residential environments has shown that social density has greater effects on crowding stress and aggressive behavior than spatial density (amount of space per person). Consistent with this evidence, the design model proposes that youth living units designed in ways that ensure lower social densities (many fewer residents than rooms) should tend to lessen crowding stress and reduce aggressive behavior. (Section 6.1.4)

- An important implication of the design model and research on social density is that rising occupancy rates in juvenile living units can be expected to markedly worsen crowding stress and aggressive behavior in poorly designed units having high social density design features such as multi-bed rooms, shared bathrooms, few communal spaces, and prominent corridors. However, increases in bed occupancy rates may be more weakly associated with stress and aggressive behavior in well-designed residential units having low social density, other stress-reducing environmental characteristics, and design for good observation. (Section 6.1.4)

- Studies indicate that persons with a history of aggressive or antisocial behavior require greater personal space distances than those with no history of such behavior. This implies the importance of providing ample space in dayrooms and other communal spaces in youth living facilities to support the greater personal space distances that many residents may need. Semi-movable and movable seating arrangements facilitate personal space regulation, sense of control, promote positive interaction, and foster reduction of crowding stress and aggressive behavior in communal spaces. (Section 6.1.3)

- The report characterizes corridors as movement paths with narrow dimensions that can exacerbate personal space intrusions and trigger aggressive behavior. Youth facilities with long corridors "require residents to interact with too many others," causing crowding stress (Roush, 2002). Data show that corridors in youth living units stand out as the locations for many aggressive incidents. (Section 6.1.4)

- Studies of adult correctional units and psychiatric wards have convincingly shown that design for good observation is associated with reductions in aggressive behavior, use of isolation, fewer rule violations, and increased perceived security. Evidence supports the conclusion that designing living units to facilitate good observation is integral to achieving effectiveness with a direct supervision treatment model, such as that used in SiS facilities. An important related finding is that floor layouts with long corridors seriously hamper staff observation and are linked with higher rates of aggressive behavior and rule violations. Corridor-dominated designs tend to support observation of corridors and bedroom doors, but often not of dayrooms, activity rooms, or other communal spaces. The report proposes that floor layouts can be more effective in facilitating visibility throughout a living unit if corridors are short and occupy a relatively low proportion of total interior space. (Sections 7.1 & 7.2)

- Providing a nature space or garden accessible to residents can reduce stress by providing calming nature views, fostering sense of control, and offering a pleasant place to seek privacy or socialize. Strong evidence from randomized controlled studies has shown that simply viewing nature (trees, plants, or water) for a few minutes -- but not most built environments lacking nature -- can produce rapid and significant psychological and physiological reduction of stress. Although a window view of nature can lessen stress, physical access to a nature space or garden can be more effective in fostering reduction of stress symptoms. (Sections 6.3.1 & 6.3.2)

- Research on gardens and outdoor smoking spaces in psychiatric hospitals and adult correctional facilities supports the advisability of building single-story facilities (two stories at most) rather than multi-story buildings. Single-story buildings can enable residents of youth facilities to access a secure outdoor space without time-consuming escort by staff through stairways and hallways. (Section 6.3.1)

- The report discusses several arguments that collectively create a strong case in favor of creating single-level, not multi-level, juvenile living facilities. (Sections 8.1 & 6.3.1)

- A growing body of research suggests that representational nature art should be considered for stressed persons in confined and/or locked environments, while abstract artwork and emotionally negative pictures should be displayed with caution. Evidence-informed selection of appropriate art or pictures for communal spaces and therapy rooms in juvenile facilities can help lessen resident stress and possibly aggressive behavior. (Section 6.3.3)

- The conceptual model may be first proposed for designing juvenile living units. Each design feature identified in the model is supported by credible research evidence suggesting that changes in the environmental factor are linked with measurable changes in stress, aggressive behavior, and/or other outcomes. The model is based on logistically consistent reasoning and capable of explaining why specific environmental features and design recommendations can be plausibly expected to influence outcomes. Parts of the model draw on a previous framework for designing improved psychiatric facilities that has been empirically evaluated in three Swedish psychiatric hospitals and found to accurately predict -- based on whether wards have several versus few of the design features identified in the model -- which hospitals have lower or higher rates of aggressive behavior (Ulrich et al., 2018).

  In a similar manner, it would be possible in future research on Swedish juvenile facilities to systematically compare and score numerous living units with respect to the extent that each has the evidence-grounded design features identified in this report. Do youth living units have lower (better) rates of aggressive behavior and rule violations if the architecture includes several of the recommended environmental features (such as single rooms with private toilets and showers, design for good observation, a nature space accessible to residents, and noise reducing features)? Are the social density values of different SiS living units significantly linked with frequency of incidents? If the Swedish National Board of Institutional Care were to develop a database with comparable reporting and measurement of incidents/outcomes across facilities, the model in this report could provide an appropriate and effective framework for the evidence-based evaluation of the efficacy of architectural design features and upgrades such as those recommended in this report.

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