

Psychologically mediated effects of the physical healthcare environment on work-related outcomes of healthcare personnel (Review)

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[Intervention Review]

Psychologically mediated effects of the physical healthcare environment on work-related outcomes of healthcare personnel

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ABSTRACT

Background

The physical healthcare environment is capable of affecting patients. This concept of 'healing environments' refers to the psychological impact of environmental stimuli through sensory perceptions. It excludes more physiological effects such as those produced by ergonomic (i.e. fall prevention) or facilitative (i.e. hygiene-related) variables. The importance of an atmosphere in the healthcare environment that promotes the health and well-being of patients is evident, but this environment should not negatively affect healthcare personnel. The physical healthcare environment is part of the personnel's 'workspace'. This can make the environment an important determinant of subjective work-related outcomes like job satisfaction and well-being, as well as of objective outcomes like absenteeism or quality of care. In order to effectively build or renovate healthcare facilities, it is necessary to pay attention to the needs of both patients and healthcare personnel.

Objectives

To assess the psychological effects of the physical healthcare environment on healthcare personnel.

Search strategy

We searched the Cochrane EPOC Group Specialised Register; Cochrane Central Register of Controlled Trials; Database of Abstracts and Reviews of Effects; MEDLINE; EMBASE; CINAHL; Civil Engineering Database and Compendex. We also searched the reference lists of included studies.

Selection criteria

We included randomised controlled trials (RCT), controlled clinical trials (CCT), controlled before and after studies (CBA), and interrupted time series (ITS) of psychological effects of the physical healthcare environment interventions for healthcare staff. The outcomes included measures of job satisfaction, satisfaction with the physical healthcare environment, quality of life, and quality of care.

Data collection and analysis

Two reviewers independently assessed studies for eligibility, extracted data, and assessed methodological quality.

Main results

We identified one study, which adopted a CBA study design to investigate the simultaneous effects of multiple environmental stimuli. Staff mood improved in this study, while no effects were found on ward atmosphere or unscheduled absences.

Authors' conclusions

One study was included in this review. This review therefore indicates that, at present, there is insufficient evidence to support or refute the impact of the physical healthcare environment on work-related outcomes of healthcare staff. Methodological shortcomings, particularly confounding with other variables and the lack of adequate control conditions, partially account for this lack of evidence. Given these methodological issues, the field is in need of well-conducted controlled trials.

PLAIN LANGUAGE SUMMARY

Psychologically mediated effects of the physical healthcare environment on work-related outcomes of healthcare personnel

Research has demonstrated that the physical healthcare environment can affect patients' health and well-being. However, the healthcare environment affects not only patients, but also the people that work in these environments: nurses and physicians. Any changes that are made to the physical healthcare environment in order to benefit patients (e.g. renovation of hospital wards) must either benefit or have neutral impacts on healthcare professionals.

A review of the effects of changes to the physical healthcare environment on healthcare professionals was undertaken. Only one study was found which compared renovated wards of a psychiatric hospital to non-renovated wards.

There is no evidence to support or refute the impact of the physical healthcare environment on work-related outcomes of healthcare staff. This review does show that more work needs to be done in order to understand the effects of changes to physical healthcare environments on healthcare professionals.

The psychological effects of the physical healthcare environment on healthcare personnel						
Patient or population: healthcare personnel Settings: healthcare facilities Intervention: physical healthcare environment						
Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control	Environmental stimuli				
Change in mood Lubin's Depression Adjective Checklist Form E. Scale from: 0 (better) to 34 (worse). Follow-up: 4-8 months	The mean change in mood in the control groups was -0.2	The mean change in mood in the intervention groups was 4.3 lower ^{1,2}		67 (1 study ³)	⊕○○○ very low ^{3,4}	
Satisfaction with physical environment - not reported	See comment	See comment	Not estimable	-	See comment	Study reported 'no difference' in ward atmosphere.
Change in unscheduled absences hours per staff person per month Follow-up: 4 to 8 months	The mean change in unscheduled absences in the control groups was -0.6 hours/staff/month	The mean change in unscheduled absences in the intervention groups was 3.2 lower ⁵		Not reported	⊕○○○ very low ^{3,4}	
*The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI). CI: Confidence interval;						

GRADE Working Group grades of evidence

High quality: Further research is very unlikely to change our confidence in the estimate of effect.

Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Very low quality: We are very uncertain about the estimate.

- ¹ Lower indicates improved mood.
- ² Intervention: 9.7 at pretest and 9.5 at posttest. Control: 10.4 at pretest and 5.9 at posttest.
- ³ Unclear how differences in sample sizes between pre and posttest occurred and were accounted for. Staff on wards were tested twice but unclear if were the same people on each occasion.
- ⁴ Study with few participants.
- ⁵ Intervention: 7.2 hours pretest and 3.4 posttest. Control: 5.4 pretest and 4.8 posttest.

BACKGROUND

A systematic review on the effects of the physical healthcare environment on the health and well-being of patients (Dijkstra 2006) demonstrated the relevance of the physical healthcare environment for patients. In their Cochrane protocol on a closely related subject, Drahota and colleagues clearly state the importance of environmental design in relation to the health of patients and give a plain overview of the relevance of the subject (Drahota 2004). Recent research suggests that the possible effects of physical environmental stimuli on the health and well-being of patients in healthcare settings has gained much attention (see for example Devlin 2003; Schweitzer 2004). This work demonstrates that the physical healthcare environment is capable of having a positive influence on the patient, a concept known as 'healing environments'.

The importance of a healthcare environment that promotes the health and well-being of patients is evident, but this healing environment should not negatively affect healthcare personnel. Moreover, the physical healthcare environment has different functions for the two main user groups; patients and healthcare personnel. Where the first group of users needs to recover as quickly as possible or adapt to specific acute and chronic conditions (Stichler 2001), the second group needs to work effectively and satisfactorily in this environment on a daily basis.

The physical healthcare environment is part of the personnel's 'workspace'. This can make the environment an important determinant of job satisfaction as well as of judgments regarding functionality of the work environment. Work-related outcomes like job satisfaction and employee well-being have been shown to be associated with work performance, productivity, and, ultimately, the quality of healthcare (Lundstrom 2002). In order to effectively build or renovate healthcare facilities, it is therefore necessary to pay attention to the needs of both patients and healthcare personnel.

Considering the substantial budgets to be spent on hospital design and construction (Babwin 2002), a rigorous, systematic review is needed for the development of evidence-based guidelines for the design of healthcare facilities.

There are two ways in which the physical healthcare environment can impact personnel. First, it can have a direct physiological influence, meaning the effects are mainly unmediated or unmoderated by psychological processes (Taylor 1997). Two literature reviews are already available that concern this direct physiological influence. In 2003, Hickman et al conducted a literature review on the effects of healthcare working conditions, but focused solely on patient safety (Hickam 2003). Ulrich 2004 performed a much broader review focusing not only on effects of the physical environment on staff and quality of care, but also on patients. Their findings with respect to staff concerned the workflow and are mainly focused on ergonomic issues.

The second way in which the physical healthcare environment may affect personnel is through psychological processes as a result of sensory perceptions. These processes can be of a cognitive or emotional nature. Since there is no review available on the effects of the physical environment on personnel, this review will be restricted to this second category of processes. In those cases where environmental changes affect healthcare personnel both psychologically and physically, studies will only be included when the outcome measures are indicative of psychological effects. For example, furniture may directly affect personnel by causing back pain. The effect may also be indirect by providing a more homely ambience. We included studies with outcome measures such as mood or stress, but excluded studies measuring back pain.

In sum, it is necessary that a healthcare environment be psychologically supportive for both patients and healthcare personnel. The patient perspective is covered by reviews of Drahota 2004 and Dijkstra 2006. Our review adds the personnel perspective. Understanding the physical environmental stimuli that may affect workplace stress, reduce absenteeism, lower staff turnover, and even support providing high-quality care, will contribute to more efficient hospital design.

OBJECTIVES

The objective of this review was to assess the psychological effects of the physical healthcare environment on healthcare personnel.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials (RCT), controlled clinical trials (CCT), controlled before and after studies (CBA: incorporates a non-randomised control group. Data is collected in control and intervention groups before the intervention is introduced and data is collected after the intervention has been introduced), and interrupted time series studies (ITS: no control group and multiple data points are collected before and after the intervention) were included.

Types of participants

This review included both medical and paramedical personnel who are directly involved in treatment and care of patients in healthcare settings. These personnel are primarily physicians and nurses.

Types of interventions

For the purpose of this review we defined physical environmental stimuli as follows:

Physical environmental stimuli are part of the (shared) healthcare environment and can be classified as ambient, architectural or interior design features that influence healthcare personnel through mediation by psychological processes.

This review included studies that investigated interventions involving work-related effects of environmental stimuli in healthcare settings, and compared these either to environmental stimuli, or to no environmental stimuli (for example music versus no music). We included studies manipulating a single environmental stimulus as well as those manipulating multiple stimuli simultaneously. Interventions are those environmental stimuli that fit the criteria described below (Harris 2002):

1) Architectural features, which can be defined as the relatively permanent aspects of the physical environment, and include for example:

- A. windows (versus none or different types of views from windows);
- B. room size (different room sizes); and
- C. spatial layout (different types of layout).

2) Interior design features, which can be defined as the less permanent aspects of the environment; they are predominantly visual in nature and include for example:

- A. coloring (e.g. of walls, different colors);
- B. artwork (different styles or art versus no art);
- C. furniture (different types);
- D. carpeting (different types); and
- E. natural elements (e.g. providing access to nature, plants versus no plants).

3) Ambient features, which can be defined as the intangible features of the environment and include for example:

- A. lighting (e.g. natural versus artificial, amount of lighting);
- B. music (different types or music versus no music);
- C. sound/noise (e.g. absence or presence of noise, effects of noise-reducing aids); and
- D. scents (different types, scents versus no scents).

We excluded environmental stimuli that have a direct, physiological effect on healthcare personnel. These include, for example, hygiene related features, such as the number or location of sinks and hand-cleaner dispensers (Muto 2000). In those cases where environmental changes affect healthcare personnel both psychologically and physically, we included studies when any outcome measures were potentially indicative of psychological effects and both physical and psychological outcomes were reported.

We also excluded studies if the environmental manipulation was confounded with non-environmental changes, such as changes in the organisational climate or nursing care policy. The aim is to demonstrate that it is the physical healthcare environment responsible for changed outcomes (and not something such as policy

changes).

All studies must have been conducted in healthcare settings. This includes hospitals, nursing homes, psychiatric facilities, and ambulatory care facilities.

Types of outcome measures

We included a broad range of outcome measures, since the healthcare environment may affect different aspects of both objective and subjective perceptions of nurses and physicians with regard to their daily work (environment). These outcomes can be categorised in measures concerning (1) job satisfaction (e.g. work morale, stress, burnout, sick leave); (2) satisfaction with the physical healthcare environment; (3) quality of life (e.g. mood, well-being); and (4) quality of care (such as medical errors).

Search methods for identification of studies

See: Cochrane Effective Practice and Organisation of Care Group methods used in reviews.

The following electronic databases were searched in November 2006 and this search was updated in July 2008:

- (a) The EPOC Register (and the database of studies awaiting assessment) (see SPECIALISED REGISTER under GROUP DETAILS);
- (b) The Cochrane Central Register of Controlled Trials (CENTRAL) and the Database of Abstracts of Reviews of Effectiveness; and
- (c) MEDLINE, EMBASE, CINAHL, Civil Engineering Database and Compendex.

We handsearched reference lists of studies included in the review. We developed search strategies for electronic databases using the methodological component of the EPOC search strategy combined with selected MeSH terms and free text terms. We used the following terms in the MEDLINE search strategy:

- 1 environment design/
- 2 exp *Environment, Controlled/
- 3 ((multisensory or multi-sensory or sensory or therapeutic or restorative or healing) adj2 (environment\$ or design)).tw.
- 4 workplace/
- 5 exp "Facility Design and Construction"/
- 6 exp Health Facility Environment/
- 7 ((environmental or ambient) adj2 (design or feature\$ or stimuli)).tw.
- 8 or/1-7
- 9 exp Health personnel/
- 10 Health manpower/
- 11 exp Patient care team/
- 12 physician\$.tw. Or nurs\$.tw. Or pharmacist\$.tw. Or dentist\$.tw. Or dental staff.tw Or laboratory personnel.tw Or medical staff.tw
- 13 or/9-12
- 14 8 and 13

15 randomized controlled trial.pt.
 16 controlled clinical trial.pt.
 17 random\$.tw.
 18 or/15-17
 19 14 and 18
 20 8 and 18
 21 8 and 19

We translated this search strategy into the other databases using the appropriate controlled vocabulary as applicable (see [Appendix 1](#)).

Data collection and analysis

Selection of studies

One author (KTD) screened titles and abstracts of potentially relevant studies and retrieved full text copies of articles identified as potentially relevant. Two reviewers (KTD and MP) independently assessed each retrieved article for inclusion and resolved disagreements about eligibility by consensus.

Quality

Two reviewers (KTD and MP) independently assessed the quality of all eligible studies using standard EPOC criteria (see ADDITIONAL INFORMATION, ASSESSMENT OF METHODOLOGICAL QUALITY under GROUP DETAILS). A 'Risk of bias' table was also completed. The following criteria are used in the 'Risk of bias' assessment for CBA study designs:

1. blinding of measurements and reliability of outcome measures;
2. addressing of incomplete outcome data;
3. free of selective reporting;
4. baseline measurements;
5. characteristics of the control site;
6. protection against contamination;
7. two control and two intervention groups.

Data extraction

Two reviewers (KTD and MP) independently undertook data extraction, using a modified version of the EPOC data collection checklist. Any disagreements were resolved through discussion among the reviewers.

We extracted the following data for all included studies.

1. Study design: the employed study designs are listed and studies with significant design flaws were excluded.
2. Type of data retrieval: data can be retrieved by observations, using records or they can be self-reported.
3. Participants: the number of participants, their occupation and demographic variables
4. Healthcare setting: type of healthcare setting in which the study took place
5. Details of the intervention: interventions were described using a full description of the physical environmental stimuli that were manipulated in the study. Results were organized by intervention.

6. Outcomes: data on the different outcome variables was extracted.

Data analysis

We only identified one study. Therefore, aggregating analysis was not possible.

RESULTS

Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#).

One study met the inclusion criteria for this review ([Christenfeld 1989](#)).

Results of the search

We carried out the initial search in November 2006 and updated it in July 2008. The adopted search strategy led to an initial number of 851 potentially relevant citations. Of these potentially relevant studies, we excluded 595 because the participants were not healthcare personnel. We excluded another 224 studies for not studying effects of physical environmental stimuli.

Of the 33 studies retrieved for full text screening, we excluded 32; the [Characteristics of excluded studies](#) table briefly indicates the reason for exclusion. Sixteen studies did not meet the study design definitions; in most cases they did not include a control condition. Seven studies did not study effects of the physical environment, and another 4 studies investigated the direct physiological effect of environmental stimuli. In three studies, effects of the physical environment were confounded with changes in policy. Two studies did not take place in a healthcare setting.

No ongoing studies were identified.

Included studies

(see [Characteristics of included studies](#))

We identified one study meeting the inclusion criteria for this review ([Christenfeld 1989](#)).

Intervention:

This study investigated the effects of multiple environmental stimuli simultaneously. The dayroom ceiling was lowered and shaded lighting was installed. The floor was redone in light-colored tiles and the walls were covered with vinyl in calm colors and sylvan designs. The room was divided by waist-high walls into a dining area and three separate seating areas with all furniture regrouped. The nursing station was relocated for maximum viewing. The ceiling was also lowered in the bedrooms and central hallway where recessed lighting, vinyl walls, and archways were installed, along with a small seating area, full carpeting, and noninstitutional clocks and

other wall hangings. No details on the control wards or the before-situation of the intervention wards were provided.

Type of healthcare setting:

The study was carried out in a long-term care psychiatric center (New York State's Harlem Valley Psychiatric Center).

Participants:

All staff members working on the wards, the specific occupation of the participants was not specified in the reporting of the study.

Outcome measures:

The study reported measurements indicative of job satisfaction (unscheduled absences), quality of life (mood; measured with Lubin's Depression Adjective Checklist Form E) and satisfaction with the physical healthcare environment (measured with Moos ward atmosphere scale).

Risk of bias in included studies

The study used a CBA design (Christenfeld 1989). The design fulfilled the criteria of contemporaneous data collection and the choice of an appropriate control site.

Existing, validated questionnaires were used. Both self-reported data and records were used as data sources.

The questionnaires were completed by 27 Model ward staff at pretest and 23 at posttest and, correspondingly by 31 control staff at pretest and 44 at posttest. It remains unclear how differences in sample sizes between pre and posttest occurred and were accounted for.

There is a source of potential bias in the characteristics for the control site: the study matched two renovated wards with four control wards housing patients as similar as possible, as well as similar staffing levels (Christenfeld 1989). One of the renovated wards had one less Therapy Aide throughout the time of the study. It remains unclear to what extent this could have influenced the results.

It is also unclear to what extent the study accounted for protection against contamination. The staff on the wards were tested twice but it is unclear whether they were the same people on each occasion.

Effects of interventions

See: [Summary of findings for the main comparison The psychological effects of the physical healthcare environment on healthcare personnel](#)

The included study investigated the effects of renovation of a ward within a psychiatric center (Christenfeld 1989). Typically in such a situation several environmental stimuli are simultaneously changed. This study incorporated architectural, ambient and interior design features. The following changes were made in the renovated ward: lowered ceilings, light-colored floor tiles, warm wall colors, furniture rearrangements, relocation of the nursing station and decorations.

Both staff and patients participated in this study. Since this review is limited to effects of the physical environment on healthcare staff, the patient data is not reported here. Christenfeld 1989 found that staff members working in the renovated wards showed an improvement in mood level. Scores on the depression checklist (range: 0 - 34) dropped significantly ($F=4.10$, $p < 0.05$) in the renovated ward from 10.4 ($n=27$) to 5.9 ($n=23$), whereas the scores in the control ward stayed nearly the same (from 9.7 ($n=31$) to 9.5 ($n=44$)). No results of a direct comparison of control versus intervention wards were reported. No differences were found regarding ward atmosphere (no data reported in the paper). Unscheduled absences (hours per staff member per month) dropped in the renovated ward from 7.2 to 3.4, and in the control ward from 5.8 to 4.8; this effect was not statistically significant ($F=3.38$, $p<0.07$).

DISCUSSION

Limitations of the review

This review aimed to demonstrate the relationship between the physical healthcare environment and work-related outcomes of healthcare personnel. We limited the review to effects of the healthcare environment on healthcare workers. Other reviews (Drahota 2004; Dijkstra 2006) provide the patient perspective of effects of the built healthcare environment. This review aims to add the perspective of the healthcare worker. It should be noted that research studying the effects of the physical environment in office settings demonstrated that the environment can affect worker productivity, mood and other work-related outcomes (see for example Elsbach 2007; Kwaliek 1990).

The other aim was to establish that changes in the physical healthcare environment are responsible for affecting healthcare workers' outcomes. In order to do so, it was necessary to exclude studies in which the environmental changes were confounded with non-environmental changes (for example, changes in the organisational climate or nursing care policy). However, when major changes are made to the physical environment, it is likely that they are accompanied by some changes in policies and procedures to ensure that the new environment functions at its optimal level. It is more likely that studies investigating effects of minor environmental changes, such as changing wall-colours or introducing indoor plants, will probably not be accompanied by policy changes. It is possible that studies investigating minor changes are likely to produce very small effect sizes, whereas those involving large changes to the environment and the accompanying policy changes are more likely to produce large effect sizes. However, intervention studies will not allow us to establish the causal link between the environment and work-related outcomes, which was the aim of the current review.

Furthermore, this review was aimed at psychological effects of the healthcare environment, as opposed to direct physiological effects

of the environment. Such psychological outcomes can be considered mediating variables in establishing the process of environmental effects on work-related outcomes. The current review looked at outcomes that are indicative of such a process, but did not assess the mediating process.

Findings of the review

No studies were retrieved that exclusively examined the manipulation of either one interior design feature or one ambient feature. Nevertheless, several environmental stimuli that can be classified as being an interior design or ambient variable were manipulated simultaneously in combination with several others.

This review identified only one study which examined the effects of the physical healthcare environment on healthcare personnel, using a CBA study design. The study was carried out in a psychiatric center and investigated the combined effect of different environmental stimuli, aimed at creating a more home-like environment. [Christenfeld 1989](#) reported improved moods but no effect on ward atmosphere or unscheduled absences. From a methodological perspective, the study also suffers from several sources of potential bias. Differences between the intervention and control groups cannot be ruled out and it also is unclear if the people participating in the pre and post-test measures are the same people.

Research that investigates how people experience their physical work environment is receiving growing attention ([Vischer 2008](#)). This research focuses on the effects of environments that only have one function, that of a workplace. The sole purpose of those environments is to facilitate the working processes that take place there. However, when thinking about staff in healthcare facilities, their workscape is not just a workplace. It also is the place in which patients come for the healthcare services provided. Different user groups can have different beliefs and meanings about their surrounding environments. Healthcare staff spends for example considerable amounts of time in patient rooms and it is thus most likely that they are affected by the design of those environments as well. But are the patient needs for the design of those rooms comparable to the needs of healthcare staff? Creating home-like environments with many decorations, soft lights, and nice furniture could give patients a positive feeling, but at the same time it might make the work of the medical team more difficult. On the other hand, efficient and professional environments can be very useful for nurses and doctors, but patients may feel less comfortable. Ideally, the environment should support the needs and preferences of both groups simultaneously. According to [Bitner 1992](#), the first step in purposeful design of service environments is to identify desirable behaviours of both groups. Healthcare organizations should be concerned with patient and staff behaviour, and the interactions between patients and staff.

Redesigning the wards resulted in an increase in mood for staff

members working in these wards ([Christenfeld 1989](#)). This finding suggests that the physical environment can potentially impact staff in healthcare settings. Based on this review, there is no evidence to support or refute the impact of the physical healthcare environment on work-related outcomes of healthcare staff.

AUTHORS' CONCLUSIONS

Implications for practice

This review provides very limited evidence in support of the idea that architectural interventions in the physical healthcare environment affect healthcare personnel. Only one study was found that met the criteria for relevance and research methodology. It is therefore difficult to draw any conclusions regarding the effects of the physical healthcare environment on job-related outcomes. Formulating evidence-based guidelines for designing healthcare environments would be premature, given the presently inadequate research.

Implications for research

This review suggests several implications for future research on this subject. When looking at the reasons for excluding studies, 19 studies were not methodologically eligible, mainly because they did not incorporate an adequate control condition. Future research should employ robust research designs. It can be argued that controlled trials are simply not suitable for this topic and that they can only be quasi-experimental at best, as there are inevitably variables that cannot be controlled for. Related to this is the confounding of architectural changes with, for example, accompanying improvements in organisational climate. From a practical perspective, it is justifiable to simultaneously change working conditions when a renovation is being realised. However, when the aim is to determine the effects of the architectural changes, such confounding makes it impossible to draw conclusions on the effectiveness of the architectural intervention.

Considering these methodological issues, more well-conducted controlled trials on this subject are certainly desired. The review by [Dijkstra 2006](#) on effects of the physical healthcare environment on patients' health and well-being included 30 well-conducted trials. These trials can be used as a starting point for designing research on how the physical healthcare environment impacts healthcare personnel.

Research studying the effects of the physical environment in office settings demonstrated that the environment can affect worker productivity, mood and other work-related outcomes (see for example [Elsbach 2007](#); [Kwallek 1990](#)). This indicates that the subject remains a promising field for future research.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Christenfeld 1989

Methods	Study design: controlled before-and-after study (follow-up: 4-8 months) Data retrieval: self-reported, records	
Participants	pre: 58 post: 67 Occupation and demographics: not reported Wards at a psychiatric center	
Interventions	renovated ward vs. control ward (lowered ceilings, light-colored floor tiles, warm wall colors, furniture rearrangements, relocation of nursing station, decorations)	
Outcomes	unscheduled absences, mood, ward atmosphere	
Notes		
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Blinding? unscheduled absences	Yes	data on unscheduled absences were collected from a routinely collected data index
Blinding? mood	No	Quote "all staff members received a questionnaire" No blinding, since data were self-reported. A validated questionnaire was used to measure mood (Lubin's Depression Adjective Checklist Form E)
Incomplete outcome data addressed? All outcomes	Unclear	Quote "questionnaires completed by 27 Model ward staff at pretest and 23 at posttest and, correspondingly by 31 control staff at pretest and 44 at posttest" Unclear how differences in sample sizes between pre and posttest occurred and were accounted for
Free of selective reporting?	Unclear	No results of a direct comparison of control versus intervention wards were reported
Baseline measurement?	Yes	Done

Christenfeld 1989 (Continued)

Characteristics for control site?	Unclear	Quote: “matched the two Model wards with four control ward housing patients as similar as possible (.....), as well as the staffing levels. There was one of the renovated wards which had one less Therapy Aide throughout the time of the study.” It is unclear what effect this difference had on the findings of the study
Protection against contamination?	Unclear	The staff on the wards were tested twice but it is unclear whether they were the same people on each occasion
2 control and 2 intervention groups?	Yes	2 intervention wards and 4 control wards

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Allen 1994	No healthcare setting
Bayo 1995	No control condition (survey)
Becker 1980	Confounded with participation of staff in the design process
Becker 2008	No control condition (survey)
Blomkvist 2005	No control condition (participants were their own control; only 1 datapoint before and after interventions)
Bond 1999	Ineligible study design
Brennan 1990	No effects of the physical work environment were studied
Buchanan 1991	Studied the direct physiological effect of an environmental stimulus
Chaudhury 2006	No control condition (survey)
Chou 2002	No effects of the physical work environment were studied
Constable 1986	No effects of the physical work environment were studied
Folkins 1977	CBA design, but not enough groups

(Continued)

Hendrich 2004	Studied the direct physiological effect of an environmental stimulus Confounded with changes in the care process
Janssen 2001	Confounded with changes in nursing education
Lethbridge 2005	No healthcare setting
Lin 1988	Studied the direct physiological effect of environmental stimuli
Manojlovich 2005	No effects of the physical work environment were studied
May 2005	No control condition (cross-sectional study)
McGillis Hall 2007	No effects of the physical work environment were studied
Morrison 2003	No control condition
Mroczek 2005	No control condition (survey)
Parker 2004	No control condition (cross-sectional study)
Shamian 2002	No effects of the physical work environment were studied
Shepley 2002	No control condition
Shepley 2003	Studied the direct physiological effect of environmental stimuli
Shepley 2008	Ineligible study design
Topf 1988	No control condition (correlational study)
Trites 1970	Ineligible study design
Tyson 2002	Confounded with changes in organizational procedures
Ullmann 2008	No control condition (survey)
Ulrich 2005	No effects of the physical work environment were studied
Verderber 1987	No control condition (correlational study)

DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix I. Non-OVID search strategies

Civil Engineering Database (1970-)

All text fields: (environment "OR" sensory "OR" design)
and
Subject headings: health care facilities

Compendex (1969-)

(environment OR sensory OR design OR therap* OR restorative OR healing) AND (health NEAR facilit*) wn TI
AND
(environment OR sensory OR design OR therap* OR restorative OR healing) AND (health care facilit*) wn AB

Cochrane CENTRAL and DARE

- #1 MeSH descriptor Environment Design explode all trees
- #2 (environment near controlled)
- #3 ((multisensory or multi-sensory or sensory or therapeutic or restorative or healing) adj (environment* or design))
- #4 [MeSH descriptor Facility Design and Construction explode all trees](#)
- #5 MeSH descriptor Health Facility Environment explode all trees
- #6 ((environmental or ambient) adj2 (design or feature\$ or stimuli))
- #7 [MeSH descriptor Workplace explode all trees](#)
- #8 MeSH descriptor Health Personnel explode all trees
- #9 MeSH descriptor Health Manpower explode all trees
- #10 MeSH descriptor Patient Care Team explode all trees
- #11 (#1 OR #2 OR #3 OR #4 OR #5 OR #6)
- #12 (#7 OR #8 OR #9 OR #10)
- #13 (#11 AND #12) in Cochrane Reviews and Clinical Trials

HISTORY

Protocol first published: Issue 4, 2006

Review first published: Issue 12, 2010

Date	Event	Description
6 May 2009	Amended	Converted to new review format.
23 August 2006	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

All review authors have contributed to the production of the protocol. KTD led the writing of the protocol and MP provided comments and feedback. For the full review: KTD developed and ran the search strategy (with support of the EPOC Group); KTD and MP screened records for eligibility; KTD and MP abstracted data, undertook analyses, interpreted the results and wrote up the review.

DECLARATIONS OF INTEREST

None known.

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Internal sources

- No sources of support supplied

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- Netherlands Board for Health Facilities, Netherlands.