Interventions to Improve Inpatients' Sleep Quality in the Intensive Care Unit and Acute Ward Settings: A Qualitative Literature Review

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Abstract

Background: Sleep is essential for physical and psychological restoration for inpatients, and lack of sleep results in sleep deprivation and poor sleep quality, with potentially harmful consequences. ***Aim*****:** to summarize sleep-promoting interventions in ICU and acute ward setting.

Method and Result: we searched six databases to obtain studies for review and eight studies selected, appraised, analyzed and produced two themes: (1) sleep-disturbing factors include environmental, illness-related factors (pain, anxiety and discomfort) clinical care and diagnostics; (2) sleep-promoting strategies, include pharmacological and non-pharmacological aid (reducing noise and disturbances, eye masks, earplugs and educational and behavioural changes).

Conclusion: Our literature review showed that both ICU and AW settings share similarities and differences of strategies to improve patients sleep. Nevertheless, noise and sleep disturbances remain the most critical sleep-inhibiting factors in both settings. Our review recommended future research to focus on staff's behavioural changes towards noise reduction to improve patients' sleep.

Keywords: Sleep-Deprivation, Sleep-Promotion, Sleep-Quality, ICU, Acute-Ward.

Conflict of Interest

None

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1. Background

Sleep is essential for physical and psychological restoration in patients with certain medical conditions (Aitken et al., 2017). Lack of sleep results in sleep deprivation with potentially increased patients' vulnerability to infection (D'Souza et al., 2019), because sleep deprivation is associated with the delay in the healing process by preventing growth hormone secretion and weakening the immune system (Ganz, 2012; Tuck, 2019).

One of the efforts to reduce patients' vulnerability to infection is by creating quieter wards and fewer disturbances from healthcare professionals [*HCPs*] to promote a good night sleep. However, to date, there is lack of consensus on the most effective strategy for different care settings. The majority of research has been focused on sleep-promotion strategies to improve patients' sleep in Intensive Care Unit [*ICU*]. However, only fewer studies that focus on Acute Ward [*AW*] settings [*in this review, we refer acute ward to noncritical and non-intensive medical and surgical wards*].

This study aims to summarize the strategies of sleep-promotion in both ICU and AW settings by reviewing the literature. Its objectives are: [*1*] to identify different sleep-promoting strategies used in ICU and AW settings, [*2*] to compare the differences and similarities of strategies between both settings for practice improvement recommendations.

2. Methods

As per the objectives of this study, we use a systematic review method to review previously published literature on the topic of sleep-promotion and sleep quality. This method of study is chosen because it is a rigorous and valid method

to summarise and critically appraise evidence from previous studies on sleep-promotion strategies, to answer our research question (Aveyard et al., 2016; Jesson et al., 2012).

2.1. Eligibility Criteria

We included the following study design: randomized controlled trials [*RCTs*], cross-sectionals, cohorts and qualitative studies. Since it would be redundant to review other literature reviews, any review was excluded. We included studies on adults and elderly patients admitted to ICU and AW settings, and excluded participants <18 years old. We included studies on sleep-promoting interventions that publish in English from 2009.

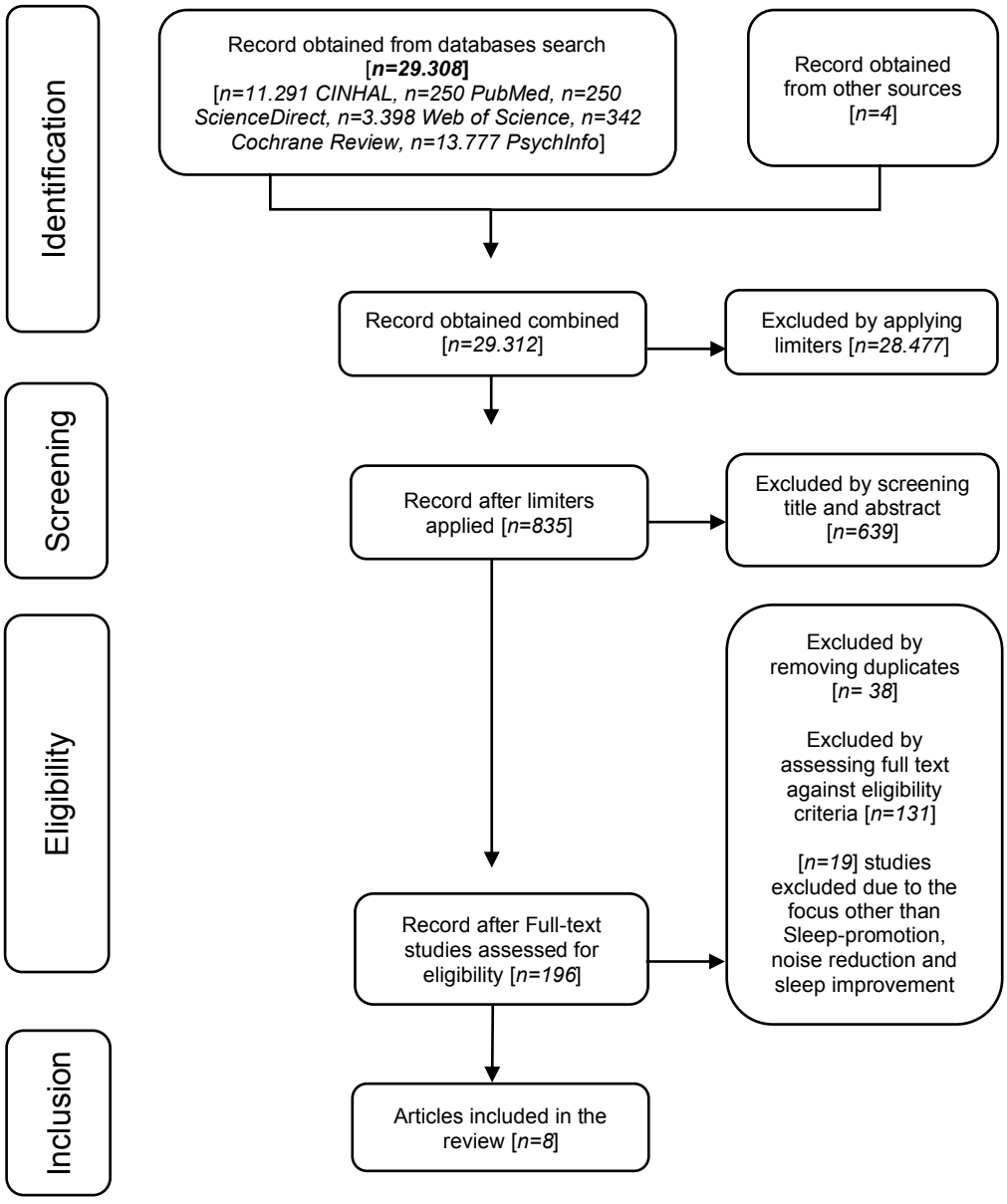
2.2. Research Question and Search Terms

We posed the following question: *"What is done to improve sleep quality in ICU and Acute Ward settings, and what are the similarities and differences between these two settings?"* This question is specific and is framed using the PICOS strategy, which is highly recommended for qualitative research (Methley et al., 2014, Jensen et al., 2018). The population [*P*] studied are adults and elderly patients that admitted to both ICU and AW settings. The intervention [*I*] is the sleep-promoting interventions that carried out in both settings. The comparison [*C*] is either no sleep-promoting interventions or no comparator; the outcome [*O*] is the improvement of sleep quality, and the study types [*S*] are all study designs as described in the eligibility criteria.

In order to answer this research question, we used specific search terms to find the relevant articles. The search terms are keywords [*extracted from the*

research question] which relate to a specific topic, combined using Boolean operators and Truncation [*], to obtain all the articles relevant to such topic (Aveyard et al., 2016; EBSCO Connect, 2018). Therefore, the search terms for this review are: *"Reduc* Noise* AND Disturb* OR Interrupt* OR Disrupt* AND Sleep At Night OR Night-time OR Night time AND Improve* AND Sleep Deprivation AND Sleep Quality AND Adult AND Elderly AND Patients*".

Figure 1: PRISMA Diagram Adapted from Moher et al. (2009. pg.3)



2.3. Search Result

We followed the PRISMA [*Preferred Reporting Items for Systematic Reviews and Meta-Analysis*] guidelines for article selection. PRISMA is one of the preferred guidelines by healthcare services for evaluating and selecting articles for review (Moher et al., 2009).

The initial result of the database search and a manual search produced 29.312 articles. This result was narrowed down to 835 articles using the limiters [*see appendix 1*]. The result was further narrowed to 196 articles by screening the titles and abstracts of the articles [*see Figure 1*]. Duplicates [n=38] were removed, and a total of 131 articles were excluded after the full-text screening. Further, 19 articles excluded because the study focus was on a different topic. The final result of the selection process led to the inclusion of eight articles [*see Table 1*].

2.4. Data Extraction

We independently extracted data from the selected studies, and any disagreement was resolved through consensus. We agreed on the final data extraction, as shown in table 1. Table 1 presents the precise aims and objectives of studies on sleep-promoting interventions carried out in ICU and AW settings. It also shows an equal number of studies from both settings, which will be necessary for a balanced comparison between the two settings.

The study designs consisted of both quantitative and qualitative studies: three RCTs, three cohorts, one qualitative and one mixed method. Although

quantitative methods dominated the included studies, we were interested in the quality of the evidence presented, not in the quantitative data.

Table 1: Data Extraction for a Qualitative Systematic Review [adapted from Aveyard et al. (2016, pg.97)

Author (Date) Country	**Research Question/Aim**	**Study Setting**	**Design**	**Sleep-inhibitor or Sleep-promotion**	**Key Themes**	**Limitation**
Delaney et al. (2018) **Australia**	To investigate the perceived duration and quality of patients sleep and identify any environmental factors associated with patient-reported poor sleep in the hospital	AW Setting	Cross-Sectional Study [*Cohort*]	Sleep Disturbing Factors	- Reduction of sleep duration and poor quality - Sleep disturbing factors [noise, light luminance, temperature and humidity] - Environmental monitoring found the elevated noise level - Light luminance found to be low *[<100 Lux*] - Temperature constant but high humidity	- Intrinsic factors [*building construction, acuity, patients staff numbers, time of the year environmental monitoring*] can all affect the sleep - Presence of observer during environmental monitoring may have Hawthorn effect
Dobing et al. (2017) **Canada**	To test the efficacy of non-pharmacologic interventions on the sleep quality of medicine inpatients	AW Setting	RCT	Non-pharmacological Intervention	- No significant self-reported duration nighttime and daytime in hospital. - No significant difference between the groups regarding efficacy or supplementation - Qualitative data shows the reason for poor sleep [*noise, an interruption for vital signs, intravenous medications, uncomfortable in bed, unfamiliar with surroundings, disease-related factors [pain, anxiety, cough*]].	- Lack of true blinding - Higher admission at night - Self-report measures
Eliassen and Hopstock (2011) **Norway**	To investigate the perceptions of the sleep-promoting interventions that ICU nurses believe they provide	ICU Setting	Survey [*Cohort without control*]	Noise reduction, Light Reduction, Patients Comfort	- Noise and light reduction are the priority at night (*prevent conversation near the patient's bedside, adjusting observation time interval*) - Patients comfort [reposition, adequate pain relief, massage and mouthcare] - Patients care activities [physiotherapist, doctors' round, administration of antibiotics] would wake patients up for these interventions	- Small sample size - Self-reported data - non-validated questionnaire
Foreman et al. (2015) **USA**	Hypothesis: patient in ICU would demonstrate similar sleep disturbance and that combination of sleep-promoting intervention would increase sleep time	ICU Setting	RCT	Pharmacological Intervention [*Melatonin, Propofol*], non-pharmacological Intervention [*Eye masks, headphones*]	- Markedly abnormal sleep in ICU - Earplugs and eye masks decrease arousal and REM latency, increase melatonin production in the previous study - Not able to provide evidence of the benefits of headphones and eye masks	- 2/3 recording could not be scored due to technical error
Litton et al. (2017) **Australia**	To assess the feasibility of earplugs as a noise –abatement strategy to improve sleep and reduce	ICU Setting	RCT	Pharmacological Intervention [*propofol or fentanyl*] Non-pharmacological Intervention	- Earplug insertion was acceptable to a high proportion - Earplugs abate noise	- The study carried out in a single centre - Non-blinding - Not clear whether noise reduction was

	delirium in patients admitted to the intensive care unit			[*Earplugs insertion*]	- The choice of earplug, adequacy of training in insertion are an essential	due to earplugs insertion or staff avoidance of unnecessary disturbance
Lopez et al. (2018) **USA**	Minimize the unnecessary sleep interruption in patients and implement evidence-based night care	AW Setting	Mixed-Method [*cohort/ qualitative*]	Minimize Sleep Interruption, Promoting Sleep	- Recommend making default vital sign order while patients awake - To change the time for routine blood draws to avoid a quiet hour - An educational program for nursing staff to minimize nighttime interruptions	- Patients underreported the number of interruptions at night - Lack of phlebotomist notification was inconsistent - Causation of pain and interruption undetermined
Patel et al. (2014) **UK**	To investigate whether the implementation of a bundle of non-pharmacological intervention, was associated with improved sleep and reduced incidence of delirium.	ICU Setting	Cohort Study	Multi-Component bundle of Intervention	- The introduction of noise and light reduction program as a bundle of non-pharmacological interventions	- Nonrandomized selection - The study was carried out in only one centre - Use of self-assessment tool - Hawthorn effect
Salzmann-Erikson et al. (2015) **Sweden**	Explore nurses' experiences and their strategies to promote inpatients' sleep	AW Setting	Qualitative Research	Sleep-promotion	- Prevention and planning as a sleep-promoting strategy - Adaptation of the environment as a sleep-promoting strategy - Use of drug as a sleep-promoting strategy - Caring conversations as a sleep-promoting strategy	- Small sample size - No validity check of data

2.5. Critical Appraisal

We used three different Critical Appraisal Skill Programme [*CASP*] checklists to assess the selected studies (see Table 2) and used CASP elements as guidelines (CASP, 2018). However, the allocation of studies to CASP checklist was determined by the study design. The CASP for cohort studies was used to appraise the studies by Delaney et al. (2018), Eliassen and Hopstock, (2011), Lopez et al. (2018), Patel et al. (2014). The studies by Dobing et al. (2017), Foreman et al. (2015), Litton et al. (2017) were appraised with CASP for RCTs. The studies by Salzmann-Erikson et al. (2015), Lopez et al. (2018) were appraised with CASP for qualitative studies. The study by Lopez et al. (2018) was a mix-method and therefore, was appraised with two different CASPs checklists [*scores see legend of Table 2*].

Table 2: Critical Appraisal Using three different CASP checklists

Studies Assessed with CASP for Cohort Study								
CASP Element	**Delaney et al. (2018)**		**Patel et al. (2014)**		**Eliassen et al. (2011)**		**Lopez et al. (2018)**	
	Answer	Score	Answer	Score	Answer	Score	Answer	Score
1. Did the trial address a focused issue?	Yes	2	Yes	2	Yes	2	Yes	2
2. Did the author use an appropriate method to answer the question?	Can't tell	1	Can't tell	1	Yes	2	Yes	2
3. Was the cohort recruited acceptably?	Yes	2	Yes	2	Yes	2	Yes	2
4. Was the exposure accurately measured to minimize bias?	Yes	2	Yes	2	Yes	2	Yes	2
5. Was the outcome accurately measured to minimize bias?	Yes	2	Yes	2	Yes	2	Can't tell	1
6. Have the authors identified all-important confounding factors? Have they taken into account the confounding factors in the design and/or analysis?	No	0	Can't tell	1	Can't tell	1	Can't tell	1
7. Was the follow up of the subjects complete enough? Was the follow up of subjects long enough	Can't tell	1	Can't tell	1	Can't tell	1	No	0
8 What are the results of the study?	Yes	2	Yes	2	Yes	2	Yes	2
9. How precise are the results?	P<0.001	2	P<0.001	2	Can't tell	1	Yes	2
10. Do you believe the result?	Yes	2	Yes	2	Yes	2	Yes	2
11. Can the results be applied to the local population?	Yes	2	Yes	2	Yes	2	Yes	2
12. *Do the result of the study fit with other available evidence*	Yes	2	Yes	2	Yes	2	Yes	2
Total Score		**20**		**21**		**21**		**20**
							Average Score	**20.5**

Studies assessed with CASP RCTs Study						
CASP Element	**Litton et al. (2017)**		**Foreman et al. (2015)**		**Dobing et al. (2017)**	
	Answer	Score	Answer	Score	Answer	Score
1. Did the trial address a focused issue?	Yes	2	Yes	2	Yes	2
2. Was the assignment of patients to treatments randomized?	Yes	2	Yes	2	Yes	2
3. Were all of the patients who entered the trial properly accounted for at its conclusion?	Yes	2	Can't tell	1	Yes	2
4. Were patients, health workers and study personnel blind to treatment?	Yes	2	No	0	No	0
5. Were the groups similar at the start of the trial?	Yes	2	Yes	2	Yes	2
6. Aside from the experimental interventions, were the groups treated equally?	Yes	2	Yes	2	Yes	2
7. How significant was the treatment effect?	*Yes*	2	Can't tell	1	*Yes*	2
8. How precise was the estimate of the treatment?	*P=0.005*	2	*P=0.005*	2	*P<0.05*	2
9. Can the results be applied in your context (or to the local population?)	Yes	2	Yes	2	Yes	2
10. Were all clinically significant outcomes considered?	Yes	2	Yes	2	Yes	2
11. Are the benefits worth the harms and costs?	Yes	2	Yes	2	Yes	2
Total Score		**22**		**18**		**20**
					Average Score	**20**

Studies Assessed with CASP for Qualitative Study				
CASP element	**Salzmann-Erikson et al. (2015)**		**Lopez et al. (2018)**	
	Answer	Score	Answer	Score

1. Was there a clear statement of the aims of the research?	Yes	2	Yes	2
2. Is a qualitative methodology appropriate?	Yes	2	Yes	2
3. Was the research design appropriate to address the aims of the research?	Yes	2	Can't tell	1
4. Was the recruitment strategy appropriate to the aims of the research?	Yes	2	No	0
5. Was the data collected in a way that addressed the research issues?	Yes	2	Can't tell	1
6 Has the relationship between the researcher and participants been adequately considered?	No	0	Can't tell	1
7. Have ethical issues been taken into consideration?	Yes	2	Yes	2
8. Was the data analysis sufficiently rigorous?	Can't tell	1	Can't tell	1
9. Is there a clear statement of findings	Yes	2	Yes	2
10. How valuable is the result?	Yes	2	Yes	2
Total Score		**17**		**14**
			Average Score	**15.5**

Legend:
Yes *(Score: 2) if the procedure (e.g. randomization) was cited and clearly described,*
No *(score: 0) if the procedure was not cited, and*
Can't tell *(Score: 1) if the procedure was only cited but not described*

3. Data Analysis

3.1. Themes Identified and Emerging Themes

We used thematic analysis and followed several steps to analyse the study results. Themes from each study were identified [*Table 3*], then coded as per similar groups, named and renamed accordingly, then compared between the studies to find the best fit of new themes (Aveyard et al., 2016; Jesson et al., 2012). As a result, two broad themes emerged [*Figure 2*]: *sleep-disturbing factors and sleep-promoting interventions.*

Table 3 Qualitative Themes from Selected Studies, (Adapted from Aveyard et al., (2016) pg.144)

Themes from Selected Studies	**Delaney et al. (2018)**	**Dobing et al. (2017)**	**Salzmann-Erikson et al. (2015)**	**Eliassen & Hopstock (2011)**	**Foreman et al. (2015)**	**Litton et al. (2017)**	**Lopez et al. (2018)**	**Patel et al. (2014)**
- *Noise from nurses*	√	√		√			√	√
- *Light*	√	√						√
- *Temperature*	√	√		√				
- *Clinical environment, discomfort, the need for toilet*	√	√						
- *Clinical care and diagnostic*	√	√		√			√	√
- *Pain, anxiety, cough*		√		√				√
- *Unfamiliar with surroundings*		√						
- *Ward layout*	√							
- *Nursed in a single room*	√		√					
- *Education and behavioural change*	√			√			√	√
- *Pharmacological*		√	√	√	√	√		√
- *Non-pharmacological: eye mask,*	√		√	√	√	√		√

earplugs, massage, toilet, pull the curtain,							
- *Reduce noise*			√		√		√
- *Prevent conversation near patients' bed*					√		
- *Patients comfort foot or hand massage and music.*			√		√		√
- *Clustering clinical activities: adjust the time for vital signs*	√		√		√	√	√
- *Reduce disturbances*			√				√
- *Involving patient in plan and implementations*	√		√		√		√

Figure 2: Emerging Themes and Sub-themes from Data Analysis

1. Sleep-Disturbing Factors

- *Noise, light, temperature and humidity*
- *Pain, anxiety, cough, discomfort and*
- *Care and diagnostic.*

2. Sleep-Promoting Strategies

- *The use of sedative (Pharmacological Aid)*
- *Reducing noise and disturbances*
- *Eye Masks, Earplugs and Massage*
- *Collaboration between patients and nurses in planning and implementation.*
- *Educational and behavioural change*

3.2. Sleep-Disturbing Factors

3.2.1. Noise, Light, Temperature and Humidity

Sleep-disturbing factors are factors that prevent patients from sleeping in a hospital environment. Several known factors that identified in both settings includes environmental factors: noise, light, temperature and humidity (Dobing et al., 2017; Delaney et al., 2018). Between those factors, noise from HCPs was the most reported sleep-inhibitor. Delaney et al. (2018) investigated patients' quality of sleep in fifteen clinical areas and revealed that the primary sleep-inhibitor was the noise from HCPs. The overall environmental noise recording showed that the average noise level was >60 decibels in all clinical areas. Similarly, Patel et al. (2014) reported a significant noise-caused sleep disruption, and this was backed by an objective measure of noise level at 68.8 decibels.

In terms of light luminance, Delaney et al. (2018) and Patel et al. (2014) measured light luminance in their experiments using two different light meters with different results. Delaney et al. (2018) used the Extech light meters [*Model SDL400*] in an AW setting and showed that the light brightness level was <100 Lux. In comparison, Patel et al. (2014) used CEM DT-8820 and showed 594 Lux. The difference was significant, and the use of two different light meters might explain the differences between readings.

Similarly, for temperature and humidity Delaney et al. (2018) recorded the temperatures overnight and showed that the range was between 22.64 – 22.27 °C and the humidity level was high above 2% until 02:00 AM and gradually declined by 1.5% and became lower than the temperature (Delaney et al., 2018). However, regardless of the differences, light, temperature and humidity were not considered as a sleep-inhibiting factor.

3.2.2. Illness-Related Factors

Previous research on pain and sleep deprivation showed that pain disrupts sleep and sleep deprivation increases pain sensitivity (Smith and Haythornthwaite, 2004; Chhangani et al., 2009; Finan et al., 2013). Chhangani et al. (2009) experimented whether sleep deprivation increases pain sensitivity on 27 healthy, pain-free normal sleeper participants categorized into sleepy and non-sleepy groups [*sleepy participants received 2-hour interval awakenings at night before the experiment*]. The participants' index finger was exposed to a controlled heat source. The experiment showed that sleepy participants experienced more rapid finger withdrawal than non-sleepy participants when exposed to heat. This showed that sleep deprivation increases the sensitivity to

pain. On the other hand, Lopez et al. (2018) reported that patients' sleep interruptions due to pain, reflected in the frequency of requested painkiller during the night. Moreover, this review also found that anxiety and uncomfortable positions in bed were reported as sleep-inhibiting factors (Eliassen and Hopstock, 2011; Dobing et al., 2017; Lopez et al., 2018) in both settings.

3.2.3. Clinical Care and Diagnostic

Several studies reported that clinical care such as nursing care, physical observations, comfort care, medications administration, clinical diagnostics and doctors' round, disturbed patients' sleep at night (Patel et., 2014; Dobing et al., 2017; Delaney et al., 2018). For example, Delaney et al. (2018) and Dobing et al. (2017) reported that clinical care, as well as environmental noise, were the sources of sleep disturbances in AW setting. Similarly, Patel et al. (2014) reported that frequent observations and blood sampling disturbed patients' sleep. The only difference was the need for a toilet that was reported in AW settings (Delaney et al., 2018; Lopez et al., 2018) but was not reported in ICU settings (Litton et al., 2017).

3.3. Sleep-Promoting Strategy

3.3.1. The Use of Medication

The use of medication was reported in both settings to aid sleep (Dobing et al., 2017; Salzmann-Erikson et al., 2015) and to control pain following surgery (Foreman et al., 2015). Zopiclone, antipsychotic, antidepressant, painkillers and melatonin were the most commonly prescribed medications to aid patients' sleep in AW settings (Dobing et al., 2017). Comparatively, ICU settings used more

propofol, fentanyl and sedatives (benzodiazepine) as well as melatonin (Foreman et al., 2015) to aid patients' sleep (Litton et al., 2017).

3.3.2. Reduce Noise and Minimize Disturbances

Salzmann-Erikson et al. (2015) discussed the use of single-rooms to reduce noise in AW settings. However, the single-room designs in AW settings were too costly (Foreman et al., 2015; Salzmann-Erikson et al., 2015); therefore, AW settings used 4-bedded rooms for economic reasons (Salzmann-Erikson et al., 2015; Delaney et al., 2018).

Other strategies for reducing noise and minimize disturbances such as closing doors, reducing volumes of medical equipment, offering toilet before bed and clustering of care have significantly reduced noise (Lopez et al., 2018; Delaney et al., 2018). Eliassen and Hopstock (2011) explored noise and light reduction interventions and highlighted the priority of lowering the voice to reduce noise and adjusting observations times to reduce disturbances. Similarly, Patel et al. (2014) implemented noise reduction strategies in ICU, which resulted in longer sleep duration and fewer awakenings. Equally, Lopez et al. (2018) implemented nighttime protocol [*offering toilet, turn off the light, shut doors, implement care while patient awake*] to minimize unnecessary interruptions in AW settings. Data from medical records were checked against patients' and staffs' interviews. They concluded that the average interruption decreased from 7.03 [*SD 3.08*] to 6.43 [*SD 3.22*] [$p<0.05$].

3.3.3. Use Eye Masks, Earplugs and Complementary Treatment

The benefits of using eye masks and earplugs to reduce light and reduce noise in both settings have been reported in the studies included in this review. Salzmann-Erikson et al. (2015) and Eliassen and Hopstock (2011) reported that the use of eye mask reduced the disruptive effect of light in AW settings and ICU settings. In terms of using earplugs, Litton et al. (2017) tested earplugs for noise reduction in the ICU setting, reported an increase of sleep quality for patients who wore earplugs. Similar benefits of earplugs were also reported by Salzmann-Erikson et al. (2015) in the AW setting.

Furthermore, complementary treatment such as foot and hand massage, music and aromatherapy (Patel et al., 2014) have been reported in other studies (Jacobs et al., 2016; Pagnucci et al., 2019) but not fully explored in the studies included in this review.

3.3.4. Patients and Nurses Collaboration

Salzmann-Erikson et al. (2015) carried out a qualitative study to explore nurses' experiences and their strategies to promote sleep. A total of eight participants were recruited using purposeful sampling. The narrative account emphasized the importance of collaboration with patients and giving information to establish a sense of safety among the patients. This finding reflects the three cores of competency of nursing professional standard practice: prioritise people, preserve the safety and promote professionalism and trust (NMC, 2015). However, the authors acknowledged that the small sample size limited the generalizability to other settings.

3.3.5. Educational and Behavioural Change

All included studies indicated that HCPs responsible for noise and sleep disturbances (Delaney et al., 2018). However, the argument is that if the planned care is not implemented due to the risk of disturbing patients, the consequence may worsen patients' clinical condition. The challenge is that there is no clear-cut balance of priority between sleep and care provision. Since both issues are closely related, it can only be solved with careful planning and prioritizing of care (Lopez et al., 2018; Patel et al., 2014). The studies included in this review recommended to raise HCPs' awareness on sleep-promotion and minimize disturbances (Lopez et al., 2018; Delaney et al., 2018; Patel et al., 2014).

4. Discussion

Our review found that both ICU and AW settings share similarities and differences in sleep-promoting strategies as well as sleep-inhibiting factors. In terms of sleep-promoting strategies, both settings share similarities in synchronization of care [*implementing multiple tasks at one visit, for example, administration of painkillers and checking observations at the same time*] to minimize sleep disturbances (Dolan et al., 2016; Garside et al., 2018; Altman et al., 2018). Both settings also share similarities in using medicine to aid sleep. The only difference is that in AW settings patients used antipsychotic, antidepressant and painkiller [*due to pre-existing medical conditions*] more than patients in the ICU setting, which instead used more sedatives.

Similarities were also found in non-medicine related interventions, as both settings reported the benefits of using eye masks and earplugs to reduce light and noise (Foreman et al., 2015; Dobing et al., 2017; Litton et al., 2017). In

addition, complementary treatment such as foot and hand massage, music and aromatherapy have been cited but not fully explored (Foreman et al., 2015; Dobing et al., 2017; Litton et al., 2017). Although the aromatherapy has been around for many years, its application as a complementary treatment for sleep in hospital is a relatively new topic (Pagnucci et al., 2019). Pagnucci et al. (2019) reported the benefit of aromatherapy application to ICU patients, but the lack of skills and techniques of nurses limited the application of this treatment (Mofredj et al., 2016; Bagheri-Nesami et al., 2015; Cooke et al., 2012).

In terms of sleep-disturbing factors, we found similarities in pain, noise, clinical care, diagnostic and room layout. These similarities are consistent with a study by Macfarlane et al. (2019), which reported that the significant barriers to sleep include the need for urinating, pain, noise and light. Our review found in particular to noise, it was a very significant barrier to sleep, as shown by high noise level recorded [*above 60 decibels*] within both settings. This recording exceeded the WHO recommendations on nighttime noise in hospitals which stated that the range of noise level for nighttime must be between 0 to 35 decibels, and daytime range between 0 to 45 decibels (Berglund, 1999). However, the significant difference between our review finding and WHO recommendation means that more efforts are required from HCPs to lower nighttime noise to meet WHO recommendations.

The differences were found in light and ward layout. Light luminance of ≤ 200 Lux is known to suppress hormone melatonin [*a hormone that plays a vital role in maintaining the 24-hour internal clock that regulates the sleepiness and alertness in human*] secretion (Brainard et al., 1997; Kamdar et al., 2012; Zisapel and Wise, 2018). The light measurements in two studies (Patel et al., 2014;

Delaney et al., 2018) set very significant differences. Delaney et al. (2018) found the light brightness level was <100 Lux in AW settings, compare to Patel et al. (2014) found that light level was 594 Lux in ICU settings. However, regardless of the differences, the light luminosity was not considered as significant sleep-inhibitor as the other environmental factors. Similar to light, temperature and humidity were not considered as sleep-inhibiting factors in both settings.

KEY POINTS

- Poor sleep quality in hospitals affects adult and vulnerable patients by reducing the body immune system to fight infections.
- Contributing factors to poor sleep quality include environmental factors [*noise, light, temperature and humidity*] as well as clinical care and clinical diagnostics.
- Research has shown evidence of the effectiveness of strategies to reduce noise and reduce disturbances to improve patients' sleep. However, night-time noise caused by healthcare professionals remains the most significant issue.
- Both ICU and AW settings share similarities and differences in factors that inhibit patients sleep in hospitals and sleep-promotion interventions.

The difference was also found on the wards' layout. Most ICU used single-rooms, while AW settings used 4-bedded bays. The reason for this difference is for cost-saving purposes, but bays are known to disperse and reflect noise (Foreman et al., 2015; Salzmann-Erikson et al., 2015; Delaney et al., 2018).

A notable finding is that all studies in this review reported that noise and disturbances from HCPs are the two main sleep-inhibitors in both settings. This report agrees with the results of a previous study that noise from alarms and HCPs are similarly disturbing and stressful (Pagnucci et al., 2019). Several suggestions for these issues may be providing single-rooms and staff education on noise reduction and minimal disturbances. The former suggestion is viable, but it is expensive to be implemented in non-acute wards. The latter suggestion seems more viable for future study as all studies in this review recommended an

educational and behavioural change to HCPs to raise awareness on noise reduction and sleep-disturbances.

4.1. Strength and Limitation

Our literature review followed strict PRISMA guidelines to minimize bias in literature selection, as well as used CASP to appraise the strength and validity of the literature. However, the databases search was not extended to unpublished literature; this may contribute to an incomplete summary of evidence in this topic. Furthermore, the population is too broad [*adult and elderly patients*] without distinction to their age-related and medical condition, such as hearing difficulties or sleep apnoea, which could impact on the validity of this review.

5. Conclusion

Our literature review showed that both ICU and AW settings share strategies to improve patients sleep quality. Although there are also differences between both settings, this is less relevant compared to the number of similarities found. Nevertheless, noise and sleep disturbances remain the most critical sleep-inhibiting factors in both settings. Even though it can be challenging, noise caused by HCPs is modifiable. One possible area for future research could be focused on changing HCPs' awareness and behaviour towards noise reduction and minimizing sleep disturbances to improve patients' sleep.

CPD REFLECTIVE QUESTION

- What are the consequences of poor sleep quality to patients in hospitals? Do they concern you? Why?
- Are you familiar with any of the sleep-promoting strategies? If so, have you ever implemented or seen them implemented for your patients? What are the benefits and challenges of the strategy?
- Who do you think is responsible for providing and promoting good quality of sleep to patients in hospitals?

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Appendix 1: Database Search Result:

Database	Record of initial search	Application of Limiter	Record of final result	Title scan	
				Included	Excluded
CINHAL	11,291	**Limiters** - Published Date: 20090101-20191231 **Narrow by SubjectMajor:** - melatonin, continuity of patient care, circadian rhythm, noise, fatigue, wakefulness, sleep deprivation, nursing care, staff, hospital, intensive care units, distraction, quality of health care, quality of life, task performance and analysis, sleep disorders, treatment outcomes, quality improvement, patient safety, sleep **Search modes** - Boolean/Phrase	118	57	61
PubMed	250	Reduc* Noise* AND Disturb* OR Interrupt* OR Disrupt* AND Sleep At Night OR Night-time OR Night time AND Improve* AND Sleep Deprivation AND "last 10 years"[PDat] AND Humans[Mesh]	109	45	64
ScienceDirect	250	Reduce Noise AND Interruption AND Sleep At Night AND Improve AND Sleep Deprivation. Year: 2009 – 2019, Review articles, Research articles	38	38	0
Web of Sciences	3,398	**TOPIC:** (Reduc* Noise* AND Disturb* OR Interrupt* AND Sleep At Night OR Night-time AND Improve* AND Sleep Deprivation) **Refined by: PUBLICATION YEARS:** (2019 OR 2011 OR 2018 OR 2010 OR 2017 OR 2009 OR 2016 OR 2015 OR 2014 OR 2013 OR 2012) AND [excluding] **DOCUMENT TYPES:** (REVIEW OR BOOK CHAPTER OR EDITORIAL MATERIAL OR PROCEEDINGS PAPER) AND [excluding] **WEB**	207	37	170

		OF SCIENCE CATEGORIES: (ENGINEERING ELECTRICAL ELECTRONIC OR AUTOMATION CONTROL SYSTEMS OR ENGINEERING MECHANICAL OR INSTRUMENTS INSTRUMENTATION OR MECHANICS OR ECOLOGY OR PHYSICS APPLIED OR COMPUTER SCIENCE ARTIFICIAL INTELLIGENCE OR OPTICS OR ENGINEERING BIOMEDICAL OR TELECOMMUNICATIONS OR MATHEMATICS INTERDISCIPLINARY APPLICATIONS OR ENGINEERING AEROSPACE OR GEOCHEMISTRY GEOPHYSICS OR REMOTE SENSING OR ZOOLOGY OR BIODIVERSITY CONSERVATION) AND [excluding] **WEB OF SCIENCE CATEGORIES:** (PHYSIOLOGY OR PHYSICS MATHEMATICAL OR PSYCHOLOGY EXPERIMENTAL OR QUANTUM SCIENCE TECHNOLOGY OR COMPUTER SCIENCE INTERDISCIPLINARY APPLICATIONS OR SPORT SCIENCES OR OCEANOGRAPHY OR TOXICOLOGY OR PHYSICS PARTICLES FIELDS OR TRANSPORTATION OR AUDIOLOGY SPEECH LANGUAGE PATHOLOGY OR PSYCHOLOGY OR AGRICULTURE MULTIDISCIPLINARY OR ANESTHESIOLOGY OR BIOTECHNOLOGY APPLIED MICROBIOLOGY OR ENDOCRINOLOGY METABOLISM OR ELECTROCHEMISTRY OR PHYSICS MULTIDISCIPLINARY OR ENGINEERING OCEAN OR ENGINEERING CIVIL OR LIMNOLOGY OR BIOCHEMICAL RESEARCH METHODS OR MANAGEMENT OR ASTRONOMY ASTROPHYSICS OR CELL BIOLOGY OR OBSTETRICS GYNECOLOGY OR RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING OR CHEMISTRY MULTIDISCIPLINARY OR OPHTHALMOLOGY OR WATER RESOURCES OR CHEMISTRY PHYSICAL OR PHYSICS FLUIDS PLASMAS OR ENGINEERING CHEMICAL OR ECONOMICS OR PSYCHOLOGY BIOLOGICAL OR ENGINEERING MULTIDISCIPLINARY OR ENGINEERING MARINE OR RESPIRATORY SYSTEM OR METEOROLOGY ATMOSPHERIC SCIENCES OR GEOGRAPHY PHYSICAL OR SOCIOLOGY OR ENERGY FUELS OR GREEN SUSTAINABLE SCIENCE TECHNOLOGY OR SOIL SCIENCE OR ENVIRONMENTAL STUDIES OR MATHEMATICS OR ANTHROPOLOGY OR MARINE FRESHWATER BIOLOGY OR METALLURGY METALLURGICAL ENGINEERING OR BUSINESS OR NUCLEAR SCIENCE TECHNOLOGY OR CARDIAC CARDIOVASCULAR SYSTEMS OR SPECTROSCOPY OR PEDIATRICS OR COMPUTER SCIENCE CYBERNETICS OR MATHEMATICAL COMPUTATIONAL BIOLOGY OR ROBOTICS OR COMPUTER SCIENCE HARDWARE ARCHITECTURE OR PSYCHIATRY OR BEHAVIORAL SCIENCES OR COMPUTER SCIENCE SOFTWARE ENGINEERING OR TRANSPORTATION SCIENCE TECHNOLOGY OR BIOPHYSICS OR DERMATOLOGY OR BIOLOGY OR EMERGENCY MEDICINE OR OTORHINOLARYNGOLOGY OR COMPUTER SCIENCE THEORY METHODS OR ENGINEERING GEOLOGICAL OR BIOCHEMISTRY MOLECULAR BIOLOGY OR FISHERIES OR ENTOMOLOGY OR COMPUTER SCIENCE INFORMATION SYSTEMS OR GERIATRICS GERONTOLOGY OR GERONTOLOGY OR CONSTRUCTION BUILDING TECHNOLOGY OR INTERNATIONAL RELATIONS OR MICROSCOPY OR ORNITHOLOGY OR NEUROIMAGING OR MATERIALS SCIENCE MULTIDISCIPLINARY OR PHYSICS CONDENSED MATTER OR PLANT SCIENCES) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*			
Cochrane Reviews	342		342	8	316
PsycInfo	13,777	**Limiters** - Publication Year: 2009-2019 **Narrow by Subject:** - wakefulness, sleepiness, sleep wake cycle **Narrow by Subject:** - sleep, sleep wake cycle, deprivation, intervention, sleep **Search modes** - Boolean/Phrase	21	11	10
Total	28,902		835	196	621