



Centre for Clinical Effectiveness

Enhancing patient outcomes through clinical application of the best available evidence

EVIDENCE CENTRE
CRITICAL APPRAISAL
Series 2002: Therapy

Optimum number of consecutive nights for shift workers

Nicki Jackson

June 2002

Southern Health

MONASH
UNIVERSITY

Centre for Clinical Effectiveness
Monash Institute of Health Services Research
Monash Medical Centre
Locked Bag 29
Clayton VIC 3168
Australia

Telephone: +61 3 9594 7505
Fax: +61 3 9594 7552
Email: cce@med.monash.edu.au (quote author of report)
URL: <http://www.med.monash.edu.au/healthservices/cce/>

June 2002

SUMMARY STATEMENT

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Publication of materials – please use the following format when citing this article:

Jackons, N. (2002). Optimum number of consecutive nights for shiftworkers. Available:
<http://www.med.monash.edu.au/healthservices/cce>

[Accessed:Access date...]

Form Version – B.2002.01.05.1

REQUEST

To see whether 2 nights on and 2 nights off is more or less healthy than 7 nights on and 7 nights off in HMO's?

REQUESTED BY

Dr Richard King, Chairman, HMO Management, Monash Medical Centre, Clayton

METHODOLOGY

Search Strategy

The Centre for Clinical Effectiveness defines the 'best available evidence' as that research we can identify that is least susceptible to bias. We determine this according to pre-defined National Health and Medical Research Council (NHMRC, 2000) criteria (see Appendix 1).

First, we search for systematic reviews, evidence based clinical practice guidelines, health technology assessments and randomised controlled trials. If we identify sound, relevant material of this type, the search stops. Otherwise, our search strategy broadens to include studies that are more prone to bias, less generalisable or have other methodological difficulties. We include case-control and longitudinal cohort studies in our critical appraisal reports. While we cite observational and case series studies, and narrative reviews and consensus statements, in our reports we do not critically appraise them. Such studies can produce accurate results but they are generally too prone to bias to allow determination of their validity beyond their immediate setting.

Details of Evidence Request

| | |
|---------------|--|
| Patients | Health professionals, shift workers |
| Interventions | Few consecutive night shifts |
| Comparisons | Longer consecutive night shifts |
| Outcomes | Cognition, task performance, sleep deprivation, sleep debt |

Search terms

(see Appendix 2 for exact search strategy)

Patient (Subject): shift work, night work, nightshift
Intervention: "Personnel staffing and scheduling", flexible scheduling, work schedule tolerance
Comparison: N.A.
Outcome: Cognition, fatigue, sleep deprivation, "Task Performance and Analysis"

Resources Searched

We searched the following databases:

The Cochrane Library (CD-ROM) 2002 Issue 2
Medline (OVID)- 1966 to April Week 3 2002
CINAHL (OVID)- 1982 to April Week 4 2002
Current Contents (OVID)- 1993 Week 27 to 2002 Week 20
PREMEDLINE (OVID)- May 16th 2002
Australasian Medical Index- accessed May 17th 2002
PsycINFO (OVID) – 1887 to May Week 1 2002

Refinements, Searching & Reporting Constraints

We included items of evidence that were available to us on the 13th, 15th, 16th and 17th May 2002. Critical appraisal was performed on the subset of studies published in English.

Excluded studies:

- Studies comparing consecutive night shifts with day shifts that did not examine the change in performance over time
- Studies with less than 5 subjects
- Studies with more than one intervention used i.e. the addition of bright light
- Studies where the mean number of consecutive nights could not be determined i.e. a mixed shift length is reported

RESULTS

From our sources we identified 54 potentially relevant articles. We obtained the full text of these articles to determine their relevance.

After examination of the 54 articles, the following were excluded as follows:

| Reason for exclusion | Number |
|---|-----------|
| More than one intervention used | 1 |
| Could not determine mean number of consecutive days | 1 |
| Less than 5 subjects | 2 |
| Not a primary study – no comparisons made between shift systems | 26 |
| Articles not available 4 th June 2002 | 3 |
| Narrative reviews | 12 |
| Total | 45 |

Eight articles then remained for appraisal. These studies are classified as follows:

| Study Design | Number included |
|--|-----------------|
| Systematic reviews or meta-analyses | 1 |
| Randomised controlled trials | 0 |
| Controlled trials, cohort or case-control analytic studies | 0 |
| Comparative studies | 8 |
| Total | 9 |

Based on our refinements, searching and reporting constraints we are reasonably confident these articles represent the most relevant findings published to date.

Findings

Overall, results of studies are not conclusive and highlight the fact that there appears to be no ideal nightshift system. In the majority of studies the shift systems have not been uniform across the sample. In addition, subjects have differed with regard to age structure, marital status, responsibility for children, freedom to choose working arrangement, and degree of self-selection. Therefore, conclusions regarding the optimum number of consecutive nights for health professionals are difficult to determine. Results from the studies outlined should be interpreted with caution.

Further studies are required which assess uniform shift length in similar subjects. Data should be collected objectively as subjective data is prone to bias and therefore less reliable.

EVIDENCE SUMMARIES

Format

Evidence summaries are presented as spreadsheets attached to this report. Each spreadsheet contains the article citation, details of the study design, patient description, scientific validity of the article, results, and pertinent remarks from the authors and Centre for Clinical Effectiveness reviewer.

REFERENCES

ARTICLES CRITICALLY APPRAISED FOR THIS REPORT

1. Barton, J., E. Spelten, et al. (1995). "Is there an optimum number of night shifts? Relationship between sleep, health and well-being." Work & Stress 9(2-3): 109-123.
2. Dingley, J. (1996). "A computer-aided comparative study of progressive alertness changes in nurses working two different night-shift rotas." Journal of Advanced Nursing 23(6): 1247-53.
3. Dirkx, J. (1993). "Adaptation to permanent night work: the number of consecutive work nights and motivated choice." Ergonomics 36(1-3): 29-36.
4. Fischer, F. M., A. D. Bruni, et al. (1997). "Do weekly and fast-rotating shiftwork schedules differentially affect duration and quality of sleep." International Archives of Occupational & Environmental Health 69(5): 354-360.
5. Pilcher, J. J., B. J. Lambert, et al. (2000). "Differential effects of permanent and rotating shifts on self-report sleep length: a meta-analytic review." Sleep 23(2): 155-63.
6. Totterdell, P., E. Spelten, et al. (1995). "Recovery from work shifts: How long does it take?" Journal of Applied Psychology 80(1): 43-57.
7. Vidacek, S., L. Kaliterna, et al. (1986). "Productivity on a weekly rotating shift system: circadian adjustment and sleep deprivation effects?" Ergonomics 29(12): 1583-90.
8. Wilkinson, R., S. Allison, et al. (1989). "Alertness of night nurses: two shift systems compared." Ergonomics 32(3): 281-92.
9. Williamson, A. M. and J. W. Sanderson (1986). "Changing the speed of shift rotation: a field study." Ergonomics 29(9): 1085-95.

ARTICLES NOT CRITICALLY APPRAISED

Articles not obtained by 4th June 2002

1. Rosa, R. R. and M. J. Colligan (1988). "Long workdays versus restdays: assessing fatigue and alertness with a portable performance battery." Human Factors 30(3): 305-17.
2. Smith-Coggins, R., M. R. Rosekind, et al. (1997). "Rotating shiftwork schedules: can we enhance physician adaptation to night shifts?" Academic Emergency Medicine 4(10): 951-61.
3. Westfall-Lake, P. (1997). "Shift scheduling's impact on morale, safety and performance." Occupational Health & Safety 66(10): 146-9.

Studies with less than 5 subjects

1. Dimilia, L. (1998). "A longitudinal study of the compressed workweek - comparing sleep on a weekly rotating 8 h system to a faster rotating 12 h system." International Journal of Industrial Ergonomics 21(3-4): 199-207.
2. Folkard, S., P. Totterdell, et al. (1993). "Dissecting circadian performance rhythms: implications for shiftwork." Ergonomics 36(1-3): 283-8.

Narrative reviews

1. Akerstedt, T. (1998). "Is there an optimal sleep-wake pattern in shift work?" Scandinavian Journal of Work, Environment & Health 24(Suppl 3): 18-27.
2. Folkard, S. (1992). "Is there a 'best compromise' shift system?" Ergonomics 35(12): 1453-63; discussion 1465-6.
3. Goh, V. H., T. Y. Tong, et al. (2000). "Sleep/wake cycle and circadian disturbances in shift work: strategies for their management--a review." Annals of the Academy of Medicine, Singapore 29(1): 90-6.
4. Higgs, V. (2000). "Learn the rhythm of the night (shift)." Nursing 30(5 Hosp Nurs).
5. Kecklund, G. A. T. (1995). "Effects of timing of shifts on sleepiness and sleep duration." Journal of Sleep Research 4(S2): 47-50.
6. Knauth, P. (1993). "The design of shift systems." Ergonomics 36(1-3): 15-28.
7. Knauth, P. (1995). "Speed and direction of shift rotation." Journal of Sleep Research 4(S2): 41-46.
8. Lowry, R. T. (1998). "An end-of-shift tale." Annals of Emergency Medicine 31(2): 287-8.
9. Raymond, C. A. (1988). "Rotating work schedules give new meanings to familiar 'early to bed, early to rise'." Jama 259(20): 2959-60.
10. Samkoff, J. S. and C. H. Jacques (1991). "A review of studies concerning effects of sleep deprivation and fatigue on residents' performance." Academic Medicine 66(11): 687-93.
11. Wedderburn, A. A. (1992). "How fast should the night shift rotate? A rejoinder." Ergonomics 35(12): 1447-1451.
12. Wilkinson, R. T. (1992). "How fast should the night shift rotate?" Ergonomics 35(12): 1425-46.

Cannot determine mean number of consecutive night shifts

1. Alward, R. R. and T. H. Monk (1990). "A comparison of rotating-shift and permanent night nurses." International Journal of Nursing Studies 27(3): 297-302.

More than one intervention used i.e. bright light

1. Bougrine S, M. R. I. G. C. A. (1998). "Days off and bright light: Effects on adaptation to night work." International Journal of Industrial Ergonomics **21**(3-4): 187-198.

APPENDIX 1

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Levels Of Evidence

Based on "How to use the evidence: assessment and application of scientific evidence" (National Health & Medical Research Council, Canberra, 2000):

| | | |
|-----------|----|---|
| Level I | | Evidence obtained from a systematic review (or meta-analysis) of all relevant randomised controlled trials. |
| Level II | | Evidence obtained from at least one randomised controlled trial. |
| Level III | -1 | Evidence obtained from pseudo-randomised controlled trials (alternate allocation or some other method). |
| | -2 | Evidence obtained from comparative studies (including systematic reviews of such studies) with concurrent controls and allocation not randomised, cohort studies, case control studies or interrupted time series with a control group. |
| | -3 | Evidence obtained from comparative studies with historical control, two or more single-arm studies or interrupted time series without a parallel control group. |
| Level IV | | Evidence obtained from case series, either post-test or pretest/post-test. |

APPENDIX 2

Search strategy

| | Search terms for MEDLINE, CINAHL, PREMEDLINE, Current Contents |
|----|---|
| 1 | "Personnel staffing and scheduling"/ |
| 2 | Work Schedule Tolerance/ |
| 3 | (Night adj5 shift).mp. |
| 4 | (Night adj5 work).mp. |
| 5 | (shift adj5 work).mp. |
| 6 | (work adj5 schedule).mp. |
| 7 | Roster.tw. |
| 8 | Or/1-7 |
| 9 | Exp Sleep Deprivation/ or exp Sleep/ |
| 10 | Exp Fatigue |
| 11 | Exp Cognition/ |
| 12 | Exp "Task Performance and Analysis"/ |
| 13 | Arousal/ or attention/ or wakefulness/ or reaction time/ |
| 14 | Or/9-13 |
| 15 | 8 and 14 |

| <p>Evidence Summary Systematic Review</p> <div data-bbox="179 215 582 375" style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Optimum number of consecutive nights for shiftworkers</p> </div> | <p>Study 1</p> <p>Pilcher, J. J., B. J. Lambert, et al. (2000). "Differential effects of permanent and rotating shifts on self-report sleep length: a meta-analytic review." <i>Sleep</i> 23(2): 155-63.</p> |
|---|--|
| <p>STUDY DESIGN & NHMRC LEVELS OF EVIDENCE</p> | <p>Level I – Meta-analysis of sleep duration only</p> |
| <p>DESCRIPTION: Patient (subjects), Interventions, Comparisons, Outcomes, Inclusion & Exclusion Criteria</p> | <p>Patients (Subjects): Permanent shiftworkers (evening and night) and rotating shiftworkers (morning, evening and night). Intervention: Permanent shiftwork (5-7 days in a row) Comparisons: Rapid rotating shiftwork (2-3 days in a row) Outcomes: Subjective self-reported sleep duration Incl and Excl criteria:</p> <ol style="list-style-type: none"> 1) Studies had to report on actual shift-work and no laboratory-based shift-work 2) The type of shift had to be either rotating, permanent evening, or permanent night, and had to be 8 hours in duration 3) Data on self-report sleep length had to be included 4) Enough information had to be provided to allow computation of an effect size statistic for each related measure (Mean and standard deviation) 5) Excluded if the study did not specifically define the type of shift |
| <p>VALIDITY: Methodology, rigour, selection, analysis</p> | <p>Focussed question: To examine the differential effects of rotating and permanent shifts on sleep length using the meta-analytic technique. Search strategy: PsycINFO (1987-1997), Medline (1986-1997), Bibliosleep (1992-1997), Sleep Research Bibliography (1986-1997), and secondary references from narrative reviews. Assessed validity: Not reported. Consistent results: Not reported. Appropriate analysis of results: Meta-analytic technique. Referenced analysis, and justified what results were deemed significant. The size of the shift-work sample was used to assign the weight factor.</p> |
| <p>RESULTS: Generally favourable or unfavourable, specific outcomes of interest, estimate of experimental effect and precision if appropriate</p> | <p>Rapidly rotating shifts resulted in less sleep in comparison to the control group (dayshift workers) than slowly rotating shifts. Night shifts under rotating shift work systems resulted in less reported sleep length than permanent night shifts. Furthermore, night shifts under rapidly rotating shift systems had the most negative effect on sleep length in comparison to the control group.</p> |

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| <p>AUTHORS COMMENTS: Limitations, implications for practice and research</p> | <p>“When comparing across the night shifts under permanent, rapidly rotating, and slowly rotating shift-work conditions, our data suggest that workers on permanent nights adjust, at least to some degree, to sleeping during the day. This limited adjustment on the part of permanent night workers may be simply due to the individuals being required to work numerous night shifts in a row, thus, increasing their physiological need for sleep, even if during the daylight hours. It is possible that rapidly rotating shifts, instead of creating a less detrimental environment by not requiring the workers to adjust their endogenous rhythms to new work schedules, may be creating an environment that causes sleep-related problems by the very nature of rapidly changing work and sleep schedules.”</p> |
| <p>OUR COMMENTS: Opportunity for bias, weakness and strength</p> | <p>Weakness: No comment on validity of individual studies included in the meta-analysis. Strength: The methodology of a meta-analysis is designed to reduce bias. Thirty-six primary studies are included which yielded a suitable sample size.</p> |

| <p style="text-align: center;">Evidence Summary Therapy/Intervention</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Optimum number of consecutive nights for shiftworkers</p> </div> | <p style="text-align: center;">Study 2</p> | <p style="text-align: center;">Study 3</p> |
|--|--|--|
| <p>STUDY DESIGN & NHMRC LEVELS OF EVIDENCE</p> | <p>Level III – Comparative Study</p> | <p>Level III – Comparative Study</p> |
| <p>DESCRIPTION: Patients (subjects), Intervention, Comparisons, Outcomes, Inclusion & Exclusion Criteria</p> | <p>Patients (subjects): Shiftworkers at a petrochemical plant in Brazil. Intervention: Cubatao plant – 7 nights/afternoon/ morning, 4 days off (n=34) Comparisons: Santo Andre plant – 3-4 nights, 2 days off (n=33) Outcomes: Sleep duration, quality of sleep assessed by Visual Analogue Scale. Assessments made on 1st night at both plants, an intermediate night (days 2-6 Cubatao, days 2-3 Santo Andre), and the last night (day 7 Cubatao, days 3-4 Santo Andre) Inclusion Criteria: Male volunteers from the petrochemical plants.</p> | <p>Patients (subjects): Convenience sample. Two groups of nurses; one working permanent night work and one working on a rapidly rotating roster. Intervention: 7-8 days, 6-7 days off (n=10) Comparisons: 4 nights, 3 days off (n=10) Outcomes: Visual analogue scale – internal feelings, perceptions, sensations. Computerised unprepared simple reaction time task at beginning and end of shift. Incl & Excl Criteria: Inclusion: Female qualified nurses. Other criteria not reported.</p> |
| <p>VALIDITY: Methodology, rigour, selection</p> | <p>Similar groups: Age distribution and mean age not significantly different. Gender, industry variables (similar working schedules-hours, time starting), mean time on job working shifts all comparable.</p> | <p>Similar groups: No significant differences in the reaction time scores at the start of the first shift. Demographics not reported.</p> |
| <p>RESULTS: Generally favourable or unfavourable, specific outcomes of interest, estimate of</p> | <p>Workers during night and morning shifts had fewer hours of sleep than during all other work and free days.</p> | <p><u>Reaction times (RT)</u> Permanent: RT on 1st night was slower than on the 4th night (p<0.05). RT on 4th night not</p> |

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| <p>experimental effect and precision if appropriate</p> | <p>Sleep duration:</p> <p>1st night : 5.71 hours for Cubatao vs. 5.25 hours Santo Andre Intermediate night : 5.75 hours vs. 5.89 hours respectively Last night : 5.53 hours vs. 4.77 hours respectively</p> <p>Quality of sleep (highest score is better): 1st night : 36.59 for Cubatao vs. 52.26 Santo Andre Intermediate night : 42.48 vs. 53.28 respectively Last night : 49.63 vs. 53.73 respectively</p> | <p>significantly different than RT on last night. RT on last night was significantly better than RT on 1st night ($p < 0.05$).</p> <p>Rotating: The RT at the end of the 1st night was significantly worse than the RT at the end of the 4th night ($p < 0.001$).</p> <p>Comparison between shift systems: No comparison made.</p> <p>Visual analogue scale</p> <p>Permanent: Nurses reported feeling significantly more alert at the start of the 1st night and 4th night than on the last night ($p < 0.01$). They were less alert on 1st night compared to the 4th night (not significant). The end of shift testing showed no significant differences between any of the nights worked.</p> <p>Rotating: The alertness at the start of the 1st night was similar to the 4th night. When tested at the end of the nurses were significantly more alert at the end of the 4th night compared to the end of the 1st night.</p> <p>Comparison between shift systems: No significant difference between shift systems.</p> |
| <p>AUTHOR(S) CONCLUSIONS: Limitations, implications for practice and research</p> | <p>"These results support recommendations by several authors to reduce the number of consecutive nights of shift work".</p> | <p>"One possible explanation [for the reaction time tasks] is that the nurses became used to the tests after the first few attempts and so their performance peaked at around the 4th day".</p> |
| <p>OUR COMMENTS: Opportunity for bias, weakness and strength</p> | <p>Potential for bias: Subjective data on sleep behaviour. Potential for recall bias and interviewer bias. Volunteers may not be representative of the total population.</p> <p>Weakness/es: Data collected in 2 different plants in 2 different years. Results may not be generalisable to the health professional population.</p> | <p>Weakness/es: No comparison made between shift systems for reaction times.</p> <p>Strength/s: A pilot study was conducted to test the applicability of the visual analogue scale and computerised reaction time test.</p> |

| <p style="text-align: center;">Evidence Summary Therapy/Intervention</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>Optimum number of consecutive nights for shiftworkers</p> </div> | <p style="text-align: center;">Study 4</p> | <p style="text-align: center;">Study 5</p> |
|---|---|---|
| <p>STUDY DESIGN & NHMRC LEVELS OF EVIDENCE</p> | <p>Level III – Comparative Study</p> | <p>Level III – Comparative Study</p> |
| <p>DESCRIPTION: Patients (subjects), Intervention, Comparisons, Outcomes, Inclusion & Exclusion Criteria</p> | <p>Patients (subjects): Male and female nightshift nurses. Intervention: Permanent full-time and part-time nurses (mean of 5.8 consecutive days (range 2-10)) (n=581) Comparisons: Rotating full-time shiftworkers (between morning, afternoon and nightshift) (mean of 5 consecutive days (range 2-15)) (n=761) Outcomes: Standard Shiftwork Index – psychological ill-health, chronic fatigue, digestive and cardiovascular symptoms, neuroticism, attitude towards shiftwork, social and domestic and nondomestic disruption. Inclusion Criteria: Not reported.</p> | <p>Patients (subjects): Two groups of female permanent night nurses Intervention: <i>Many nights (5-8) in a row (n=42)</i> Comparisons: Few (1-4) nights in row (n=36) Outcomes: Subjective health, job satisfaction, lifestyle, social support and coping Incl & Excl Criteria: Inclusion: Female nurses in Belgian general and psychiatric regional hospitals.</p> |
| <p>VALIDITY: Methodology, rigour, selection</p> | <p>Similar groups: No comparisons reported.</p> | <p>Similar groups: Groups did not differ significantly. Matched for important moderating variables (previous experience with night shift, percentage full-time and part-time, age, number of children)</p> |
| <p>RESULTS: Generally favourable or unfavourable, specific outcomes of interest, estimate of experimental effect and precision if</p> | <p>Permanent night workers For full-time nurses more consecutive nights worked were associated with more positive</p> | <p>Subjective health No significant differences between the 2 groups concerning 10 measures used to operationalise</p> |

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| <p>appropriate</p> | <p>attitudes towards shiftwork. For part-time nurses more consecutive nights were associated with lower levels of chronic fatigue. No significant association between number of nights and sleep quality. Significant positive association between number of nights and sleep duration between night shifts. Longer sleeps were associated with better quality sleep. Significant positive relationship was found for sleep quality and all outcome measures. Mediating effect: Therefore, more consecutive nights worked were predictive of longer sleep durations between night shifts. Longer sleeps were in turn predictive of better quality sleep, with better quality sleep being the stronger predictor of less chronic fatigue, better psychological health, and fewer symptoms of physical ill-health.</p> <p>Rotating night workers No significant relationship between number of consecutive nights and health and well-being. No significant association between number of nights worked and sleep quality. Significant association between sleep duration and number of nights worked. More nights worked resulted in longer sleep duration. More ill-health associated with shorter sleeps. Mediating effect: Same as for permanent night workers, but the strength of the association was weaker than for permanent nurses.</p> | <p>subjective health.</p> <p>Sleep behaviour Significant difference for day sleep after last work night, with the many-night nurses staying in bed about 1 hour less.</p> <p>Job satisfaction, lifestyle No difference between the 2 groups concerning 5 subscales of the Job Description Index. No difference in lifestyle satisfaction between the 2 groups, with the means lying between moderately satisfied and slightly satisfied.</p> <p>Social support and coping Active Coping Scale – many night nurses scored significantly higher than the few night nurses. No differences found in other scales.</p> <p>Risk factors More many night nurses smoked cigarettes ($p=0.05$). Those who smoked, smoked more cigarettes per day than the few night nurses. Significantly more many night nurses drink alcoholic beverages ($p=0.02$). Many night nurses who engaged in sport spent twice as much time therein than the few night nurses ($p=0.008$).</p> |
| <p>AUTHOR(S) CONCLUSIONS: Limitations, implications for practice and research</p> | <p>“All the data presented were in fact self-reported. Given the potential bias in responding that may be associated with this methodology, caution must be exercised in interpreting the results. It should be noted that the amount of variance explained in the present study was in fact small, and therefore firm conclusions cannot be drawn”.</p> | <p>“In conclusion, it appears that the many night nurses seem to put more effort in dealing with their schedules. However, the difference between the 2 schedules concerning outcome measures is not so great that, in our actual sociocultural setting, we should suggest that nurses refrain from working 7 nights in a row.”</p> |

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| <p>OUR COMMENTS: Opportunity for bias, weakness and strength</p> | <p>Potential for bias: Interviewer may elicit desired response from participants. Weakness/es: Huge variation in number of consecutive nights worked in all subjects. May not be suitable to pool all workers together. Strength/s: Standard Shiftwork Index may be more reliable than an interview carried out by the investigator.</p> | <p>Potential for bias: Information was obtained through interviews, which can be fraught with biases, including interviewer bias and recall bias. Weakness/es: Only 29% of the many-night nurses were full-time; 22% of the few night nurses were full-time. The addition of full-time and part-time nurses may not be suitable, as these groups differ in a number of ways. Strength/s: Use of validated questionnaires for some outcome measures.</p> |
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| <p style="text-align: center;">Evidence Summary Therapy/Intervention</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>Optimum number of consecutive nights for shiftworkers</p> </div> | <p style="text-align: center;">Study 6</p> | <p style="text-align: center;">Study 7</p> |
|---|--|---|
| <p>STUDY DESIGN & NHMRC LEVELS OF EVIDENCE</p> | <p>Level III – Comparative Study</p> | <p>Level III – Comparative Study</p> |
| <p>DESCRIPTION: Patients (subjects), Intervention, Comparisons, Outcomes, Inclusion & Exclusion Criteria</p> | <p>Patients (subjects): 61 female nurses</p> <p>Intervention: 32 nurses working in a fast internal rotation system (mean of 4.16 consecutive days, 2.43 days off)</p> <p>Comparisons: 29 full-time and part-time permanent night nurses (full-time: mean of 3.73 consecutive days, 3.88 days off; part-time: mean of 2.73 days, 4.30 days off)</p> <p>Outcomes: Sleep diary. Self-rating scales – sleep length and quality, alertness, cheerfulness, calmness, mood symptoms, social satisfaction. Reaction time test and memory test every 2 hours during shift.</p> <p>Incl & Excl Criteria: Inclusion: Female nurses. Insufficient data reported.</p> | <p>Patients (subjects): Female student night nurses.</p> <p>Intervention: 7 consecutive nights, 6 days off (n=16)</p> <p>Comparisons: 3-4 nights, 3-4 days off (n=8) 3 month roster</p> <p>Outcomes: Unprepared Simple Reaction Time task. Performed twice per night on days 1, 4 and 7 for the many-nights nurses and on days 1, 4, 45, 87 and 90 for the fewer-night nurses.</p> <p>Incl & Excl Criteria: Inclusion: Female student nurses.</p> |
| <p>VALIDITY: Methodology, rigour, selection</p> | <p>Similar groups: The permanent group of nurses were significantly older and more</p> | <p>Similar groups: Demographics not reported. Reaction time on both the early and late 1st</p> |

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| | <p>experienced with shift-work. The sample of 61 nurses was representative of the 1532 nurses that took part in a survey of nursing shift work in England and Wales.</p> | <p>night tests revealed no significant differences between the 2 groups.</p> |
| <p>RESULTS: Generally favourable or unfavourable, specific outcomes of interest, estimate of experimental effect and precision if appropriate</p> | <p>Compliance rate for end-of-day self-rating scales was 85%, for sleep diaries 91%.</p> <p>Recovery on rest days All of the measures, except sleep quality, for the full-time and part-time night nurses and calmness for the rotating shift workers showed a pattern in which the measures were at their worst on the 1st rest day following a night shift and were better on the subsequent rest days. The number of previous night shifts did not affect recovery.</p> <p><u>Effects of consecutive nights</u> (i.e. 4 or fewer – part-time nurses excluded) Alertness was lowest on the 2nd night shift of the rotating system. The perceived workload increased over consecutive nights. For permanent night workers sleep length and sleep quality decreased significantly over consecutive nights ($p < 0.007$). No other measures were significant. Reaction time decreased over consecutive nights for the permanent night workers.</p> <p><u>Effects of rest days on subsequent workdays</u> (for all nurse which had 2-5 rest days between night shifts) Social satisfaction was significantly greater after more rest days following night shift ($p < 0.007$). Sleep quality showed the same trend, but the other 5 measures were actually worse after night shifts that followed more than 2 rest days. Reaction time was highest on night shifts that were preceded by 4 rest days (not significant).</p> | <p>End of shift test: The last night was worse than the 1st night in the weekly system ($p < 0.01$). The 90th night (last night) was no different than the 1st night for the 3-month fewer-night system.</p> <p>Comparison of the 2 shifts: maintenance of performance (last night minus first night) was taken as an index of deterioration in performance. The early test yielded no significant results but the late shift test showed greater deterioration in the weekly rotating routine than in the 3 month fewer-night routine ($p < 0.02$).</p> <p>There was considerable individual variation in the nurses' ability to sustain alertness during continuous night work.</p> |
| <p>AUTHOR(S) CONCLUSIONS: Limitations, implications for practice and</p> | <p>"Although we controlled for day of study in our analyses, it is still possible that some of the</p> | <p>"As might be expected, significant effects were only found for tests carried out later in the shift,</p> |

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| research | results from the performance tasks reflect practice effects...Participants were less practiced following more rest days and were more practiced at the end of longer sequences of consecutive shifts.” | when fatigue and the time of night would be expected to interact with any loss of sleep present. The results during the night shift exemplify the problems inherent in weekly rotating systems. The arrangement does not allow enough time for adaptation of the circadian cycle to allow work to be done well at night and sleep to be taken during the day. Caution must be exercised in generalising from the present trainee nurses to nurses as a whole and still more to the general body of shift workers”. |
| OUR COMMENTS: Opportunity for bias, weakness and strength | Potential for bias: Subjective data – may be reported in a non-comparable manner. Weakness/es: Permanent nurses not uniform in their shift length. | Weakness/es: Insufficient data was reported on similarity of the groups studied. Trainee nurses may not be representative of the larger population of qualified nurses. Strength/s: Sensitivity proved for Reaction Time task. |

| <p style="text-align: center;">Evidence Summary Therapy/Intervention</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Optimum number of consecutive nights for shiftworkers</p> </div> | <p style="text-align: center;">Study 8</p> | <p style="text-align: center;">Study 9</p> |
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| <p>STUDY DESIGN & NHMRC LEVELS OF EVIDENCE</p> | <p>Level III – Comparative Study</p> | <p>Level III – Comparative Study</p> |
| <p>DESCRIPTION: Patients (subjects), Intervention, Comparisons, Outcomes, Inclusion & Exclusion Criteria</p> | <p>Patients (subjects): 53 female shift workers performing simple perceptual motor jobs in an electronics factory. Intervention: 5 successive night shifts, 2 rest days Comparisons: Successive morning and afternoon shifts Outcomes: Sleep, productivity assessed over 4 month period without the workers’ knowledge Inclusion Criteria: Female shift workers employed in manufacturing capacitors.</p> | <p>Patients (subjects): Controllers of an emergency service Intervention: Stage 1 -Weekly rotating 3 shifts of morning, afternoon and night shifts – 7 consecutive days, 2 days off (n=33) Comparisons: Stage 2- Rapidly rotating shift system – no more than 3 consecutive nights, 3 days off (n=26). This change was made to the above system. 16 controllers were involved in both parts of the study. Outcomes: Interviews – demographics and well-being, Work Environment Scale, State-Trait Anxiety Inventory Inclusion Criteria: Not reported.</p> |
| <p>VALIDITY: Methodology, rigour, selection</p> | <p>Similar groups: The 30 shiftworkers who completed the questionnaire on sleeping habits was representative of all the shiftworkers employed in manufacturing capacitors.</p> | <p>All patients accounted for: Not reported. Similar groups: Similar in age, educational background, travel time, and experience with shift-work.</p> |
| <p>RESULTS: Generally favourable or unfavourable, specific outcomes of interest, estimate of experimental effect and precision if appropriate</p> | <p>Married workers slept the shortest between successive night shifts. Overall, nightshift workers slept less than the morning and afternoon shiftworkers. Morning and afternoon shift productivity was relatively constant over the week, night shift</p> | <p>Incidence of occasional appetite loss did not change with the new shift roster; 46% of controllers complained in each group. Sleep difficulties were common in Stage 1 but</p> |

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| | <p>productivity varied quite considerably ($p < 0.001$). Productivity was lowest on the 1st and 2nd days of the week. Highest on the 3rd day, and then decreasing slightly on days 4 and 5. Day 5 productivity was higher compared to Day 2.</p> | <p>the incidence had fallen considerably with introduction of the rapidly rotating shift system.</p> <p>Problems waking too early, feeling tired, irritable or unrefreshed after sleep were virtually eliminated in Stage 2 ($p < 0.001$).</p> <p>Changes in use of cigarettes, alcohol and caffeine-containing beverages was not significant over the study period. Overall, absentee rates dropped from 6% to 4%, with a lower incidence of illness reported. For those who participated in both stages 63% had some improvement in reported symptoms (major improvements in incidence of headache and digestive problems $p < 0.05$). Job satisfaction was significantly higher in Stage 2 ($p < 0.03$). Work pressure was significantly reduced in Stage 2 ($p < 0.001$).</p> |
| <p>AUTHOR(S) CONCLUSIONS: Limitations, implications for practice and research</p> | <p>"Circadian adjustment played the major role for the first 3 nights, but sleep deprivation effects subsequently dominated. However, it is unclear whether there was residual circadian adjustment after the first 3 nights that was masked by cumulative sleep deprivation effects, or whether complete circadian adjustment had occurred at this point. The present results indicate that a weekly rotating shift system may be a relatively good one from the point of view of simple perceptual motor productivity on the night shift."</p> | <p>"Thus, any positive effects detected by this study may not be due solely to the specific change in shift roster, but to the effects of change itself and all the attendant activity. This study shows therefore that a reduction in the number of consecutive number of the more anti-social shifts can be highly beneficial to the worker".</p> |
| <p>OUR COMMENTS: Opportunity for bias, weakness and strength</p> | <p>Potential for bias: Subjective data is very prone to bias. Weakness/es: Results may not be applicable to the healthcare setting, as the work was very monotonous.</p> | <p>Potential for bias: Interviewer bias – may elicit desired response from employees. Subjective data – subjects may recall data in a non-comparable manner.</p> |

