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Effectiveness of staffing models in residential, subacute, extended aged care settings on patient and staff outcomes (Review)

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[Intervention Review]

Effectiveness of staffing models in residential, subacute, extended aged care settings on patient and staff outcomes

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A B S T R A C T

Background

A key concern for managers and nurse administrators of healthcare settings is staffing. Determining and maintaining an appropriate level and mix of staff is especially problematic for those working in the long-term aged-care sector, where resident needs are complex and recruitment and retention of staff is challenging.

Objectives

To identify which staffing models are associated with the best patient and staff outcomes.

Search methods

We searched the Effective Practice and Organisation of Care (EPOC) Group Trials Register, the Cochrane Central Register of Controlled Trials (CENTRAL) and the Database of Abstracts of Reviews of Effectiveness (DARE) in *The Cochrane Library* and the databases MEDLINE, EMBASE, Ageline, CINAHL, and Dissertation abstracts. We also handsearched the reference lists and bibliographies of all retrieved articles.

Selection criteria

This review considered interrupted time series studies and studies with concurrent control designs of care staff or residents of residential or subacute or extended aged-care settings that evaluated the effectiveness of staffing models and skill mixes on resident and care staff outcomes.

Data collection and analysis

Two review authors critically appraised all studies that were retrieved based on the screening of titles and abstracts according to the EPOC Group's data collection checklist.

The same two review authors independently extracted and summarised details of eligible studies using the data abstraction form developed by EPOC.

Main results

We included two studies (one interrupted time series and one controlled before-and-after study); both evaluated a primary-care model compared with a either a team-nursing model or a usual-care model. The primary-care model was found to provide slightly better results than the comparator for some outcomes such as resident well-being or behaviour. While nursing staff favoured the primary-care model in one study, neither study found significant improvements in staff outcomes using the primary model compared with the comparator. One study evaluated the uptake of the primary-care model within their facilities and found incorporation of this model into their practice was limited.

Authors' conclusions

Apart from two small studies evaluating primary care, no evidence in the form of concurrently controlled trials could be identified. While these two studies generally favour the use of primary care, the research designs of both ITS and CBA studies are considered prone to bias, specifically selection and blinding of participants and assessors. Therefore, these studies should be regarded with caution and there is little clear evidence for the effective use of any specific model of care in residential aged care to benefit either residents or care staff. Research in this area is clearly needed.

PLAIN LANGUAGE SUMMARY

Effectiveness of staffing models in residential/subacute/extended aged-care settings

No conclusive research exists to suggest that any nursing model or skill-mix model would be effective at improving patient or staff well-being in a residential aged-care facility. The evidence presented for a primary-care model is not sufficient to suggest its use in an aged-care facility.

BACKGROUND

A key concern for managers and nurse administrators of healthcare settings is staffing. Determining and maintaining an appropriate level and mix of staff is especially problematic for those working in the long-term aged-care sector, where resident needs are complex and recruitment and retention of staff is challenging. Many staffing models exist, however, knowing which model is associated with the best outcomes for residents of aged-care facilities is not well established. For example, does having more nurses necessarily equate with better care? Which staffing models are associated with lower staff stress and turnover? How many nurses per resident are optimal? What mix of skills is most appropriate?

One approach is providing staff as a ratio of the number of residents on a unit or ward. The State of Victoria in Australia introduced staff-patient ratios in the public sector in 2001. The ratios were not derived from a strong evidence base but arose as part of an industrial agreement with the State Government. In the US, California has also adopted a staff-patient ratio approach to staffing. However, the literature is divided about the effectiveness of patient-staff ratios. A study conducted by Abt Associates for Centres for Medicare and Medicaid services concluded that there are thresholds of optimal staffing levels, below which quality of care is

compromised and above which, there is no significant impact on quality outcomes (Cambridge 2001). A recent systematic review which investigated the effects of nurse staffing in the acute care setting on patient, nurse employee and hospital outcomes failed to find any evidence to support minimum nurse-patient ratios (Lang 2004). The authors recommended that other variables, such as "patient acuity, skill mix, nurse competence, nursing process variables, technological sophistication and institutional support of nursing" (p.335) should be considered when arranging staffing requirements.

An alternate staffing model takes into account the skill mix of staff. Skill mix can be operationalised as the "mix of posts, grades or occupations in an organisation" (Buchan 2002). Staffing ratios have been criticised for being too simplistic, in that they are based on the assumption that all patients and patient days are equal. This is not reflective of reality, where care among patients varies substantially; the amount of care required for an entire admission varies and a focus on patient-staff ratios ignores patient differences and needs (Graf 2003).

Mueller suggests that there are a number of factors which should be taken into consideration when considering staffing and skill mix

(Mueller 2000). Aside from the actual care requirements, these factors include the type of unit/ward (e.g. dementia specific), available supporting services, architectural design and layout and staff competency.Mueller uses all these factors to develop a framework for nurse staffing in long-term care (LTC) nursing facilities.

Bowers, Lauring and Jacobson (Bowers 2001) found that nurses working in long-term care reported that consistent assignments (continuity of care) reduced the time necessary to complete their work by reducing the number of unanticipated interruptions. Nurses who organised their workload by *resident* found they were able to talk to the residents while completing work, spent less time going from room to room and increased the interaction time with residents. Nurses who organised themselves by *tasks* spent less time interacting with individual residents and more time travelling between 'tasks'.

Similarly the concept of a primary-care/primary-nursing model has been defined as consisting of the following four fundamental principles (Manthey 1980):

1. 24-hour accountability and decision making by one nurse for several patients over time,

2. case method of assignment,

3. direct communication between caregivers, and

4. a shift in emphasis in the head nurse role to that of facilitator.

McGilton proposed a model of care to enhance the quality of life for residents of long-term care facilities, which involves continuity of care provider, as well as the acquisition of skills and knowledge required to enhance interpersonal relationships and support from nursing supervisors (McGilton 2002). McGilton's literature review found that continuity of care was not just of benefit to residents (fewer incidences of agitation, improved affect, improved physical integrity, increase in well-being) but also of benefit to care providers (improved attitude towards older people, reduced turnover, decreased job-related stress levels and improved perceptions of the work environment, more certainty about interpretation of residents behaviours, closer relationship with residents). However, it is important to note that continuity of care can be challenging at times when particular residents are difficult to be with on a daily basis.

Some other approaches to staffing in long-term care facilities have been listed (Goldman 1998).Under a functional or hierarchical model, nursing assistants (NAs) assist residents with activities of daily living while licensed practising nurses (LPNs) administer medication and treatments, and both registered nurses' (RNs)/LPNs' roles include assessment, documentation and care planning. The focus of a team-based model is shared responsibility and accountability for a specific group of residents, while under a case-management approach, total care is provided for a resident by one nurse per shift, however without any 24-hour responsibility. Under a primary-nursing approach, every patient is assigned an individual nurse who plans, evaluates and administers care.

Finally, evidence from a number of studies suggest that there is a correlation between the number of nursing staff and the quality of care residents receive in residential aged-care facilities (Maas 2008a). Other reports have described the likely reduction in outcomes common to residents of nursing homes such as pressure ulcers, falls, urinary incontinence and even social isolation with an increase in knowledgeable nursing staff. However, few studies have attempted to directly evaluate the effectiveness of reducing these outcomes.

Therefore, the objective of this review was to identify all available controlled trials that have evaluated nursing models in residential aged care designed to reduce negative outcomes for residents.

Description of the condition

Not applicable.

Description of the intervention

Staffing models, in the context of this review, refer to how staffing was organised to meet resident/patient needs and thus includes the mix, and the level of skills. Staffing models have further been defined as "integrating the vision on the patient and the design of the organisation" (Boumans 2005). Therefore, such interventions as staffing ratios, skill mixes, continuity of care and primary nursing and their effects on resident and staff outcomes are of interest.

How the intervention might work

There is a body of qualitative and narrative evidence to suggest that:
- there is a distinct relationship between staffing levels in residential aged care and outcomes of improved well-being in residents as well as staff satisfaction and staff turnover (Bostick 2006; Maas 2008a);

- consistent assignments (**continuity of care**) reduce the time necessary to complete work by reducing the number of unanticipated interruptions (Bowers 2001);

- continuity of care was not just of benefit to residents (fewer incidences of agitation, improved affect, improved physical integrity, increase in well-being) but also of benefit to care providers (improved attitude towards older people, reduced staff turnover, decreased job-related stress levels and improved perceptions of the work environment, more certainty about interpretation of residents' behaviours, and closer relationship with residents) (McGilton 2002).

Why it is important to do this review

Getting staff mixes and numbers right to ensure that residents of aged-care facilities receive the best care and experience the best quality of life possible has been an ongoing issue for managers of these facilities. To date, it is unclear if there are effective models of care that can ensure the most positive outcomes for residents. Therefore, this review will attempt to identify and assess the quality of all experimental research designed to evaluate the effectiveness of specific nursing models in improving resident quality of life and health outcomes. The review will also consider what research in this area still needs to be conducted.

OBJECTIVES

This review aimed to:

- identify which staffing model/s are associated with best outcomes (e.g. improved patient health outcomes, reduced error rates), for residents of residential/subacute/extended aged-care setting;

- identify which staffing model/s are associated with lower staff turnover in residential/subacute/extended aged-care settings;

- identify which staffing model is associated with reduced staff sick leave in residential/subacute/extended aged-care settings..

To address these aims, we conducted the following comparison:

- effects of new staffing models compared with current staffing models and evaluations of current staffing models.

METHODS

Criteria for considering studies for this review

Types of studies

In this review we considered randomised controlled trials (RCTs), controlled clinical trials (CCTs), interrupted time series (ITSs) and controlled before-and-after designs (CBAs).
We included studies written in any language provided there was an English abstract and the intervention and results of the study could be accurately evaluated (i.e. from tables).

Types of participants

Participants were staff of residential/subacute/extended aged-care settings (may also be referred to in the literature as nursing homes, skilled nursing facilities) such as;

- registered nurses;
- enrolled nurses;
- personal care attendants.

Participants were also residents or patients of residential/subacute/ extended aged-care settings aged 65 years or older. Studies which included participants ranging from 55 upwards were considered for inclusion if the standard deviation fell within one unit of 65.

Types of interventions

Interventions of interest included organisational interventions (e.g. team/modular nursing, primary nursing, hierarchical nursing, care pairs or partner-in-care models) or regulatory interventions (e.g. staff patient/resident ratios).

Types of outcome measures

Primary outcomes

The primary outcomes that were the focus of this review for residents/patients of residential/subacute/extended aged-care settings were as follows:
- incidence of pressure ulcers;
- incidence of falls;
- incidence of medication errors and adverse events;
- validated quality of life measurements.

Primary outcomes for staff of residential/subacute/ extended aged-care settings that we identified in this review were:
- days/hours lost to sick leave;
- days/hours lost to stress leave;
- staff turnover rates (as a percentage of staff total);
- staff burnout (as defined by the authors).

Studies were not required to address all these outcomes to be eligible for inclusion.

Secondary outcomes

Outcomes that were identified from the included studies were:

Residents

- tranquility-agitation;
- vitality;
- personal control;
- performance of activities of daily living.

Staff

- measurement of nursing activities (e.g. notes, entries in care plan);
- job satisfaction.

Search methods for identification of studies

We identified primary studies by searching bio-medical bibliographic databases, hand-searching and searching grey literature resources. The Effective Practice and Organisation of Care (EPOC) Group's Trials Search Co-ordinator (TSC) developed search strategies for the EPOC Trials Register, and MEDLINE, EMBASE and CINAHL databases in consultation with the review authors. We constructed and ran additional searches in *The Cochrane Library* and Ageline. We searched DARE (Database of Abstracts and Reviews) for related reviews. Search strategies used controlled vocabulary, such as MeSH (Medical Subject Headings), and keywords describing the concepts of staffing models and residential care. We restricted search results by methodological filters for study design (RCT, CCT, CBA, ITS) and EPOC-relevant interventions. We did not apply any language restrictions. The search date was August 27, 2007. Starting dates and interface for each database searched are provided below. We searched grey literature resources using the following keywords in Google: residential aged care, nursing homes, nurse skill mix.

Database information

1. EPOC Group Register of Studies (Biblioscape): 1960.
2. The Cochrane Central Register of Controlled Trials (Wiley): 1950.
3. MEDLINE; MEDLINE Daily Update; MEDLINE in Process & Non-Indexed Citations (OVID): 1950.
4. EMBASE (OVID): 1980.
5. CINAHL (Cumulative Index to Nursing & Allied Health Literature) (OVID): 1981.
6. AARP Ageline (OVID): 1978- ; and selective retrospective (pre-1978) coverage.

For detailed search strategies, see: MEDLINE--Appendix 1; EMBASE--Appendix 2; CINAHL--Appendix 3; EPOC Trials Register--Appendix 4

Data collection and analysis

Selection of studies

Two review authors (BH and MO) screened all titles and abstracts for relevance. The same two review authors retrieved the full text of articles for those that required further information in order to make a decision on whether or not the inclusion criteria were met. A third review author (RN) arbitrated any disagreements

Data extraction and management

Two review authors (BH and MO) critically appraised all studies that were retrieved based on the screening of titles and abstracts for quality according to the EPOC Group's data collection checklist. The same two review authors independently extracted and summarised details of eligible studies using the data abstraction form developed by EPOC.

Assessment of risk of bias in included studies

As none of the participants in any of the trials underwent randomisation into respective treatment groups, we did not perform an assessment for bias in sequence generation. EPOC reviews assess risk of bias using nine criteria for CBA studies and seven criteria for ITS studies (see 'Risk of bias' table and Assessment of risk of bias in included studies section).

Measures of treatment effect

See Data synthesis below.

Unit of analysis issues

Not applicable.

Dealing with missing data

While some data presented in Wilson 1989 could not be independently verified due to poor presentation (incomplete reporting), we did not contact the authors for the original data due to the age of the paper.

Assessment of heterogeneity

We anticipated that this topic would generate studies with significant heterogeneity due to differing interventions and differing outcome measures, limiting the usefulness of comparative analysis. As only two studies met the inclusion criteria and were of sufficient heterogeneity, comparative analysis was not possible and therefore we have described the studies in a narrative summary.

Assessment of reporting biases

We did not perform an assessment of reporting bias due to:
   1. the limited number of identified trials meeting the inclusion criteria for this review (two);
   2. the age of one included trial (Wilson 1989) with missing data.

Data synthesis

Two review authors (BH and MO) independently extracted data. Where possible, we calculated relative risk reduction (RRR), risk ratio (RR) odds ratios (OR), number needed to treat to benefit (NNTB) or number needed to treat to harm (NNTH) and associated 95% confidence intervals (CI) from individual studies containing count data. We calculated mean differences (MD) and 95% CI for normally distributed continuous outcomes in individual studies using the independent t-test when data were presented. Meta-analyses were not possible for any of the presented data as the evidence base was heterogeneous with studies conducted against different comparators, measuring different outcomes or presenting data in different formats that could not be combined. Therefore, we presented data from each study in a narrative summary.

Subgroup analysis and investigation of heterogeneity

Not performed.

Sensitivity analysis

Not performed.

R E S U L T S

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

Results of the search

We identified 1760 studies and excluded 1729 outright from examination of the title and abstract. We retrieved 41 studies for evaluation of the full paper. We included two studies; one ITS study and one CBA study. The majority of papers that we identified by the search strategy did not evaluate any nursing models with a concurrent control group or with another nursing model, rather they examined the relationship between staffing levels and resident outcomes, usually over a number of sites.

Both studies that met the inclusion criteria evaluated primary models of care in residential aged care against a team-nursing model (involving RNs and NAs) (Wilson 1989), or against a usual-care model (involving RNs only) (Boumans 2005). While the Wilson study described their intervention as "primary care" and the Boumans study termed it "patient-centred care", they are essentially referring to the same type of care model; one in which resident assignment to one nurse or care staff member, and changes in nursing practice is the focus of the intervention.

One study was performed in Canada within two 45-bed units of an extended-care department in which the participants were exclusively veterans indicating a primarily male population (Wilson 1989). The second study was performed in three aged-care facilities in the Netherlands (Boumans 2005).

Included studies

Models of primary care

Wilson 1989

In a single ITS study with cross-over, both residents and staff of a 45-bed geriatric rehabilitation unit (Unit 1) and a 45-bed, long-term care unit (Unit 2) received or provided care using either a primary-care model or a team-nursing model (control).

Primary care was defined as consisting of the following four fundamental principles as defined by Manthey 1980;
   1. 24-hour accountability and decision making by one nurse for several patients over time,
   2. case method of assignment,
   3. direct communication between caregivers, and
   4. a shift in emphasis in the head nurse role to that of facilitator.

Team nursing was defined as a hierarchical system where patient care is supervised by a RN, the team leader and the actual provision of care is assigned to various skill levels of personnel according to the complexity of the patients needs and care requirements .

Over a two-year period evaluation of resident well-being and satisfaction, changes in nursing practice, and measures of staff morale, the results showed that neither nursing model was superior to the other for many of the measures (Table 1; Table 2; Table 3). Where a significant difference was identified, the primary-nursing model was in all cases found to be superior.

For measures of patient well-being, the authors reported that primary nursing led to a limited number of improvements, specifically an increase in the score for the Geriatric Residents' Goals scale for Unit 1 only (highest mean score of 58 for primary nursing compared with 51 for team nursing P = 0.007), and an improvement in the Tranquility-Agitation Scale score for Unit 2 only (highest mean score 38 for primary nursing compared with 36 for team nursing, P = 0.004). Patient knowledge of nurses' names was significantly greater in those cared for with the primary-care model compared with the team model in the geriatric unit (Unit 1) but not reported for Unit 2 (Table 1).

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Nursing practice measures identified a number of significant improvements when the primary-care model was practiced compared with team nursing (Table 2).

The chance that the same caregiver provided care from one week to the next was higher with the primary-care model for both units (e.g. 4.8 ± 1.3 days/week primary nursing versus 2.0 ± 1.0 days per week team nursing for Unit 1, P < 0.001) (Table 2).

The number of days that the nurse signature on the daily nurses notes matched the signature on the monthly nursing summary was significantly higher during primary care for both units (P < 0.05), and the number of days in which the nurse who signed the monthly nursing summary actually cared for the patient was significantly higher during primary care for both units (P < 0.01) (Table 2).

No significant difference between primary and team nursing was seen for any staff morale measures (Table 3).

The cost of nursing hours and use of medical-surgical supplies was not found to be different between the two nursing models.

Overall, the staff survey found that primary nursing was the favoured nursing model compared with the team-nursing model.

Boumans 2005

In a CBA study, the effectiveness of a resident-oriented care model (experimental) was evaluated compared with usual care (control). This study first evaluated the extent of uptake of the components of the model, specifically:

1. resident assignment to one nurse,
2. use of nursing process (evaluating care plans, nursing histories, addressing nursing problems and goals),
3. extent of resident- and ward-oriented tasks, and
4. changes in communication between nurses.

Next, the study evaluated the effectiveness of the intervention to significantly improve effect variables (quality of care, well-being, satisfaction), compared with the control.

Degree of protocol implementation

The study collected data on the extent of implementation of the protocol for a number of variables such as assignment of a resident to a specific caregiver or use of nursing care plans, for both the resident-oriented model and usual care before implementation (pre-test) and at six and 16 months post-implementation (post-test one and two respectively) (Table 4).

The study found that with one exception, assignment of the same nurse to a resident occurred significantly more often in the experimental wards compared with the control wards (P < 0.001) (Table 5).

The use of the nursing process (i.e. use of nursing care plans (P = 0.008), taking nursing histories and identifying nursing problems and goals (P = 0.002) was also significantly greater in the experimental wards compared with controls (Table 5).

Despite the focus on the resident in these areas, the conduct of resident-oriented tasks was only significantly different within the psychogeriatric wards (P < 0.001) but not in the somatic wards (P = 0.32) compared with controls (Table 5).

There was no significant difference in ward-oriented tasks, or in the variety of resident- or ward-oriented forms of communication between experimental and control wards (Table 5). Interestingly, the quality of various forms of communication implemented (e.g. making clear agreements as to how to approach the residents) was found to be significantly in favour of the usual-care protocol (P = 0.047) (Table 5).

Effectiveness of intervention

The study also collected data on the effect that resident-oriented care had on specific effect variables such as co-ordination of care and resident satisfaction with care compared with usual care before implementation (pre-test) and at six and 16 months post-implementation (post-test one and two respectively) (Table 6).

Analysis of the effect variables found that the intervention did not significantly improve resident or family satisfaction with care, resident well-being, assessment of resident well-being by a significant other compared with control (Table 7).

Effect variables that indicate the quality of care (co-ordination of care, instrumental aspects and expressive aspects) showed mixed results by post-test two. Co-ordination of care was found to have significantly increased in three of the experimental wards (two psychogeriatric wards and one somatic ward) compared with controls (P < 0.003) (Table 7), whereas one somatic ward actually showed significant improvement in co-ordination of care in the usual-care ward (P < 0.001) (Table 7). Measurement of expressive aspects found a significant improvement in the experimental wards compared with controls (P = 0.02) (Table 7), but no significant difference was found between treatment groups for the measure of instrumental aspects (P = 0.4) (Table 7).

Excluded studies

We excluded 32 studies based on the full paper. The majority of these studies examined the relationship between nurse staffing levels and quality of care outcomes. In these studies cross-sectional data from existing data sets were used. A few studies evaluated changes in the nursing home environment which may have included increasing staff levels but the effect of this component of the intervention on resident outcomes could not be isolated from the overall intervention. Finally, a few studies examined the use of paid staff to improve the mealtime experience, however, these were strictly qualitative studies examining the experience of instituting the intervention.

Risk of bias in included studies

Allocation

No study performed a true randomisation of either individuals or wards but instead used convenience sampling to determine which wards would receive which intervention.

In Wilson 1989 however, this was primarily remedied by using a cross-over design to ensure that both study groups received both interventions.

In Boumans 2005, management from each of three nursing homes were asked to select one somatic and one psychogeriatric ward to form the experimental group based on pre-specified criteria (comparability, provision of general long stay somatic and psychogeriatric nursing home care, stability, willingness to participate and implement the intervention). One somatic and one psychogeriatric ward from each of the same three nursing homes was then matched (based on the number of beds, bed occupation, length of stay and care load), to the experimental wards to act as the control group.

Blinding

While both studies showed some significant improvement in one or more residents' outcomes, when the intervention was being performed, the research design precluded the ability of either study to blind residents, staff or assessors to treatment designation. In fact, no mention was made in either study of any attempt to blind any component of the study. Therefore, there was the potential for significant performance and detection bias within both studies. Even with a cross-over design used in one study (Wilson 1989), at each assessment point the allocation of each resident was known. In the study of the resident-oriented care model (Boumans 2005), blinding of the resident to treatment designation may have been accounted for by the application of the intervention to a whole ward while keeping a control ward separate, and by the assessment of some of the effect outcomes by the residents or families pre- and post-intervention.

Incomplete outcome data

The significance of any of the data presented in Wilson 1989 could not be independently verified due to poor presentation of the data. Due to the age of the paper, we did not contact the authors for the original data. Data presented for patient well-being were provided in the form of a range over a time period and a P value (no mean ± standard deviation (SD)) or a direct indication of the number of patients these values were derived from (no N). This would also be true of data presented for nursing practice measures and for responses to the staff survey where no N values were provided to accompany the means and SD reported.

Selective reporting

Selective reporting was not an issue in any of the two included studies.

Other potential sources of bias

No other potential sources of bias were identified.

Effects of interventions

See included studies (above).

D I S C U S S I O N

This review has highlighted that little, if any, research using a concurrent control group method has been performed to evaluate the effectiveness of any nursing models in residential aged care for the improvement of resident and care staff outcomes. Despite the overwhelming volume of publications that suggests that there is a distinct relationship between staffing levels in residential aged care and outcomes of improved well-being in residents as well as staff satisfaction and staff turnover (Bostick 2006), no experimental evidence was found to substantiate these claims for these outcomes. There is also little evidence on the precise skill mix required to improve these same outcomes. The only experimental evidence identified in this review was in the form of two studies that evaluated the implementation of primary-care models on resident outcomes, staff satisfaction and nursing practice.

Summary of main results

The two studies identified in this review suggest that at the very least the primary-care model is preferred by staff. In a single ITS, cross-over study, 92% of respondents preferred the primary nursing model over the team-nursing model after one year of exposure to both models (Wilson 1989). Interestingly, in a single CBA study the implementation of a primary-care model had no effect on perceived resident well-being or satisfaction or on family satisfaction (Boumans 2005). While the primary-care model was shown to produce better outcomes for residents on some outcome measures, the results are hardly convincing. Despite the cross-over nature of Wilson 1989, improvements in the residents' outcomes were not consistently found for the primary-care intervention. For example, Unit 2 found a significant improvement in the residents tranquillity-agitation score under the primary-care model but Unit 1 found no difference between the two groups scores after cross-over from the team-nursing model into the primary-care model. Further, this study showed no effect of a primary-care nursing model on improving staff outcomes such as job satisfaction, absenteeism or staff turnover when compared with a team-nursing model.

This was also the case with a study of a primary-care model described as "patient-oriented care" situated in three aged-care facilities in the Netherlands (Boumans 2005). While the incorporation

of some of the process aspects of the primary model were instituted, principally resident assignment to one carer, the intervention had little effect on improving resident outcomes of well-being and satisfaction with care. A possible explanation for the lack of an improvement is likely to be due to the poor overall uptake of the process components of the model. While there was an increase in the degree of resident assignment and the use of nursing processes, the degree of implementation was not universal over the period of the study. In fact, no significant difference was found in the extent of uptake of ward-oriented tasks or in the degree of nursing communication during the study compared with the control period. The authors acknowledge that maintaining the processes within the ward was made difficult due to instability on the ward (staff turnover and leadership changes).

Overall completeness and applicability of evidence

As previously noted, the early study performed by Wilson was hampered by poor data reporting which prevented independent confirmation of the findings of the authors (Wilson 1989) (see Table 1). Therefore, the results of this study should be seen as an encouraging beginning in the evaluation of a primary-care model in aged-care facilities but of little value in informing practice.

Quality of the evidence

The quality of evidence to assess the effectiveness of staffing models in residential aged care is poor. Only two studies of the number we originally identified met the inclusion criteria, primarily due to the absence of a concurrent control group. Both examined the effectiveness of primary-care or patient-centred care nursing models compared with team nursing or usual care on resident and staff outcomes. Lack of randomisation, blinding or prevention of contamination are key limitations of the validity of the studies. Variability in results, such as effects in favour of the control group in one ward or unit and similar effects in favour of the experimental group in another ward or unit, make any concrete conclusions about the effectiveness of the intervention difficult.

Finally, it is interesting that since 1993 only one concurrently controlled study has evaluated the effectiveness of primary-care models in residential aged-care facilities on resident or staff outcomes. The reason is unclear, but is consistent with the general absence of research being performed in the residential aged-care setting compared with that in the acute-care sector.

Potential biases in the review process

Due to difficulties in ensuring accurate translation, we did not consider identified non-English publications.

Agreements and disagreements with other studies or reviews

Not applicable.

AUTHORS' CONCLUSIONS

Implications for practice

Little evidence is available for any recommendations to be made concerning implementation of any nursing model into residential aged-care facilities.

Implications for research

The implications for research are extensive, with few identifiable controlled studies available evaluating any form of nursing model or skill mix in residential aged care. The two studies evaluated in this review provide less than convincing evidence of the effectiveness of a primary-care model compared with team nursing or usual care.

ACKNOWLEDGEMENTS

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Boumans 2005

Methods	Controlled before and after study.
Participants	*Residents*: mean age 78 years, 70% female. *Family of residents*: mean age 57 years, 72% female. *Nurses*: mean age > 31 years, 93% female, > 71% full time employed, 95% shift workers, mean > 5 years experience on ward Wards chosen by facility management based on comparability, provision of long stay somatic and psychogeriatric nursing care, stability, willingness to participate and implement resident-oriented care (in experimental wards) Control wards matched by number of beds, bed occupation, length of stay, and care load
Interventions	Project implemented in three nursing homes in the Netherlands. Each home selected 4 wards to participate (2 somatic and 2 psychogeriatric) designating one somatic and one psychogeriatric to the control condition and one each to the experimental condition Experimental condition: Resident-oriented care. Consisted of four characteristics: 1. Resident assignment to the same nurse. 2. Use of nursing process - use and evaluation of nursing care plans, nursing histories, nursing goals and actions for each resident. 3. Tasks - resident-oriented and ward-oriented. 4. Communication - nurse communication either resident-oriented or ward-oriented. Control condition: No description. Outcomes evaluated prior to implementation of intervention and then at 6 months and 16 months post-implementation
Outcomes	Extent to which characteristics of resident-oriented care were followed 1. Resident assignment - 10-item scale measuring extent to which residents allocated to the same nurse for the total admission period. Cronbach's alpha of 0.91. Roodbol 1993. 2. Use of nursing process - 14-item scale measuring the use and evaluation of nursing care plans. Cronbach's alpha 0.88 andd 9-item scale measuring the taking of nursing history, nursing problems, goals and actions. Cronbach's alpha 0.85. Verkooijen 1992. 3. Tasks - self constructed scale consisting of assessment of: resident-oriented tasks - 8-item scale, Cronbach's alpha 0.79 and ward-oriented tasks - 7-item scale, Cronbach's alpha 0.80. 4. Communication - evaluating change in communication between nurses and based on a) quality of various forms of communication, 14 items, Cronbach's alpha 0.86, b) variety of resident-oriented forms of communication, 9 items, Cronbach's alpha 0.91, and c) variety of ward-oriented forms of communication, seven items, Cronbach's alpha 0.68. Van Zonneveld 1993. Effect variables 1. Quality of care: 2 instruments a) for psychogeriatric wards (72 items) Bus 1993, b) for somatic wards (77 items) Van Lingen 1990. Both evaluate co-ordination of care,

Boumans 2005   (*Continued*)

	instrumental aspects (not described) and expressive aspects (not described). Data collected by analysis of nursing records, interviews of nurses and of residents of somatic wards (cognitively-intact residents).	
	2. Resident well-being - 2 themes to inquire about general health (10-point scale) Van Rossum 1993 and life satisfaction (10-point scale) Courtens 1993. Questions answered by participating residents, nurses and family members of experimental and control residents.	
	3. Satisfaction with patient care - instrument adapted to nursing home setting Bekkers 1990. Participating residents answered 15-item scale and family members of experimental and control residents answered a 26-item scale.	
	4. Demographics.	

Notes		

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	No randomisation method used.
Allocation concealment (selection bias)	High risk	Experimental wards were assigned by aged-care facility managers based on specified criteria. Control wards were matched by investigators
Blinding (performance bias and detection bias) All outcomes	High risk	While not mentioned, residents may have been blinded to the intervention however, participating staff would be aware of the intervention they were implementing
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The number of dropouts was specified but reason for dropout was not described
Selective reporting (reporting bias)	Low risk	All specified outcomes identified in the method were reported in the results
Other bias	Low risk	No other bias was evident. The authors were willing to report negative outcomes/results of this study (i. e. the intervention was not very effective for the outcomes measured)
Baseline outcomes similar?	Low risk	Resident and ward characteristics of experimental and control wards matched
Baseline characteristics similar?	Low risk	Characteristics of care Table 4 and effect variables Table 6 similar between groups at pretest.

Boumans 2005 (*Continued*)

Protected from contamination?	High risk	As wards within the same facility were selected to be under experimental or control conditions, it is unclear whether nursing staff may have moved amongst both ward types

Wilson 1989

Methods	Interrupted time series (with cross-over).
Participants	53 staff members of the Department of Extended Care at Sunnybrook Medical Centre, University of Toronto Hospital (30 registered nurses, 17 registered nursing assistants, 6 nursing orderlies) Residents were war veterans. Mean age 79 years, cognitively intact. An average of 23. 5 residents in Unit 1 (geriatric rehabilitation unit) and 21.7 residents in Unit 2 (long-terml care unit)

Interventions	<u>Time 1</u>: 0 to 4-month baseline period: Unit 1 and Unit 2 - team nursing only
	<u>Time 2</u>: 5 to 13 months: Unit 1 - primary nursing only, Unit 2 - team nursing only
	<u>Time 3</u>: 14 to 20 months: Unit 1 - cross-over to team nursing, Unit 2 - cross-over to primary nursing
	<u>Time 4</u>: 21+ months Unit 1 and Unit 2 - both units to primary nursing
	Interventions based on following definitions.
	<u>Primary nursing</u> - four essential components:
	   1. 24-hour accountability and decision making by one nurse for several patients over time,
	   2. case method of assignment,
	   3. direct communication between caregivers,
	   4. shift in emphasis in the head nurse role to that of facilitator.
	<u>Team nursing</u> - hierarchical system where patient care is supervised by a registered nurse, the team leader, and the actual provision of care is assigned to various skill levels of personnel according to the complexity of patient needs and care requirements

Outcomes	**A.** Patient well-being:
	   1. Tranquility-Agitation Scale,
	   2. Vitality Rating Scale,
	   3. Personal Control rating Scale,
	   4. Geriatric Residents Goals Scale.
	Measures collected at 21 time intervals.
	B. Measures of General Nursing Practice:
	   1. frequency of entries into the bedside nursing notes at 3-week intervals,
	   2. number of entries into the nursing care plan at 2-week intervals,
	   3. consistency of patients assigned caregivers within a 7-day period,
	   4. the frequency with which the signatures on the daily nurses' notes matched the signature on the monthly nursing summary,
	   5. the number of days within a month where the nurse who signed the monthly nursing summary also provided direct care to the patient,
	   6. a patient's knowledge of nurses' names.
	Measures collected between 17 and 24 times for each unit.

Wilson 1989 (*Continued*)

	C. Staff morale:
	   1. self-report of job satisfaction,
	   2. absenteeism records,
	   3. staff turnover.
	Measures collected at 21 time intervals (minimum of three data collection points per time period, see Interventions(above))
	D. Cost of nursing hours and cost of medical and surgical supplies
	E. Staff satisfaction survey.

Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	High risk	Patient well-being measures (Vitality Rating Scale, Personal Control Rating Scale, Geriatric Residents Goal Scale) all completed by participating staff who were aware of the intervention (to the extent that there was some resistance to change at the cross-over back to team nursing)
Incomplete outcome data (attrition bias) All outcomes	High risk	No description of dropout (if any) and number of participants used in analysis and presentation of results for some outcome data were omitted
Selective reporting (reporting bias)	Low risk	All outcome measures were reported as to significance. Not all data were described (for non-significant outcomes such as staff morale measures)
Other bias	High risk	Study units consisted of different populations (Unit 1 was a geriatric rehabilitation unit while Unit 2 was a long term care unit)
Independent intervention?	Low risk	Both units measured were in the same facility. No evidence of wholesale staff or policy/ procedure changes (other than the intervention) during the study
Intervention shape?	Low risk	Point of analysis is the point of intervention.
Data collection unaffected?	Low risk	Sources and methods of data collection were the same before and after the intervention

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bates-Jensen 2004	Cross-sectional observational study. No direct intervention. Identification of predictors of resident time in bed, extent of social engagement
Bostick 2004	Cross-sectional descriptive study to identify association of 6 quality indicators (weight loss, bladder or bowel incontinence, pressure ulcers, problem behaviours, ADL decline, physical restraint use) with staffing hours per resident per day
Boumans 2008	Process model, not a staffing model. Model evaluated effects of creating a home-like environment (encouraging residents to cook and clean), centralising resident needs and regularly assessing whether care is meeting needs, and integration of services
Buerhaus 1996	Retrospective analysis comparing trends in employment and earnings of nursing personnel. No intervention
Burgio 2004	Observational study (no direct intervention) to examine the relationship between permanent or rotating assignment, and work shift, on indicators of quality of care as well as staff outcomes such as turnover and absenteeism
Castle 2007	Cross-sectional survey to evaluate the association between staffing characteristics and quality of care and staffing outcomes. No direct intervention
Cavalieri 1993	Use of geriatric assessment teams that include Geriatricians in the intervention. Not strictly a nursing model
Cohen 2004	Retrospective analysis of workload indices and their association with rates of musculoskeletal injuries, burnout and self-reported health
Dellefield 2000	Literature review.
Dellefield 2006	Assessment of a patient classification system (Resource Utilisation Groups (RUG-III)), not a staffing model
Dyck 2007	Retrospective analysis of databases to examine relationships between nursing staffing and resident outcomes
Finnema 2005	Implemerntation of emotion-oriented care. Not a nursing model of care but a psychosocial approach to care
Ganz 2005	Development of a cost-effectiveness model of increasing staffing levels in an acute care facility
Hanson 2005	Quality Improvement intervention to design tools to improve palliative care delivery
Harrington 2000	No direct intervention. Correlation of existing data on staffing hours with nursing home deficiencies
Hickey 2005	No direct intervention. Correlation of existing data on staffing hours and levels of care with pressure ulcer rates

Hofmann 2003	Before and after study instituting 3 interventions and evaluating their effectiveness on falls in a nursing home population. One of the three interventions involved the addition of one extra staff member. Not possible to elicit the effect of the staff member from the other interventions on the reduction in falls
Johnson-Pawlson 1996	Cross-sectional study examining the relationship between RN staffing, total nursing staff with quality of care outcomes
Kane 2007	Evaluation of the "Green House" intervention. A change in the design of a nursing home ward not a staffing intervention
Kash 2007	Cross-sectional study to evaluate the spending behaviours of nursing homes with staffing levels and turnover
Kayser-Jones 1997	Qualitative study observing how staffing affected the mealtime experience of residents with advanced dementia
Laakso 2001	Qualitative study examining the experience of residents, family members and nurses to a change to primary nursing from functional nursing
Laitinen 1996	Programme directed at increasing informal caregiver participation in older patient care through the development of activity programmes
Rantz 2004	Evaluation of staff processes (e.g. helping with ambulation) that are associated with good resident outcomes. Not a staffing model evaluation
Remsburg 1999	Evaluation of a restorative care programme to improve mobility of nursing home residents using either a full time Nursing assistant or spreading the role over all Nusing assistants
Remsburg 2001	Evaluation of a buffet style dining program with conventional meal delivery (tray) on resident health outcomes (e.g. weight and biochemical indicators). Not an evaluation of a staffing model
Remsburg 2004	Qualitative evaluation of the impact of providing paid feeding assistants to deliver a buffet style dining program
Schnelle 2004	No direct intervention. Observational data collected to identify the association between staffing data and quality of care measures
Shipman 2007	Review.
Teresi 1993	Before-and-after study with no concurrent control group.
Weech-Maldonado 2004	Cross-sectional study to provide data for modelling the association of nurse staffing patterns with quality of patient care
Zhang 2006	Cross-sectional to provide data for modelling the association of nurse staffing patterns with quality of patient care

ADL: activities of daily living
RN: registered nurse

DATA AND ANALYSES

This review has no analyses.

ADDITIONAL TABLES

Table 1. Effect of primary nursing on resident outcomes (Wilson 1989)

Outcome	Team nursing	Primary nursing	Result
Patient well-being			
Vitality Rating Scale	Not reported	Not reported	no difference
Personal Control Rating Scale	Not reported	Not reported	no difference
Geriatric Residents' Goals Scale	Unit 1:mean score 43 to 51 Unit 2: mean score not reported	Unit 1: mean score 51 to 58 Unit 2: mean score not reported	Unit 1: P = 0.007 Unit 2: no difference
Tranquility-Agitation Scale	Unit 1: mean score not reported Unit 2:mean score 32 to 36	Unit 1: mean score not reported Unit 2:mean score 35 to 38	Unit 1: no difference Unit 2: P = 0.004
Patients knowledge of nurses' names	Unit 1: mean score 0.2 to 0.75 Unit 2: mean score 0.2 to 0.7	Unit 1: mean score 0.95 to 1.3 Unit 2: mean score 0.35 to 1.2	Unit 1: P = 0.000 Unit 2: not reported

Table 2. Effect of primary nursing on nursing practice (Wilson 1989)

Outcome	Team nursing (N = ?)	Primary nursing (N = ?)	Result
Number of nurses note entries	Unit 1: 8.58 ± 4.4 Unit 2: 2.97 ± 2	Unit 1/Time 1: 12.7 ± 6.8 Unit 1/Time 2: 12.32 ± 4 Unit 2: 8.6 ± 3.85	no difference no difference significant, P = ?
Number of care plan entries	Unit 1: 0.27 ± 0.4 Unit 2: 0.41 ± 0.5	Unit 1/Time 1: 0.7 ± 0.5 Unit 1/Time 2: 0.88 ± 0.6 Unit 2: 2.5 ± 0.9	no difference no difference P < 0.001
Same care giver (days per week)	Unit 1: 1.97 ± 1.0 Unit 2: 2.25 ± 0.3	Unit 1/Time 1: 4.33 ± 0.6 Unit 1/Time 2: 4.16 ± 5 Unit 2: 4.76 ± 1.3	P < 0.001 P < 0.01 P < 0.001
Nurses notes: signature same on daily notes and monthly summary	Unit 1: 1.13 ± 1.3 Unit 2: 0.3 ± 0.4	Unit 1/Time 1: 3.75 ± 4.7 Unit 1/Time 2: 3.8 ± 1 Unit 2: 3.48 ± 2	P < 0.05 P < 0.05 P < 0.001
Signature and care given (nurse signed gave care)	Unit 1: 2.63 ± 5.2 Unit 2: 1.81 ± 0.7	Unit 1/Time 1: 14.12 ± 2.7 Unit 1/Time 2: 10.8 ± 1.8 Unit 2: 12.7 ± 5.4	P < 0.001 P < 0.01 P < 0.001

Table 3. Effect of primary nursing on staff morale (Wilson 1989)

Outcome	Team nursing	Primary nursing	Result
Job satisfaction	not reported	not reported	no difference
Absenteeism	not reported	not reported	no difference
Staff turnover	not reported	not reported	no difference

Table 4. Characteristics of resident-oriented care (Boumans 2005)

Variables	Group	Pre-test (N = 210)	Post-test 1 (N = 167)	Post-test 2 (N = 147)
Resident assignment	Experimental	1.53 ± 0.78	4.08 ± 0.51	4.21 ± 0.42
	Control	1.61 ± 0.85	1.58 ± 0.79	1.81 ± 1.04
Use of nursing care plans and their evaluation	Experimental	3.25 ± 0.71	3.56 ± 0.64	3.67 ± 0.64
	Control	3.43 ± 0.80	3.65 ± 0.69	3.56 ± 0.71
Taking nursing history, nursing problems and goals and actions	Experimental	4.15 ± 0.77	4.28 ± 0.55	4.39 ± 0.48
	Control	4.36 ± 0.57	4.31 ± 0.76	4.19 ± 0.85
Resident-oriented tasks	Experimental	2.65 ± 0.72	3.29 ± 0.74	3.32 ± 0.81
	Control	2.62 ± 0.74	2.64 ± 0.78	2.79 ± 0.83
Ward-oriented tasks	Experimental	3.04 ± 0.79	3.15 ± 0.69	3.08 ± 0.74
	Control	3.02 ± 0.77	3.09 ± 0.79	3.04 ± 0.67
Quality of forms of communication	Experimental	3.79 ± 0.39	3.69 ± 0.41	3.65 ± 0.32
	Control	3.84 ± 0.44	3.83 ± 0.44	3.83 ± 0.40
Variety of resident-oriented forms of communication	Experimental	4.09 ± 0.60	4.08 ± 0.57	4.16 ± 0.59
	Control	4.24 ± 0.60	4.24 ± 0.55	4.19 ± 0.61
Variety of ward-oriented forms of communication	Experimental	3.05 ± 0.55	3.21 ± 0.60	3.30 ± 0.56

	Control	3.35 ± 0.51	3.38 ± 0.54	3.40 ± 0.43

Table 5. Degree of protocol implementation (Boumans 2005)

Variable	Stratification	ß[a]	N	p
Resident assignment	A, somatic	0.170	22	0.205
	A, psychogeriatric	0.962	21	0.000
	B, somatic	0.933	17	0.000
	B, psychogeriatric	1.008	21	0.000
	C, somatic	0.948	30	0.000
	C, psychogeriatric	1.029	21	0.000
Use of nursing care plans and their evaluation		0.182	143	0.008
Taking nursing history, nursing problems and goals and actions		0.219	145	0.002
Resident-oriented tasks	somatic	0.059	76	0.321
	psychogeriatric	0.542	64	0.000
Ward-oriented tasks		0.070	138	0.160
Quality of forms of communication		-0.127	139	0.047
Variety of resident-oriented forms of communication		0.037	142	0.330
Variety of ward-oriented forms of communication		-0.047	139	0.280

[a] 0 = control group, 1 = experimental. positive value favours experimental, negative value favours control.

Table 6. Comparison of scores on effect variables (Boumans 2005)

Variables	Group	Pre-test (N = 91)	Post-test 1 (N = 90)	Post-test 2 (N = 92)
Co-ordination of care	Experimental	42.4 ± 10.5	49.6 ± 11.5	45.4 ± 13.0
	Control	41.8 ± 10.6	37.1 ± 9.6	39.2 ± 9.9
Instrumental aspects	Experimental	66.0 ± 18.8	72.2 ± 13.3	73.7 ± 11.1
	Control	68.7 ± 17.5	69.0 ± 11.9	74.0 ± 14.1
Expressive aspects	Experimental	62.0 ± 15.5	73.4 ± 11.6	76.5 ± 12.3
	Control	61.4 ± 14.3	67.0 ± 12.0	72.6 ± 11.0
Well-being assessed by residents	Experimental	7.33 ± 1.26	6.81 ± 1.62	7.35 ± 1.07
	Control	6.27 ± 2.14	6.22 ± 2.39	6.93 ± 1.58
Well-being assessed by significant others	Experimental	6.14 ± 1.42	6.19 ± 1.04	6.08 ± 1.31
	Control	5.96 ± 1.52	5.84 ± 1.21	6.09 ± 1.28
Residents' satisfaction with patient care	Experimental	7.78 ± 1.08	7.30 ± 0.71	7.44 ± 1.18
	Control	6.93 ± 1.90	7.68 ± 1.30	7.44 ± 1.18
Family's satisfaction with patient care	Experimental	7.36 ± 1.10	7.39 ± 1.11	7.32 ± 0.94
	Control	7.54 ± 0.68	7.36 ± 1.00	7.34 ± 1.20

Table 7. Post-test 2 differences between the experimental and control groups on effect variables (Boumans, 2005)

Variables	Stratification		$ß^a$	N	P
Co-ordination of care	A - somatic	without pre-test	-0.555	19	0.014
		pre-test/post-test	-0.788	19	0.000
	A - psychogeriatric	without pre-test	0.959	13	0.000
		pre-test/post-test	0.963	13	0.000
	B - somatic	without pre-test	-0.036	15	0.898

		pre-test/post-test	-0.551	15	0.033
	B - psychogeriatric	without pre-test	0.778	13	0.002
		pre-test/post-test	0.760	13	0.003
	C - somatic	without pre-test	0.714	15	0.008
		pre-test/post-test	0.760	15	0.001
	C - psychogeriatric	without pre-test	-0.531	15	0.042
		pre-test/post-test	0.111	15	0.693
Instrumental aspects			0.074	92	0.405
Expressive aspects			0.217	92	0.020
Well-being assessed by residents			0.130	32	0.524
Well-being assessed by significant others			0.012	88	0.916
Resident's satisfaction with patient care			0.127	25	0.685
Family's satisfaction with patient care			0.046	80	0.651

[a] 0 = control group, 1 = experimental. positive value favours experimental, negative value favours control.

APPENDICES

Appendix 1. MEDLINE Search Strategy

Database: Ovid MEDLINE(R) <1950 to August Week 3 2007>

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1 "Personnel Staffing and Scheduling"/ (10253)
2 (personnel schedul$ or personnel staffing).tw. (54)
3 Nursing Staff/ (12671)
4 nurse patient ratio$.tw. (68)
5 ((nurs$ or rn) adj (mix or ratio?)).tw. (86)
6 Health Manpower/ (8712)
7 exp Patient Care Team/ (39416)
8 ((nursing or patient care) adj team?).tw. (716)
9 (personal adj2 attendant$).tw. (23)
10 community health aides/ or home health aides/ or nurses' aides/ (5290)
11 ((community or health or home or nurs$) adj aide$).tw. (1015)
12 (staff$ adj model$).tw. (411)
13 or/1-12 (75047)
14 exp Nursing Homes/ (25049)
15 (nursing adj home$).tw. (14968)
16 (residential adj (aged or elderly or geriatric)).tw. (91)
17 Long-Term Care/ (17145)
18 ((long term or extended) adj care).tw. (9762)
19 17 or 18 (22133)
20 exp Aged/ (1638076)
21 19 and 20 (10212)
22 14 or 15 or 16 or 21 (36448)
23 13 and 22 (3195)
24 randomized controlled trial.pt. (240688)
25 controlled clinical trial.pt. (75766)
26 intervention studies/ (3539)
27 experiment$.tw. (882864)
28 (time adj series).tw. (6579)
29 (pre test or pretest or posttest or post test).tw. (7906)
30 random allocation/ (58787)
31 impact.tw. (207947)
32 intervention?.tw. (249884)
33 chang$.tw. (1406095)
34 evaluation studies/ (117851)
35 evaluat$.tw. (1238074)
36 effect?.tw. (2493606)
37 comparative study.pt. (1358984)
38 or/24-37 (5724011)
39 animal/ (4183149)
40 human/ (9917377)
41 39 not (39 and 40) (3170506)
42 38 not 41 (4013283)
43 23 and 42 (940)

Appendix 2. EMBASE Search Strategy

Database: EMBASE <1980 to 2007 Week 34>

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1 staffing.tw. (2963)
2 ((personnel or employee or nurs$) adj schedul$).tw. (27)
3 Nursing Staff/ (2620)
4 Nurse Patient Ratio/ or Nursing Shortage/ (85)
5 nurse patient ratio$.tw. (35)
6 ((nurs$ or rn) adj (mix or ratio?)).tw. (56)
7 Health Care Manpower/ (1214)
8 exp Patient Care/ (193323)
9 ((nursing or patient care) adj team?).tw. (219)
10 (personal adj2 attendant$).tw. (18)
11 health auxiliary/ or exp health care personnel/ or nursing assistant/ (228834)
12 ((community or health or home or nurs$) adj (aide$ or assistant? or worker?)).tw. (3742)
13 (staff$ adj model$).tw. (293)
14 or/1-12 (392245)
15 Nursing Home/ or Assisted Living Facility/ or Residential Home/ (12016)
16 (nursing adj home$).tw. (9948)
17 (residential adj (aged or elderly or geriatric)).tw. (48)
18 Long Term Care/ (38914)
19 ((long term or extended) adj care).tw. (5452)
20 18 or 19 (41017)
21 exp Aged/ (898311)
22 20 and 21 (10855)
23 15 or 16 or 17 or 22 (24228)
24 14 and 23 (4789)
25 randomized controlled trial/ (146354)
26 (random$ adj (assign$ or allocate?)).tw. (41376)
27 experiment$.tw. (683920)
28 (time adj series).tw. (6043)
29 (pre test or pretest or posttest or post test).tw. (6598)
30 impact.tw. (191123)
31 intervention?.tw. (221305)
32 evaluat$.tw. (1065692)
33 effect?.tw. (2038076)
34 compar$.tw. (1819146)
35 (controlled adj (study or trial)).tw. (48174)
36 or/25-35 (4350096)
37 nonhuman/ (2945895)
38 36 not 37 (2836478)
39 24 and 38 (2166)

Appendix 3. CINAHL Search Strategy

Database: CINAHL - Cumulative Index to Nursing & Allied Health Literature <1982 to August Week 3 2007>
Search Strategy:
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1 exp "Personnel Staffing and Scheduling"/ (11385)
2 (personnel schedul$ or personnel staffing).tw. (5)
3 exp Nursing Manpower/ (97307)
4 nurse patient ratio$.tw. (103)
5 ((nurs$ or rn) adj (mix or ratio?)).tw. (90)
6 Health Manpower/ (535)
7 Multidisciplinary Care Team/ (10577)
8 ((nursing or patient care) adj team?).tw. (565)
9 (personal adj2 attendant$).tw. (25)
10 community health workers/ or home health aides/ or nursing assistants/ (4084)
11 ((community or health or home or nurs$) adj (worker? or assistant? or aide?)).tw. (2635)
12 (staff$ adj model$).tw. (120)
13 or/1-12 (116469)
14 exp Nursing Homes/ (8992)
15 ((nursing or intermediate care) adj (facilit$ or home$)).tw. (8374)
16 (residential adj (aged or elderly or geriatric)).tw. (117)
17 Long Term Care/ (9683)
18 ((long term or extended) adj care).tw. (5644)
19 17 or 18 (11962)
20 exp Aged/ (142051)
21 19 and 20 (5865)
22 14 or 15 or 16 or 21 (16678)
23 13 and 22 (2530)
24 clinical trial/ (35580)
25 (controlled adj (study or trial)).tw. (8897)
26 (randomised or randomized).tw. (27563)
27 (random$ adj1 (allocat$ or assign$)).tw. (6856)
28 exp pretest-posttest design/ (10519)
29 exp quasi-experimental studies/ (3792)
30 comparative studies/ (41280)
31 time series.tw. (573)
32 experiment$.tw. (15168)
33 impact.tw. (36850)
34 intervention?.tw. (62435)
35 evaluat$.tw. (89837)
36 effect?.tw. (93868)
37 or/24-36 (278561)

Appendix 4. EPOC Register Search Strategy

((staff* or ratio* or shift* or schedul* or manpower) and (nurs* or "care attendant*" or "health aide*" or "personal aide*" or "home aide*") and ("nursing home*" or "care home*" or aged or elderly or geriatric or "care unit*" or "long-term care" or "long term care" or "extended care" or "subacute care" or "sub-acute care"))

H I S T O R Y

Protocol first published: Issue 2, 2007

Review first published: Issue 6, 2011

C O N T R I B U T I O N S   O F   A U T H O R S

BH acted as the principal review author of the review.

MO was the secondary review author and edited and developed the protocol.

EH, LM were review authors and edited and developed the protocol.

RN developed the protocol, acted as arbitrator for disagreements on trial selection, and was the primary sponsor of project.

D E C L A R A T I O N S   O F   I N T E R E S T

The director of the Australian Centre for Evidence Based Aged Care (Professor Rhonda Nay) was involved in the creation of one

staffing model (the Nay/Garratt model (Nay 2004)). To avoid any implication of bias, research pertaining to this model was subject to the same evaluation as all other models. Professor Nay was not directly involved in the assessment and data extraction of this model.

S O U R C E S   O F   S U P P O R T

Internal sources

- Australian Centre for Evidence Based Aged Care, La Trobe University, Australia.

External sources

- No sources of support supplied

INDEX TERMS

Medical Subject Headings (MeSH)

*Models, Nursing; Attitude of Health Personnel; Homes for the Aged [*manpower]; Long-Term Care; Models, Organizational; Nursing Homes [*manpower]; Personnel Staffing and Scheduling [*organization & administration]

MeSH check words

Humans