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A systematic review of the effectiveness of strategies and interventions to improve the transition from student to newly qualified nurse

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Abstract

Background: The transition from student to newly qualified nurse can be stressful for many newly qualified nurses who feel inadequately prepared. A variety of support strategies to improve the transition process have been reported across the international literature but the effectiveness of such strategies is unknown.

Objectives/Aim: To determine the effectiveness of the main strategies used to support newly qualified nurses during the transition into the clinical workplace and, where identified, evaluate the impact of these on individual and organisational outcomes.

Design: Systematic review

Data Sources: A search of electronic databases to identify published studies (CINAHL, MEDLINE, British Nursing Index, Cochrane Library, EMBASE, PsychLit, PsychINFO, PsychARTICLES, Web Of Science, EBM Reviews, BioMed, TRIP, ERIC, SCOPUS (January 2000 – April 2011) was conducted. Relevant journals were hand-searched and reference lists from retrieved studies were reviewed to identify any further studies. The search was restricted to English language papers. The key words used were words that described new graduate nurses and support strategies (e.g internship, residency, orientation programmes)

Review Methods: The inclusion criteria were quantitative studies that investigated the effectiveness of support strategies for newly qualified graduate nurses. Studies that involved students in their final year of graduate study were excluded (for example extern programmes) Extraction of data was undertaken independently by two reviewers. A further two reviewers assessed the methodological quality against agreed criteria.

Findings: A total of 8199 studies were identified from the database search and 30 met the inclusion criteria for the review. The evidence suggests that transition interventions/strategies do lead to improvements in confidence and competence, job satisfaction, critical thinking and reductions in stress and anxiety for the newly qualified nurse.

Conclusions: This systematic review demonstrates the beneficial effects of transitional support strategies for newly qualified nurses from the perspective of the new nurse and their employer. The overall impact of support strategies appears positive irrespective of the type of support provided. This may suggest that it is the organisations' focus on new graduate nurses that is important, rather than simply

leaving them to acclimatise to their new role themselves. Future research should involve well designed randomised controlled trials with larger sample sizes using more objective and reliable outcome measures.

Keywords: internship, mentorship, new graduate nurses, orientation, preceptorship, residency, simulation, transition.

1. Introduction

Globally, nurses can find the transition from nursing student to qualified nurse stressful and intimidating despite ongoing attempts to address this problem (Butler, 2005; Dearmun, 1998; FitzGerald, 2001; Gerrish, 2000; Maben, 1998; Oermann et al 1997; Oermann, 2002; O'Shea, 2007).

A poor experience during this transition period can delay newly qualified nurses reaching their full potential. Those who feel overwhelmed may leave the profession altogether (Park and Jones 2010), or leave their first job within less than 12 months (Beecroft et al 2001). The consequence of this is an exacerbation of already stretched staffing levels, and a loss of investment made in the preparation of staff. To counteract this attempts have been made to ease the transition by providing strategies that might have a direct impact on increasing confidence and reducing anxiety, stress in the individual and turnover rates and retention levels in organisations..

A variety of support strategies to improve the transition process has been reported in the international literature. These range from structured approaches such as graduate programmes (Johnstone et al 2008), residency programmes (Goode and Williams 2004, Happell and Gough 2007, Williams et al 2007), orientation programmes (Young et al 2008, O'Malley-Floyd et al 2005) and nurse internships (Beecroft et al 2010, Ulrich et al 2010). The more informal approaches reported include mentoring (Melnyk 2007), lecturer practitioner support (Dearnum 2000), preceptorship (Robinson and Griffiths 2009), clinical practice facilitators (Agnew 2000) and peer support (Brown 2000). All of these approaches aim to increase the confidence, competence and sense of belonging of new graduates. Currently, there is little agreement in terms of what constitutes best practice and limited available evidence on the effectiveness of such approaches in achieving these aims and outcomes.

The literature review conducted by FitzGerald et al (2001), considered the effects of transition support on a wide variety of employer outcomes (retention rates, levels of competency, costs, satisfaction) and new graduate outcomes (anxiety reduction, job satisfaction, role recognition, satisfaction with programme / intervention, knowledge acquisition, role consolidation and level of expectations met). Thirteen studies were included in the review, with many being descriptive studies and very few comparative studies. The conclusion was that programmes using multiple strategies over an extended period are useful. Nevertheless, there is a lack of evidence to indicate the optimal structure, length and content of programmes. Where single support strategies were implemented their success was influenced by the characteristics of individuals involved. The success of preceptorship programmes was dependent on the preceptors being experienced, selected on specific criteria, and provided with training and support. As far as peer-support groups are concerned, informal, unsupervised support was more effective than facilitator-led support groups. However, this evidence was based on a small number of studies with low scientific quality ratings. In terms of employer outcomes of recruitment and retention, there was no evidence to indicate which type of programme was more effective but some weak evidence to suggest that all strategies assist in the retention of new graduates. For new graduate outcomes, there was no evidence to determine which of these strategies was more effective in reducing anxiety and enhancing social integration. There were conflicting results for strategies that aimed to improve levels of competence.

A narrative literature review was undertaken of Australian transition programmes (Levett-Jones and Fitzgerald, 2005) which included elements of formal or informal preceptorships or mentorships, study days or formal orientation programmes. It was found that transition programmes differed in duration, structure, financial support and content across the country. No formal investigation of the effectiveness of these programmes within this review but the authors did suggest that formal orientation programmes can have a positive impact on graduates' transition to practice, whereas mentorship and preceptorship have the potential to reduce the "reality shock" described by Kramer (1974).

A systematic review was conducted to determine the effectiveness of retention strategies targeted at new graduate nurses in the United States of America (USA) (Salt et al 2008). Retention strategies were categorised as preceptorship programmes (new graduate nurse focus or preceptor focus), graduate nurse orientation programmes and externship programmes). Preceptorship programmes of 3-6 months duration appeared to be the most effective. This finding should be viewed cautiously given the lack of experimental studies (3 out of 16).

An integrative narrative review examined the effects of orientation programs for newly graduated nurses on confidence, competency, and retention (Park and Jones 2010). The review included studies conducted within USA hospitals between 1990 and 2007 which evaluated internship programmes (nine articles), residency programmes (five studies) and structured orientation programmes (three articles). It was concluded that orientation programmes promote confidence and competency in new nurses and increase retention. The feasibility of nurse internship programs in promoting staff retention was examined in a narrative review by Winfield et al (2009). This review was limited by lack of information about the selection criteria and quality of the studies included.

A more recent integrative review aimed to review the use of simulation in graduate nurse orientation (Olejniczak et al 2010). It was found that simulation did appear to assist the socialisation of new graduates nurses, increase confidence and competency and in the development of clinical and decision making skills. However, these findings were based on only three studies which were methodologically weak using small convenience samples and relying heavily on participants' perceptions as outcome measures.

The background literature has identified that programmes for new graduate employment continue to be developed. In response to world-wide recognition that transitional support is essential for the personal and professional development of newly qualified nurses (Beecroft et al; Haggerty et al 2009). The purpose of this systematic review is therefore to update the previous systematic review by Fitzgerald et al (2001). It will and evaluate any papers from 2000 onwards which focus on interventions to achieve a smooth transition from student to qualified nurse in the first year of qualification. Unlike the original work by FitzGerald et al 2001 it will focus only on recently graduated nursing staff as opposed to all recently graduated health care professionals. Previous reviews have looked at literature published in one country (Park and Jones 2010; Salt et al 2008) or focused on a single support strategy (Park and

Jones 2010; Olejniczak et al 2010), or have not applied quality criteria to the literature (Winfield et al 2009). This systematic review addressed these limitations by systematically reviewing and assessing the quality of international studies across a full range of support strategies.

This systematic review aimed to determine the effectiveness of strategies used to support newly qualified nurses during the transition into the clinical workplace and, where identified, evaluate the impact of these on individual and organisational level outcomes. The protocol (Edwards et al 2009) and systematic review (Edwards et al 2011) are fully reported and available from the Joanna Briggs Library of Systematic Reviews.

2 Methods

2.1 Search strategy

2.1.1 Electronic searches

The databases searched for published material are shown in Figure 1.

Insert Figure 1 here

The search included published and unpublished studies from 2000 - April 2011. The search strategy consisted of high precision MeSH terminology and keywords, to ensure that all relevant material was captured. Terms that described graduate nurses were combined using the Boolean operator OR (for example novice, neophyte, new graduate,) with terms that described the support strategies or programmes used to improve the transition period (for example orientation programmes, internship, residency). Full details are provided in Figure 1 and an example of a full search using MEDLINE is provided in Appendix 1

The Journal of Continuing Education in Nursing and Journal for Nurses in Staff Development were hand-searched. Reference lists from retrieved studies were reviewed to identify studies that could not be located through other search strategies. The search was restricted to English language papers.

All studies identified were assessed for relevance based on the title and where available the abstract. When a definite decision could not be made based on the title or abstract alone, the full paper was obtained. These were assessed by two researchers against the inclusion criteria. Any disagreement was resolved by consultation with a third independent reviewer. A screening tool was developed by the reviewers to ensure consistency and equity across the screening process. The screening tool was based on the inclusion criteria (see below).

2.2 Inclusion / Exclusion Criteria

2.2.1 Population

This systematic review focused on newly qualified nurses during their first year of practice in the clinical area. These included diplomates (those qualifying on a diploma level course) and graduates, depending on the scheme of education. Student nurses who had completed the substantive components of their course and were involved in

externship programmes or other such programmes prior to commencing formal employment were excluded. Studies including a combination of newly qualified nurses and registered nurses, where separate results for newly qualified nurses were not reported, were excluded.

2.2.2. Type of Support

Of interest were any support strategies or programmes that assist newly qualified nurses in their transition from student to practitioner. These include strategies/programmes;

- where qualified nursing staff are specifically trained and allocated to support and work alongside newly qualified staff within the clinical environment (e.g. mentorship and preceptorship);
- that aim to bridge the gap between academic preparation and the demands of clinical practice by including a period of structured didactic style teaching for specific periods of time during the first year of practice (e.g. longer periods of teaching as in residency and internship programmes, and shorter periods of teaching as in graduate orientation programmes, graduate nurse programmes);
- where newly qualified nurses are exposed to a number of patient scenarios that they are likely to encounter, with the opportunity to develop knowledge and skills in a safe simulated environment.

2.2.3. Types of outcome measures

The outcome measures for this review were broad and evaluated the impact of support strategies and programmes on any individual and organisational outcomes.

2.2.4 Types of studies

The selection criteria for studies included all quantitative study designs, in order to determine the effectiveness of the support strategies and programmes.

2.3 *Data Extraction*

Data were extracted from papers included in the review using the data extraction tool developed by Fitzgerald et al (2001). Two reviewers independently extracted data. Any disagreements were resolved by discussion with a third reviewer.

2.4 *Assessment of methodological quality*

Studies meeting the inclusion criteria were quality assessed using the appropriate Joanna Briggs Institute checklists (Joanna Briggs Institute 2011) specific to types of identified studies (i.e, experimental design and non experimental design). Assessments were undertaken by two reviewers independently, with any disagreements resolved by discussion with a third reviewer.

2.5 Data Synthesis

The review did not identify any comparable randomised controlled trials which could be pooled for further statistical analysis. Outcome data extracted from included studies were combined and presented as a narrative summary.

3 Results

A total of 8199 potential papers were identified in database searches. Please see Figure 2 for search results and study selection. Thirty papers were finally included in this review.

3.1 *Description of studies*

Table 1 details the 30 studies involving 11,929 participants that met the inclusion criteria for the review. The studies were conducted in the United Kingdom (UK) (n=2), USA (n=24), Australia (n=2), New Zealand (n=1) and Thailand (n=1). Sample sizes ranged from 9 (Squires 2002) to 6000 (Ulrich et al 2010).

Insert table 1 here

In addition to the one randomised control trial and two quasi experimental studies, a variety of research approaches were used including: one pre and post-test design (Young et al 2008), one non-experimental descriptive correlation study (Vasseur 2009), one comparative intervention study as part of an action research project (Edmond 2004), three descriptive comparative surveys (Beecroft et al 2001; Halfer et al 2008; Krugman et al 2006), two cross sectional descriptive studies (Setter et al 2011, Crimlisk et al 2002), eight longitudinal studies (Altier and Kresk 2006; Beecroft et al 2008; Beyea et al 2010; Roud et al 2005; Squires et al 2002; Ulrich et al 2010; Williams et al 2007), one mixed methods (Beyea et al 2007) and one 6 year evaluation study (Beecroft et al 2006), one retrospective study (Friedman et al 2011) and eight descriptive case studies (Allanson and Fulbrook 2010; Goode et al 2009; Kowalski and Cross 2010; Leigh et al 2005, Marcum and West 2004; Messmer et al 2004; O'Malley Floyd et al 2005; Owens et al 2001). In mixed method studies only the quantitative data have been extracted, the qualitative data are not reported in this review.

3.2 *Description and narrative summaries of support strategies and programmes*

Four different types of support strategies were reported. Fourteen studies focused on nurse internship/residency programmes (Altier and Kresk 2006; Beecroft et al 2001; Beecroft et al 2008; Goode et al 2009; Halfer et al 2008; Kowalski and Cross 2010; Krugman et al 2007; Messmer et al 2004; Newhouse et al 2007; Owens et al 2001; Roud et al 2005; Setter et al 2010; Ulrich et al 2010; Williams et al 2007). Seven studies explored as graduate nurse orientation programmes (Allanson and Fulbrook 2010; Crimlisk et al 2002; Friedman et al 2011; Marcum and West 2004; O'Malley Floyd et al 2005; Squires 2002; Young et al 2008) Six studies focused on mentorship/preceptorship (Beecroft et al 2006; Edmond 2004; Komaratat and Oumtane 2009; Leigh et al 2005, Sorenson and Yankech 2008; Vasseur 2009). Three studies evaluated simulation-based graduate programmes (Beyea 2007, 2010, Shepherd et al 2007).

3.2.1 *Internship/Residency Programmes*

The purpose of these programmes is to bridge the gap between academic preparation and the demands of clinical practice. All include common elements of taught days with additional clinical support for all new graduate nurses. The majority of the programmes were of 6 months to 1 year duration with only two studies of shorter duration (6 -8 weeks) (Messmer et al 2004; Owens et al 2001). Findings were reported across the individual outcomes of confidence, competence, confidence,

knowledge, stress, anxiety and job satisfaction and across the organisational outcomes of retention and turnover. A narrative summary is presented below.

Confidence and Competence

One study observed an increase (Ulrich et al 2010) and the other (Kowalski and Cross 2010) reported a significant increase in clinical competency. Two studies observed an increase in self-confidence (Beecroft et al 2001, Ulrich et al 2010).

Knowledge

Messmer et al (2004) observed increases in knowledge scores across two internship/residency cohorts but the pre and post programme knowledge scores were not compared with a control group.

Job Satisfaction

A number of studies (Altier and Kresk 2006; Goode and Williams 2004; Krugman et al 2006; Setter et al 2011; Williams et al 2007) used the McCloskey-Mueller Satisfaction (MMS) survey to measure job satisfaction. Three of the studies (Altier and Kresk; Setter et al 2011; Williams et al 2007) reported mean levels for the measure and showed no significant change from baseline to study end. The mean scores for this measure at baseline however, were higher than the average mean for the scale, indicating that staff already experienced high levels of job satisfaction. When the MMS survey was also done at a 6-month time point the results fluctuated, with 2 studies reporting a significant V shaped decrease in satisfaction at the 6-month stage of the programme (Goode and Williams 2004; Williams et al 2007). At 12-months job satisfaction was significantly higher than at 6-months, this was slightly lower than at the beginning of the programme but was not statistically significant. Altier and Kresk, (2006) found a decrease in 2 out of 8 domains relating to job satisfaction of the MMS survey at the end of the 12-month programme. However, these results should be treated with caution, as the response rate was only 35% (111/316). Krugman (2006) reported that all but one of 6 sites in their evaluation had a positive perception of future opportunities at their hospital. Setter (2011) reported that the residency programme was not significantly associated with job satisfaction but was significantly related to reasons for staying. Two further studies explored job satisfaction and one observed an increase over 24 months (Ulrich et al, 2010) and the other (Halfer et al, 2008) reported a non-significant decrease in at 12 months but a significant increase 18 months.

Stress and anxiety

One study observed a reduction in levels of stress at 6 months (Krugman et al 2006) and two studies reported statistically significant reductions in levels of stress at 1 year (Goode and Williams 2004; Williams et al (2007) between the beginning and end of the programme. Kowalski and Cross (2010) also reported that overall anxiety decreased, but not significantly.

Retention / Turnover

High retention rates of between 73–94% were reported at one year (Altier and Kresk 2006; Kowalski and Cross 2010; Owens et al, 2001; Setter et al, 2011). One study reported a drop in the retention rate by 18%, 4 years later and noted that the retention rate decreased after ^{the} first year, particularly after ^{the} third year (Setter et al,

2011). Significant differences were noted in retention between internship/residency groups and comparison groups, Newhouse et al, 2007) at 12 months but not at 18 and 24 months. The authors suggest that program extension through the second year may be helpful in nurse retention.

Turnover rate was reported in 5 studies (Ulrich et al, 2010; Williams et al 2007; Halfer et al, 2008; Krugman et al, 2006; Goode et al, 2007) and ranges from 8%-16.5%. One study (Ulrich et al, 2010) retrospectively examined retention rates over a ten year period and found these decreased. Two studies (Beecroft et al, 2001, Newhouse et al, 2007) demonstrated that anticipated turnover/turnover intent was significantly lower in internship/residency groups than comparison groups at 6 months. By 12 months however, these differences had diminished (Beecroft et al 2001).

3.2.2 Graduate nurse orientation programmes

Seven studies explored graduate nurse orientation programmes (Allanson and Fulbrook 2010; Crimlisk et al 2002; Friedman et al 2011; Marcum and West 2004; O'Malley Floyd et al 2005; Squires 2002; Young et al 2008) Although similar to nurse residency/internship programmes in the way they are structured including both didactic elements and clinical support through preceptorship, they are generally shorter in duration (1 to 20 weeks).

Confidence, competence and knowledge

Graduate nurse orientation programmes made 23/32 participants feel more able to provide competent care (Crimlisk, 2002). Only self-reported competency was measured, no objective measure was used to confirm actual competency levels. O'Malley Floyd et al (2005) showed that 24/31 participants envisaged themselves becoming more knowledgeable and confident as measured using a yes/no questionnaire reply. Similarly, Squires (2002) found that respondents reported an overall perception of 'increased confidence'; however this was not statistically significant due to a very small sample size (n=9).

At the end of the programme studied by Allanson and Fulbrook (2010), participants were asked to reassess their competency, confidence and knowledge levels using a 10 point scale. From the mean scores, it was demonstrated they had initially over-estimated their competency and knowledge levels but a multiple choice questionnaire showed observed increases in all three areas. No further statistical analysis was conducted due to the small sample size (n=11), making it difficult to assess any objective outcomes. At the end of the one-week program examined by Marcum and West (2004) it was stated that all core competencies were met but did not provide any further description. .

Retention

Significant differences were noted in retention between those in graduate nurse programmes and comparison groups in the study conducted by Friedman et al, 2011 at 12 months. Three further studies (Crimlisk et al 2002; O'Malley et al, 2005; Squires 2002) reported 1 year retention after undergoing graduate nurse programmes ranging from 77% to 94.5%. Marcum and West (2004) reported that at 18 months post completion of the graduate nurse programme that 89% of orientees remained

employed compared to 29% in 1999 and 41% in 2000 prior to the graduate nurse orientation programme. The reasons for leaving were classed as personal.

3.2.3 Mentorship / Preceptorship

Six studies investigated mentorship/preceptorship programmes (Beecroft et al 2006; Edmond 2004; Komaratat and Oumtanee 2009, Leigh et al 2005, Sorenson and Yankech 2008; Vasseur 2009). The terms mentorship and preceptorship are often used interchangeably, they are defined specifically in some countries, for example the UK (NMC 2008). However the common element in all, is that qualified nursing staff were specifically trained and allocated to support and work alongside newly qualified staff within the clinical environment and are therefore these studies are discussed together. Two studies referred to this process as mentoring, with no other didactic or clinical programme (Beecroft et al 2006; Komaratat and Oumtanee 2009), whilst four papers referred to it as preceptorship (Edmond 2004; Leigh et al 2005, Sorenson and Yankech 2008; Vasseur 2009). Findings were reported across the individual outcomes of confidence, competence, confidence and stress and across the organisational outcomes of retention and turnover. A narrative summary is presented below.

Competence and Confidence

Komaratat and Oumtanee (2009) reported that competency levels had significantly increased by the end of the mentorship period and Edmond's (2004) results indicated higher levels of perceived competence in the ability to perform of the staff nurse role in the mentorship group, when compared to those in the comparison group. In the study by Leigh et al (2005), the preceptees self-reported a general increase in confidence levels, whereas managers reported that the majority of nurses achieved an acceptable level of competence for this stage in post but no statistical analysis was performed. In Vasseur's study (2009) no significant changes in confidence were reported at 3 months or 6 months. Poor reporting of data and small sample size limited statistical analysis.

Stress

Beecroft et al (2006) reported that 50% (159/318) of participants surveyed felt that that mentors moderated their stress levels. The scheme was significantly more effective when regular meetings were held between mentors and mentees; when mentees "clicked" with the mentor, for older rather than younger mentees and when the mentor offered support.

Retention

Two studies considered retention (Leigh et al 2005; Vasseur 2009). No significant difference was found between retention in the control group and the group which experienced preceptorship (Vasseur 2009). Leigh et al (2005) found that the retention rate reduced from 24% in 2002 to 1% in 2004.

3.2.4 Simulation-Based Graduate Programmes

Through simulation, new graduates are provided with exposure to patient scenarios they are likely to encounter, and have the opportunity to develop knowledge and skills in a safe environment. Findings were reported across the individual outcomes of

confidence, knowledge and stress and for the organisational outcomes of retention. A narrative summary is presented below.

Confidence and competence

The pilot study (Beyea et al 2007) observed improvement in the mean visual analogue scale scores of confidence, competence and readiness for practice between weeks 2 and 10. In a later study, Beyea et al (2010) found a statistically significant improvement in confidence, competence and readiness for practice from the baseline measure to the end of the program.

Knowledge

A simulation-based programme was found to be significantly more effective compared to other types of programmes offered (self-learning and didactic education) in developing knowledge and skills (Shepherd et al 2007).

Retention and turnover

Turnover was observed to be reduced at one year and two years compared to levels before simulation based practice was implemented (Beyea et al 2010).

3.3. Narrative Synthesis Outcomes

The studies utilised a variety of tools to measure these outcomes and as a result could not be statistically combined, therefore, presented as a narrative summary.

3.3.1 Narrative Synthesis of Individual Outcomes

Competence

One internship/residency study observed a general increase in competence (Ulrich et al 2010) and the other reported a significant increase in the levels of clinical competency (Kowalski and Cross 2010). Three graduate nurse orientation programmes observed a general increase in perceived competence (Allanson and Fulbrook 2010, Crimlisk 2002; Marcum and West 2004). Two mentorship/preceptorship studies reported statistical significant increases in the levels of competence (Edmond 2004; Komaratat and Oumtanee 2009). New graduates who completed a simulation-based programmes showed statistically significant improvements in competence and readiness for practice over the life of the program (Beyea et al 2010).

Knowledge

Two internship/residency programmes observed increases in knowledge scores (Allanson and Fulbrook 2010, Messmer et al 2004). One graduate nurse orientation programme observed improvement in levels of perceived knowledge (O'Malley Floyd et al 2005). One simulation-based programmes was found to be significantly more effective than both self-learning and didactic education in developing knowledge and skills (Shepherd et al 2007).

Confidence

One Internship/residency programme reported a significant increase in the level of confidence (Kowalski and Cross 2010) and two further studies observed increases in self-confidence (Beecroft et al 2001, Ulrich et al 2010). Graduate nurse orientation

programmes observed a general increase in perceived confidence (Allanson and Fulbrook 2010, O'Malley Floyd et al 2005; Squires 2002). One mentorship/preceptorship study reported a statistical increase in confidence (Edmond 2004). New graduates who completed a simulation-based programmes showed a statistically significant improvement in confidence over the life of the program (Beyea et al 2010).

Stress and anxiety

One internship/residency programmes study observed a reduction in stress levels at 6 months (Krugman et al 2006) and two reported statistically significant reductions in levels of stress at 1 year (Goode and Williams 2004; Williams et al 2007) between the beginning and end of the programme. Kowlowski and Cross (2010) also reported that overall anxiety decreased, but not significantly. One mentorship/preceptorship programme reported that 50% of nurse residents surveyed felt that that mentors moderated their stress levels (Beecroft et al 2006).

Job Satisfaction

Three Internship/residency programmes showed no significant change by the end of the programme for job satisfaction (Altier and Kresk; Setter et al 2011; Williams et al 2007), one observed an increase over 24 months (Ulrich et al, 2010) and the other (Halfer et al, 2008) reported a non-significant decrease in at 12 months but a significant increase 18 months.

3.3.2 Narrative Synthesis of Organisational Outcomes

Recruitment and retention

High retention rates of 73-94.5% (Altier and Kresk 2006; Crimlisk et al 2002; Kowalski and Cross 2010; O'Malley et al, 2005; Owens et al, 2001; Setter et al, 2011; Squires 2002) were reported at one year across all strategies. Significant higher retention rates were noted for internship/residency programmes groups, Newhouse et al, 2007) and for graduate nurse orientation programmes groups (Friedman et al, 2011) at 12 months when compared to control groups.

Turnover rates

Turnover was reported as actual turnover and turnover intent/anticipated turnover. One simulation-based programme observed that actual turnover reduced at 1 year and 2 years compared to levels before simulation-based practice was implemented (Beyea et al 2010).

Three internship/residency programmes reported improved turnover rates (Beecroft et al, 2001, Newhouse et al, 2007; Ulrich et al, 2010) but these results were not always sustained (Beecroft et al 2001). This impact was significantly influenced when the new graduates were satisfied with their jobs and pay, felt committed to the organisation, had previously passed the NCLEX, and when the establishment had greater experience of running internship/residency programs.

3.4 Methodological quality

The studies in this review set out to answer a number of different questions regarding transition support for graduates. Levels of evidence relating to study design were

assigned to each study in accordance with the Joanna Briggs Institute (2011) Levels of Evidence FAME scale (feasibility, appropriateness, meaningfulness, and effectiveness) see table 2. The evidence was then ranked into one of four levels (High – Level one, Moderate – Level two, Low - Level three, Very Low – Level four) The number of studies in each level are included in this table. The majority of the studies found were low quality - level three studies (a. Cohort studies (with control group); b. Case controlled; c. Observational studies (without control group)).

Insert table 2 here

The methodological quality of these studies varied considerably, influenced by the sample size of the study and the data collection tools employed. Well-validated tools were used to measure such outcomes measures as job satisfaction and anxiety whereas other studies relied on the new graduates' self-perceptions of their confidence; competence and knowledge levels.. However, a number of studies only reported mean scores and observed changes in outcomes without conducting any statistical analysis to confirm their findings (Beecroft et al 2001, Krugman et al 2007, Messmer et al 2004, Ulrich et al, 2010).

The quality of the studies was also influenced by the lack of a comparison group, small sample size and poor response rates. In studies investigating the outcome of nurse internship/residency schemes, a lack of control/comparison groups was frequently seen (Altier and Kresk 2006; Messmer et al 2004). Even when comparison groups were used in studies, they were usually convenience samples and often poorly matched (Beecroft et al 2001) or the point at which measurements took place was not clear (Ulrich et al, 2010). Orientation periods were found to be variable and where programmes were rolled out across sites there was acknowledgment that consistency could not be guaranteed, thus limiting generalisability.

Analysis of the majority of studies that investigated retention and turnover revealed a weak study designs. Most of the studies were one time experimental case study designs conducted by researchers working within the organisation/facility where a new program/retention strategy was being implemented. This type of study does not provide sufficient evidence to determine what factors influenced the success or failure of a program, as there is limited/no control for potential confounders.

Of the studies that explored graduate nurse orientation programmes, only one used a comparative group (Friedman et al 2011). There was no commonality amongst these studies regarding outcome measurement tools. The other four studies used satisfaction/opinion surveys, and/or self-assessment questionnaires (Allanson and Fullbrook 2010, Crimlisk et al, 2002; O'Malley Floyd et al 2005; Squires, 2002). There is clearly a need for more well designed and conducted studies.

It is difficult to make any firm comparisons or conclusions from the two preceptorship studies (Beecroft et al 2006; Komaratat and Oumtanee 2009). The programmes varied considerably in quality, length and content. The studies also examined different outcomes and the sample size varied from 19 mentees (Komaratat and Oumtanee 2009) to 318 (Beecroft et al 2006).

Simulation-based programmes varied with Beyea et al (2007, 2010) using high fidelity simulators (realistic experiences, primarily using computer-based manikins) and Shepherd et al (2007) using low fidelity simulators (basic written case studies, role playing e.g. simulated administration of injections). The duration of simulation was also different, with weekly simulation reported in the pilot study (Beyea et al 2007) and 40 hours of simulator based scenarios reported in the later study (Beyea et al 2010). This compared to two 30 minute simulation sessions used in the work by Shepherd et al (2007) make it difficult to compare the studies.

4. Discussion

This systematic review has considered the effects of transition support on a wide variety of organisational and individual outcomes. As found in previous reviews (Salt et al 2008, Rush et al 2013) drawing firm conclusions with regard to the effectiveness of the main strategies used to support newly qualified nurses during the transition into the clinical workplace is limited due the poor methodological quality of these studies.

Competence

There is a lack of studies where competence is measured using validated tools at the beginning and end of a support programme. For the majority of studies programme participants were asked to rate themselves with regard to how competent they felt or researchers were asked to observe participants with regard to improvements in competence. General increases for competence using these methods were reported for participants within internship/residency programmes (one study) and graduate nurse orientation programmes (four studies). This concurs with the findings of Rush et al 2013 who found that increased competency occurred regardless of who rated the level of competency (self, peer, preceptor, manager or administrator), duration or type of programme.

Findings from previous reviews on the effectiveness of internship/residency programmes on levels of competency have been contradictory, with Park et al 2010 reporting improved self-competency (two studies) and Fitzgerald et al (2000) reporting no difference (one study). There are few studies in previous reviews which have investigated competency as an outcome. Similarly, this review found only a small number of low quality studies (level three) measuring competence before and after the introduction of a particular support programme. When this was the case then internship/residency programmes (one study), mentorship/preceptorship (two studies) and a simulation-based programmes (one study) were effective in increasing perceived competence of graduate nurses.

Knowledge

There is a lack of studies where knowledge is measured at the beginning and end of a support programme. In the majority of studies, programme participants were asked if they felt more knowledgeable at the end of the programme rather than their knowledge being objectively tested. General increases in knowledge using these methods were reported for participants within internship/residency (two studies) and graduate nurse orientation programmes (one study). Within the review by Park et al 2010, four studies of internship/residency programmes administered the Basic Knowledge Assessment test and improvements were reported in test scores. But the

review failed to report whether these findings were statistically significant. One low fidelity simulation-based programmes was found to be significantly more effective than both self learning and didactic education in developing knowledge and skills (Shepherd et al 2007).

Confidence

There is a lack of studies where confidence was measured using validated tools. In the majority of studies programme participants were asked to self-rate their confidence or researchers were asked to observe participants for improvements in confidence.

General increases for confidence using these methods were reported for participants within internship/residency (one study) and graduate nurse orientation programmes (4 studies). This finding concurs with the review by Park et al (2010), who also reported improved self-confidence for internship/residency programmes (three studies) and an extended orientation programme. A small number of low quality studies (level three) measured confidence before and after the introduction of a particular support programme. When this was the case then internship/residency programmes (one study), mentorship/preceptorship (one study) and simulation-based programmes (one study) were effective in increasing perceived confidence of graduate nurses.

Stress and anxiety

Internship/residency programmes and mentorship/preceptorship programmes were effective in reducing levels of stress of graduate nurses (Low quality evidence – all studies level three)

Job Satisfaction

Internship/residency programmes were effective in increasing levels of job satisfaction, although some studies were based on low numbers. The level of this varied, but overall job satisfaction appeared to increase, despite fluctuation at points.

Retention

There is some evidence from the work of Fitzgerald et al (2000) upon which this review builds to suggest that programmes such as internships, graduate nurse orientation programmes and preceptorships do assist in retention of new graduates. Two previous reviews strongly suggested that retention of new graduate nurses could be improved through a period of supported and structured preceptorship (Whitehead et al 2013) and last between 3 and 6 months (Salt et al 2008). This systematic review has found that the majority of programmes led to increased retention rates but cannot provide any evidence to indicate which style of programme is more effective. This finding from across the international literature concurs with findings from previous reviews from the Australia (Fitzgerald et al 2000; United States (Park et al 2010). Although Fitzgerald et al (2000) gathered data from a small number of comparative studies that examined recruitment/retention rates this was not demonstrated with statistical significance and the level of evidence was therefore only rated at very low - level four.

Some of these studies in this review use previous retention rates or literature to compare their success and failure, each failed to show the cause and effect of the implemented programme and retention rates. As a result no strong clear

recommendations or conclusions can be drawn from the data. This concurs with the review by Salt (2008), who recommended that at a minimum non-randomised control group, pre-post test designs should be used to assess the effectiveness of retention strategies with 2 similar groups. However, data from a small number of level three studies showed that internship/residency programmes (one study) and graduate nurse orientation programmes (one study) were effective in improving retention rates up to 12 months. All studies agree however, that many factors affect retention that could not be controlled, such as family relocation, changes in health status, family responsibilities, or other personal or family issues.

Turnover

Three internship/residency programmes reported improved turnover rates (Beecroft et al, 2001, Newhouse et al, 2007; Ulrich et al, 2010) but these results were not always sustained (Beecroft et al 2001). This impact was significantly influenced when the new graduates were satisfied with their jobs and pay, felt committed to the organisation, had previously passed the NCLEX, and when the establishment had greater experience of running internship/residency programs. A general reduction in turnover was reported for a simulation-based programme (one study) at 1 year and 2 years compared to levels before simulation-based practice was implemented. Previous reviews have also reported a reduction in the turnover rate of newly graduated nurse after participating in internship/residency programmes (2 studies) (Park et al 2010) but the review by Parks et al (2010) failed to report whether these findings were statistically significant. One simulation-based programme observed that actual turnover to be reduced at 1 year and 2 years compared to levels before simulation-based practice was implemented (Beyea et al 2010).

5. Limitations of the review

The search was restricted to English language. There may have been studies in other languages relevant to the review. The validity of the results of this review is limited by the methods of included primary studies.

6. Conclusion

The literature provides some support for the beneficial effects of transitional support strategies to assist the transition of new qualified nurses. The review highlights that the type of support strategy is less important. It is the focus upon and investment in easing new graduate nurses' transition by organisations that is important, rather than simply leaving them to acclimatise to their new role themselves. The findings of this review are based upon weak evidence which concurs with earlier reviews and shows that there has been little advancement in this area.

Although findings vary depending on the type of transition programme reported, transition programmes for new graduate nurses are generally effective in increasing retention and improving overall experience. This is an important finding that suggests that a well organised attempt by health organisations and clinical areas to smooth the transition period with such schemes as preceptorship and mentorship schemes will have an impact on a number of outcomes relevant to both the organisation and the individual newly qualified nurse.

A number of studies mentioned the importance of structured support from colleagues, as well as the organisation, in this situation, mentors/preceptors need to be adequately prepared for the role if it is to be successful. A combination of approaches including didactic and clinical elements appear to facilitate the journey from graduate student to competent qualified nurse.

Future research on transitions should build on the strengths and limitations of the current studies. There is clearly a need for more robust studies with larger sample sizes and a greater emphasis on objective and reliable measures of the outcomes included. More comparative and experimental studies in order to determine the efficacy of support strategies. When investigating retention, researchers need to measure retention rates attributed to the intervention and not just retention rates for the hospital in general in the year that the intervention was conducted. More valid and reliable measures are needed to explore the outcomes of confidence, competence, knowledge, stress and anxiety.

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Table 1: Description of included studies

Authors	Study Design	Sample size	Intervention	Outcome Measures	Findings
Internship/Residency Programmes					
Paper 1: Altier & Kresk (2006) USA	Prospective longitudinal	316	UHC/AACN National Post baccalaureate nurse residency programme 1 year	MMSS Retention	Job satisfaction: no change (p=0.055) 1 year retention rate: 87%
Paper 2: Beecroft et al. (2008) USA	Prospective longitudinal (7 years)	889	RN residency programme 22 weeks	CNRCS / OCQ PNAS / SCSCS SNCRS / WOOR CWEQ / GCS NJSS / CDMS WSS / LEBS Turnover intent	Older respondents were 4.5 times more likely to have turnover intent if they did not get their ward choice(p<0.01). When GNs were satisfied with their jobs (p<0.01) and pay (p<0.01) and feel committed to the organisation (p<0.01) the odds of turnover intent were low these factors explained 79% of the variance. 2 year retention rate - estimated 83% to 98%.
Paper 3: Beecroft et al. (2001) USA	Descriptive comparative survey	I = 50 C = 28	RN residency programme 6 months	CNRCS / OCQ PNAS / SCSCS NCRS / ATS	I group comparable or better on all measures than the C group* Self Confidence: increased for I group and C group* Anticipated voluntary turnover at 6 mths significantly lower for I group then C group (p<0.05) but no significant difference between I group and C group at 12 mths (p=0.20)
Paper 4: Goode et al. (2009) USA	Descriptive case study	1,484	UHC/AACN National Post baccalaureate nurse residency programme 1 year	CFGNES / MMSS GCOPS / Turnover REF	Significant decrease increase In job satisfaction at 6 months (p=0.00) and rising again by 12 months but still lower than baseline (p=0.00) Significant increase in skills and abilities (p=0.002), organising and prioritising their work (p=0.00), comfortable communicating with the care team, patients, and families (p=0.00), and clinical leadership (p=0.00) at 12 mths

					Significant decreases in stress scores (p=0.00) at 12 mths Turnover rate - 9%
Paper 5: Halfer et al. (2008) USA	Descriptive comparative	I = 212 C = 84	Paediatric RN internship programme 1 year	JSS Turnover	I group: 12 mth job satisfaction: non-significant decrease I group: 18 mth job satisfaction: significant increase (p=0.046) Voluntary turnover at 1 year: I (12%) C (20%)
Paper 6: Kowalski and Cross (2010) USA	Descriptive case study	55	Residency programme 1 year	PERF / FGNES CQS / STAI	Clinical competency: Significant increase (p<0.001) Sense of threat: Significant decrease (p=0.004) Communication / Leadership skills: significant increase (p=0.022) Anxiety – no significant decrease 1 year retention rate: 78%.
Paper 7: Krugman et al. (2007) USA	Descriptive, comparative	ns	UHC/AACN National Post baccalaureate nurse residency programme 1 year	CFGNES / REF / GCONPS MMSS	6 mths stress - observed decrease * 6 mths organising and prioritizing – observed increase* 6 mths professional opportunities subscale of MMSS positive perception reported* Turnover rate 8%
Paper 8: Messmer et al. (2004) USA	Descriptive case study	24	The “Shadow-A-Nurse” ICU internship programme 6 weeks	WGCTA BKAT NICU-NACE	Critical thinking: observed decrease* Knowledge: observed increase*
Paper 9: Newhouse et al. (2007) USA	Quasi-experimental Post –test only control design	I=321 C = 159	SPRING internship 1 year	OCQ / SoBI ATS	V Shaped pattern in sense of belonging: Significantly lower at 6 mths than baseline and 12 mths for I group Anticipated turnover significantly higher baseline than 6 mths for I group than C group (p=0.009) 1 year retention significantly higher for I group than C group (p=0.014)
Paper 10: Owens et al. (2001) USA	Descriptive case study	75	Internship 8 weeks	BPET Retention	GN orientees were able to accurately assess their performance. 1 year retention - 74% cohort 1 / 73% Cohort 2

Paper 11: Roud et al. (2005) New Zealand	Longitudinal	54	Entry to practice programme 1 year	6-DSNP	Significant increases in frequency of performance - domains of leadership (p<0.001), critical care (p<0.001), teaching/ collaboration (p=0.006), and planning/evaluation (p=0.039) Significant increase in quality of nurse behaviours - domains of critical care (p<0.001), planning/evaluation(p=0.042) and interpersonal relations/communication (p=0.042)
Paper 12: Setter et al. (2010) USA	Cross-sectional	202	UHC/AACN National Post baccalaureate nurse residency programme 1 year	CS / MMSS RFSTS / NRSS Retention	Mean score MSS 112.4 The scores on the NRSS were not significantly related to job satisfaction but were significantly related to reasons for staying (p<0.05) 1 year retention rate - 94%, dropping to 74% after 4 years of the programme.
Paper 13: Ulrich et al. (2010) USA	Longitudinal (10 year)	6000	Versant RN residency programme 6 months	NSCR / OCQ SPNAS / SCSCS SNCRS / CWEQ NJSS / WSS LEBS / GCS / TI	Observed increases in competence and self confidence* 24 mth job satisfaction – observed increase* Turnover rate – 7.1% (1 year), 19.6% (24 mths), 19.6% (36 mths) which was lower than rates reported for previous cohorts who had not undergone the residency programme
Paper 14 Williams et al. (2007) USA.	Longitudinal	679	UHC/AACN National Post baccalaureate nurse residency programme 1 year programme	CFGNES / MMSS GCONPS	V shaped pattern for job satisfaction and autonomy: Lower at 6 mths than baseline and 12 mths for I group (I) most differences being statistically significant (p<.05) Significant reduction in stress (p<.05) Turnover rate: 16.5%
Graduate Nurse Programmes/Orientation Programmes					
Paper 15: Allanson & Fulbrook (2010) Australia	Descriptive case study (pre post test)	11	Peri-operative introductory programme 5 days	Competency Confidence Knowledge	Knowledge: observed increase Perceived confidence: observed increase Perceived confidence: observed increase Initially over estimated levels of competence
Paper 16:	Cross-sectional	232	Orientation float pool	Competency	The majority of participants felt able to provide safe,

Crimlisk et al. (2002) USA			programme 4-5 months	Retention	competent care in assessment skills, technology, communication skills, medication administration and critical thinking skills (n=23/32) . 19 month retention rate: 96%
Paper 17: Friedman et al. (2011) USA	Retrospective descriptive, comparative	I – 60 C - 30	Critical care nurse fellowship programme 1 year	Retention data Cost data	1 years retention rate 78.3% (2007 cohort orientation programme) significant improvement compared to 2004 cohort receiving standard orientation) (p=0.015) The 5.8% change in turnover resulted in the retention of 9.8 nurses (potential saving of \$1,367,100 annually).
Paper 18: Marcum and West (2004) USA	Descriptive case Study	20	New graduate orientation programme 13 weeks	PBDS ASTD RNCA	Critical thinking and interpersonal skills: significant increase (p=0.020) 18 month retention rate: 89%
Paper 19: O'Malley Floyd et al. (2005) USA	Descriptive case Study	31	Graduate RN orientation 4 months	Knowledge Confidence Retention	The RNs envisaged becoming more knowledgeable and confident over the next year (N=24/31) ; they identified challenges including lack of confidence, knowledge and experience and found the work/life balance challenging 1 year retention rate: 94.5%
Paper 20: Squires (2002) USA	Descriptive case study (longitudinal)	9	Orientation 8 weeks	CPRSAQ	Perception of 'increased confidence' 1 year retention rate: 77%
Paper 21: Young et al (2008) USA	Longitudinal (pre post test)	25	Orientation programme 6 weeks	NRCI	Service role discrepancy scores: significantly increased (p=0.01)
Mentorship / Preceptorship					
Paper 22: Beecroft et al. (2006) USA	Evaluation study 6 years	318	Mentorship with a RN residency programme 6 months	ID mentorship experience Survey	50% felt that mentors moderated stress. Regular meetings were significantly positively influenced the likelihood of the mentor being a stress reducer (p<0.001), clicking with the mentor (p<0.001), mentor providing support (p<0.001) and mentee being older (p<0.005).

Paper 23: Komaratat & Oumtanee (2009) Thailand	Quasi experimental one group time series approach	19	Mentorship model 1 month	NCS	Levels of competency: significantly increases (p<0.05)
Paper 24: Edmond (2004) UK	Comparative intervention (part of an action research study)	I - 10 C - 10	Competency based preceptor programme (4 months)	SNRG VASS	Perceived competence: Significant higher for those I Group than C group (p<0.05) Positive benefits of the programme were reported.
Paper 25: Leigh et al. (2005) UK	Descriptive case Study	34	Preceptorship programme 3 week orientation & 6 month preceptorship	EFQM	Perceived confidence levels : observed increase * Managers reported that the majority of nurses achieved an acceptable level of competence 1 year turnover rate: observed reduction over 2 years of programme from 24% to 1% *
Paper 26: Sorenson & Yankech (2008) USA	Quasi-experimental (mixed methods)	I=15 C=16	Preceptor facilitated orientation. 3-14 weeks - I	CCST	Critical thinking: no significant differences between I group and C group Preceptors' participation in the educational sessions however, contributed to the evaluation subscale of critical thinking skills for the I group (p=0.039)
Paper 27: Vasseur (2009) USA	Descriptive correlation	I - 10 C - 10	Nurse transition programme 9-12weeks	CFGNES	Confidence : no significant changes at 3mths or 6 mths Other subscales of CFGNES: no significant changes at 3mths or 6 mths There were no significant differences found in retention in the C group and the I group at 3 months (p=0.694) and 6 mths (p=0.148) Retention rates: 3 mths 93.8% (C group). 891.% (I group): non- significant (p=0.694), 6 mths 93.8% (C group), 82.6% (I group): non-significant (p=0.148)
Simulation based programmes/interventions					

Paper 28: Beyea et al. (2010) USA	Longitudinal	260	Simulator based residency programme 12 weeks	NNRREP SSCSE Turnover	Confidence, competence and readiness for practice from baseline to the end of the programme: significant increase (p<0.001) 1 year turnover 9% compared to 17% pre programme* 2 year turnover of 43% compared to 34% pre programme*
Paper 29: Beyea et al (2007) USA	Mixed method, pilot study	42	Simulator based residency programme 12 weeks	NNRREP	Improvement in mean VAS scores for confidence, competence and readiness for practice from between week 2 and 10*
Paper 30 Shepherd et al. (2007) Australia	Randomised controlled trial	80	Graduate nurse programme 1 year Group 1 - self directed learning package (SDLP) Group 2 - SDLP & 30 mins PowerPoint scenarios Group 3- SDLP & 30 mins low fidelity simulation	CRVT	Knowledge: Group 1: significant increases than compared to those in Group 2 and Group 3 (p<0.001)

Key: 6 DSNP - The Schwirian's Six-Dimensional Scale of Nursing Performance; ATS - Anticipated Turnover Scale; ATSD - American Society for Training and Development Evaluation Tool; C – control/comparison group; CCST - California Critical Thinking Skills Test; CCTDI - The California Critical Thinking Disposition Inventory; CDMS - Clinical Decision Making Scale; CFGNES - Casey-Fink Graduate Nurse Experience Survey; CNRCS - Corwin's Nursing Role Conception Scale; CPRSAQ - Clinical Practice Readiness Self assessment questionnaire, CRVT- Clinical Response Verification Tool; CS- Commitment Scale; CSQ - Clinical Stress Questionnaire (Pagana); CWEQ - Conditions for Work Effectiveness Questionnaire; EFQM - European Foundation for Quality; GCOPS - Gerber Control Over Practice Scale); GCS - Group Cohesion Scale; GN – Graduate Nurse; I – Intervention; ID – Investigator designed, JSS - Job Satisfaction Survey; LEBS - Leader Empowerment Behaviours Scale; Management; SNRG - The Staff Nurse Role Grid – SNRG; MMSS - McCloskey-Mueller Satisfaction Survey; NCRI - Nursing Role Conceptions Instrument; NCRS - Nursing Competencies Rating Scale; NCS - Nursing Competence Scale; NJSS – Nurse Job Satisfaction Survey; NS – Not specified, NLMAT - National League for Nursing Medication Administration Test; NLNITT - National League for Nursing Intravenous Therapy Test; NNRREP - Nursing Residents' Readiness for Entry into Practice; OCQ - Organisational Commitment Questionnaire – OCQ; OCQ - Organizational Commitment Questionnaire 15 items; PBDS - Performance Based Development System; PERF - Preceptor Evaluation of Resident Form; PFGNPQ - Graduate Nursing Practice Questionnaire; PNAS - Professional Nursing Autonomy Scale; RCNA - RN Competency Assessment; RN – Registered Nurse; SCSCS - Skills Competency Self-Confidence Survey ; SoBI - Sense of Belonging Instrument; SSCSE- Structured Simulation Clinical Scenario Evaluation; STAI - State-Trait Anxiety Inventory (Spielberger); TI - Turnover Intention; VASS -Visual Analogue Support Scale; WOC - Ways of Coping – Revised (Beecroft); WSS – Work Satisfaction Survey

* Statistical analysis not performed

Table 2: Included Studies by JBI Levels of Evidence

JBI Levels of Evidence	Effectiveness	Number of Included Studies	Citation
1	Meta-analysis (with homogeneity) of experimental studies (e.g. Randomised Controlled Trials (RCT) with concealed randomisation) OR One or more large experimental studies with narrow confidence intervals	1	Shepherd et al. (2007)
2	One or more smaller RCT's with wider confidence intervals OR Quasi-experimental studies (without randomisation)	2	Newhouse et al. (2007), Sorenson and Yankech (2008)
3	a. Cohort studies (with control group) b. Case controlled c. Observational studies (without control group)	30	Beecroft et al. (2001), Setter et al. (2010), Goode et al. (2009), Williams et al. (2007), Krugman et al. (2007), Altier and Kresk (2006) Owens et al. (2001), Messmer et al. (2004), Kowalski and Cross (2010), Roud et al. (2005), Ulrich et al. (2010) Beecroft et al. (2008),

4	Expert opinion, or physiology bench research, or consensus	Halfer et al. (2008), Cantrell and Browne (2006), Nash et al (2008), Olson et al (2001), Beyea et al (2007), Beyea et al (2010), Leigh et al. (2005), Vasseur (2009), Edmond (2004), Komaratat and Oumtanee (2009), Beecroft et al (2006), O'Malley Floyd et al 2005, Allanson and Fulbrook 2010, Crimlisk et al 2002, Friedman et al. (2011), Young et al. (2008), Marcum and West (2004), Squires (2002)	None found
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