

12-hour shifts: Prevalence, views and impact

Report to Dr Ruth May, National Lead 'Compassion in Practice: Action Area 5'

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1. Introduction and background

1.1 Introduction

One of the action areas in the NHS England's 'Compassion in practice nursing, midwifery and care staff – our vision and strategy' is action area five: 'ensuring we have the right staff, with the right skills in the right place'. Dr Ruth May (Regional Chief Nurse, Midlands and East of England) is the senior responsible officer leading this work nationally. On behalf of Dr Ruth May, Pauline Milne (Head of Clinical Workforce Development and Planning, Health Education East of England) invited the National Nursing Research Unit (NNRU) of King's College London to undertake research into 12-hour shifts, using existing data sets and published evidence to explore the prevalence, views and potential impact of 12-hour shifts.

1.2 Background

The provision of 24-hour nursing care inevitably involves shift work and flexible working, including "long days" or 12-hour shifts (Newey and Hood 2004, Lorenz 2008). However, these shift patterns have become increasingly controversial, with concerns raised over performance, fatigue, stress and patient safety. Historically, traditional shift work patterns were based on three eight-hour shifts per day (Ferguson and Dawson 2011, Estabrooks et al. 2009), but over the past 20 years there has been a tendency to move away from this pattern of working in preference for the 12-hour shift (Todd et al. 1989, McGettrick and O'Neill 2006).

In the UK, many hospitals utilise 12-hour shifts primarily because managers believe it is a more cost effective way of providing 24-hour care, with lower costs and greater continuity of staffing (Estabrooks et al. 2009). Some nurses also prefer to work longer daily hours with fewer shifts, which gives them greater flexibility and more days away from work (Josten et al. 2003). As the majority of the nursing workforce is female, this may also make it easier to balance work and personal responsibilities (Messing 1997, Josten et al. 2003).

However, there are increasing concerns over potential threats to patient safety and quality of care (Stimpfel and Aiken 2013), and some employers now question the benefits of such extended hours and are choosing to revert to eight-hour shifts (Geiger-Brown and Trinkoff 2010). Although the handover period has been criticised for being unproductive, with no formal 'overlap' 12-hour shifts can have a negative impact on opportunities for ward meetings, teaching, mentorship, teambuilding and research (Sprinks 2012). A study in the US by Stimpfel and colleagues published in 2013 found that nurses who worked shifts of 12-hours or longer were significantly more likely to report poor quality care and poor patient safety when compared to those working eight-hour shifts. Patients also reported lower satisfaction with care in hospitals where staff worked longer shifts (Stimpfel et al. 2012).

Shift work is a common feature across many industries. Fatigue associated with long shifts has been linked with disasters such as the Chernobyl nuclear accident, Three Mile Island incident and the grounding of the Exxon Valdez (Miller 2011). However, research to date is equivocal and some studies have found little differences in terms of cost or productivity (Williamson et al. 1994) or levels of fatigue (Duchon et al. 1994) by shift length. A systematic review by Smith et al. (1998) compared eight and 12-hour shifts across a broad range of industries and concluded that longer shifts increased fatigue but also led to an increase in job performance. Tucker et al. (1998) examined the effect of shift length on alertness. Their findings showed that more rest days between shifts were associated with slightly higher levels of alertness and lower levels of fatigue.

In nursing, Geiger-Brown and Trinkoff (2010) reviewed studies up until 2008. In five of the seven studies reviewed, those working 12-hour shifts were significantly more fatigued. Estabrooks et al. (2009) reviewed 12 studies comparing the effect of eight and 12-hour shifts on quality of care and health care provider outcomes. They found insufficient evidence to conclude that shift length had an effect on patient or healthcare outcomes.

A common question asked by health care employers and employees around shift work is “*is it OK to work 12-hour shifts?*” (Ferguson and Dawson 2011, p. 519). Our current study brings together findings from previously published studies and from new analysis of previously collected data, to address this question.

1.3 Aim

The aim of this study is to review existing data sources to identify what we know about the prevalence of 12-hour shifts in nursing and the impact on both staff and patients. Specifically, this study aims to address the following questions:

- What is the prevalence of 12-hour shifts in nursing?
- How much internal variation in shift length is there in NHS hospitals?
- What impact does shift length have on quality of patient care and staff experience?

1.4 Approach

We have drawn on three data sources: a review of the published literature, the Employment Surveys conducted for the Royal College of Nursing (RCN), and a survey of nurses in a random sample of English hospitals, conducted as part of the RN4Cast study. All three data sources relate to shift patterns of ‘nurses’, and in both the survey sources and review of the literature, this is almost entirely focussed on registered nurses. There is a dearth of data about health care support workers working 12-hour shifts.

1.4.1 Review of literature

A review of the literature on 12-hour shifts was undertaken to explore the potential impact of 12-hour shifts on nurses and patients. The literature was also reviewed to identify any evidence regarding the

variability and financial implications of different shift patterns. A search of online databases including CINAHL, British Nursing Index, Web of Science and ASSIA was undertaken for the period 1982 to 2014. Key words included '12-hour shifts', 'shift length', 'shift work', 'long days', 'long shifts' and 'fatigue', 'stress', 'burnout', 'musculoskeletal disorders', 'job satisfaction', 'patient satisfaction', 'patient experience' and 'errors'. Reference lists of retrieved publications were also scrutinised for further relevant studies.

1.4.2 RCN Employment Surveys

The RCN Employment Surveys have been undertaken annually (1988-2002) and then bi-annually since 2003 to provide a national cross-sectional overview of the working patterns and work-life experiences of nurses employed both inside and outside of the NHS. Three of these surveys explored working hours and shift patterns and shift length (Ball and Pike 2005, 2007, 2009). Each year survey was based on a sample of 9,000 RCN members from across the UK, and achieved a response rate of 54% in 2009, 59% in 2007, and 56% in 2005. These data are analysed to present a profile of how common 12-hour shifts are, nurses' views of their working hours, how shift patterns vary between employment settings, and whether there has been any change between the times of the surveys.

Data on the way in which nurses work, their working hours and shift patterns are not routinely collected in the UK through any other mechanisms. These datasets therefore offer a unique repeated cross-sectional national view of the prevalence of nurses working 12-hour shifts in different employment settings, and an opportunity to explore changes since 2005.

1.4.3 RN4Cast nurse survey data

RN4Cast was an EU 7th Framework funded study of the nursing workforce covering 12 EU countries and three international partner countries beyond Europe. The study sought to examine the relationship between nursing inputs and patient outcomes, whilst controlling for other potentially confounding factors (such as hospital size and medical staffing). The objective was to use an understanding of this relationship to inform workforce plans, or 'forecast' (hence '4Cast') the volume of RNs required to deliver care in a way that minimises the risk of hospital related mortality and other negative outcomes.

The study included a survey of registered nurses in medical and surgical wards in England, in 2010. The survey covered 32 Trusts (2,990 registered nurse respondents from 400 wards, in 46 acute hospitals). The questionnaire covered: practice environment, staffing and patient numbers on the last shift worked, quality and safety measures, frequency of adverse events, care left undone, emotional exhaustion and working hours (including shift length). This survey provides a unique opportunity to identify how shift patterns vary within hospitals, and to explore relationships between shift length and indicators of staff well-being, satisfaction and nurse reports of patient safety and quality.

2. Review of literature

2.1 Approach

A systematic literature search was undertaken to identify literature exploring the potential impact of shift length. The main aim of the literature review was to synthesise evidence of 12-hour shifts on nurse and patient outcomes.

A search of databases including CINAHL, British Nursing Index, Web of Science and ASSIA was undertaken. Key words included '12-hour shifts' 'shift length', 'shift work', 'long days', 'long shifts' and 'fatigue', 'stress', 'burnout', 'musculoskeletal disorders', 'job satisfaction', 'patient satisfaction', 'patient experience' and 'errors' (Table 2.1). Reference lists of retrieved publications were also scrutinised to uncover any further relevant studies.

Table 2.1 Search Terms

a) 12-hour shifts (or)		b) Nurse*Nurses* (or)		c) Fatigue (or)
Shift work (or)		Nursing		Stress (or)
Shift length (or)				Burnout (or)
Long shifts (or)				Musculoskeletal disorders (or)
Long days (or)				Job satisfaction (or)
	AND		AND	Patient satisfaction (or)
				Patient experiences (or)
				Errors (or)

Inclusion and exclusion criteria

Publications detailing empirical research, published between 1982 and 2014 investigating the effects of 12-hour shifts on nurses were retrieved. To be included in the review, the studies met the following criteria; (1) the effect of 12-hour shifts on nurses, including fatigue, stress, burnout, job satisfaction, safety, and/or errors, (2) the effect of 12-hour shifts on patients, including patient satisfaction and experience, (3) the paper was a research study (any design) and peer-reviewed, (4) the sample and setting were nurses working in acute hospital settings, (5) written in English. 'Health Care Support Workers' was not included initially as a search term because this is not internationally recognised. The terms for nurse would retrieve most studies on un-registered nursing support workers. In order to assess the consequences of this decision, we undertook additional scoping searches using the same search strategy replacing the nursing terms with "Health Care Support Workers". We identified no relevant material.

Studies exploring shift patterns in general including night duty and unscheduled overtime were excluded unless they specifically reported on 12-hour shifts. As this analysis is confined to the general (acute) hospital ward population, studies relating specifically to critical care, paediatrics, mental health and community nursing (including nursing homes) were also excluded.

Table 2.2 Databases searched and results by search term

	CINAHL	BNI	Web of Science	ASSIA
12-hour shifts	144	81	4086	88
Long days	12	339	489,649	1969
Shift work	1964	230	80,533	1288
Nurses	272,958	72,608	620,086	31,709
Fatigue	17,321	1398	246,716	2565
Stress/burnout	78,205	6624	30,565	21,104
Job satisfaction	22,900	2360	40,478	2668
Patient satisfaction	26,349	3442	152,127	3678
Patient experience	775	9580	812,538	9956
Patient safety	53,809	3839	387,397	2729
Errors	32,893	2748	139,223	1215

Table 2.3 Combined results: number of papers by type of search term and database

Search terms :	Shifts	nurses	outcomes	combined
Database				
CINAHL	621	223048	275	149
BNI	361	42809	193	383
Web of Science	620,086	620,086	35,219	1471
ASSIA	3647	872766	2625	1484
Relevant papers (abstracts reviewed)				205
Papers that met inclusion criteria				25
Final papers retrieved (including citations for additional studies)				26

Data extraction and synthesis

Data were extracted from included studies by a single researcher (TD). The following data were abstracted; aims/objectives, study design, sample and setting (inclusion/exclusion criteria), outcome measures, results and generalisability of findings. Data synthesis included examining relationships between the sample population and outcome measures. The studies were further divided according to type of outcomes and findings.

2.2 Results

The search identified 205 potentially relevant papers, the title and abstracts of which were reviewed to determine eligibility. One hundred and thirty were excluded after reading the abstract and/or browsing the text. A total of 75 were identified as potentially eligible, but on further scrutiny 49 were excluded as on closer examination they did not meet the inclusion criteria. Studies were not excluded on the basis of the quality of research methods used. Twenty-six papers were included in the final review.

None of the studies were RCT's. The studies ranked highest at 2c, according to OCEBM (2011) were cross sectional surveys with good sample sizes, most of which were representative. All except three studies (Vik and MacKay 1982, Reid et al. 1993, Fitzpatrick et al. 1999) used self-report (a potential cause of bias and limits generalisability of findings). Vik and MacKay (1982) and Reid et al. (1993) both used observation; inter-rater reliability between observers (0.93) was achieved by Vik and MacKay (1982) but was not reported by Reid et al. (1993).

Poor response rates were a feature of many studies including; Bae (2013) 29.8%, Day (2004) 48%, Hoffman et al. (2003) 41.6%, Gillespie and Curzio (1996) 48.5%, Rogers et al. (2004) 40%, and Stone et al. (2006) 42%. Studies by Ilhan et al. (2006) and Trinkoff et al. (2006a, 2006b, 2007, 2011) had more acceptable response rates of 87, 62, 85 and 86% respectively, and Griffiths et al. (2014) had a response rate of 62%. The questionnaire survey by Lea and Bloodworth (2002) was limited by a very small sample size ($n=30$) although achieved 100% response rate.

Studies by Day (2004), Ilhan et al. (2006), Rogers et al. (2004) were ranked lowest at 4. Ilhan et al. (2007) was confined to one acute hospital with limited assessment of outcome measures. Rogers et al. (2004) was limited by a poor response rate and lack of analysis of drop outs. Finally, there were significant flaws in the study by Day (2004), with incomplete reporting of data collection and analysis methods, and insufficient evidence to support the conclusions drawn.

Overview of findings

The 26 studies originated from a range of countries. The vast majority of studies ($n=16$, 61%) were from North America, with only $n=6$ (23%) studies from the UK. The remaining studies were from Europe ($n=1$, 4%), Austria ($n=1$, 4%), Finland ($n=1$, 4%), and Turkey ($n=1$, 4%).

The six UK studies range from the years 1989 to 2002, and it is important to note that nursing practice has changed considerably from this time. Furthermore, given the differences in nursing practice, studies from the US and Europe are not necessarily transferable to this country, which highlights the need for further research in the UK.

The main research methods were survey design ($n=23$, 88%). Researchers used cross sectional descriptive designs using a wide range of validated ($n=8$) and self-designed (not previously validated) questionnaires ($n=6$).

Across the studies, the number of times each of the outcomes were the subject of research are as follows (note some studies covered multiple outcomes):

• Job satisfaction	7
• Quality of care	6
• Patient safety	6
• Adverse events	5
• Fatigue	4
• Stress/burnout	2
• Musculoskeletal disorders	2
• Performance	2
• Needle stick injuries	2

Three studies used observation (11%). Analyses of secondary data were a feature of three (11%) studies. All studies were quantitative, there were no qualitative studies. There was one quasi-experimental study. There were no randomised control trials.

Prevalence of 12-hour shifts

Several studies have investigated the prevalence of 12-hour shifts. A survey by Ball and Pike (2009) showed that 41% of NHS hospital and 63% of care home nurses regularly worked 12-hour shifts. Stimpfel and Aiken (2013) found that 65% ($n=14370$) of US nurses reported working 12-13 hour shifts.

In a study exploring how long and how much nurses are working, Trinkoff et al. (2006b) examined the nature and prevalence of shift patterns across settings. This was a longitudinal survey of 2273 US nurses based on a Nurse's Worklife and Health Study. Questionnaire data about work schedule variations in the preceding months, hours worked per day, per week, weekend and on-call were analysed. Twenty eight percent of nurses typically worked >12 hours per day. A third worked more than

40 hours a week and more than a third worked six days or more in a row. Many had more than one job and worked 50 or more hours per week.

Kalisch and Lee (2013) examined the relationship between US hospital staff, units, and team work and staff characteristics. A total of 3769 staff from 95 patient units (across six hospitals) took part in the survey. Most nurses ($n=2230$, 59.2%) worked 12-hour shifts. Others worked 8 hour ($n=1150$, 30.5%), 10 hour ($n=163$, 4.3%) or a combination of 8 and 10 hour rotating shifts ($n=191$, 5.1%).

However, there are apparent differences across Europe. As part of the RN4Cast study, Griffiths et al. (2014) undertook a European cross-sectional survey of nurses working in acute general medical and surgical wards. Data were collected from 31,627 nurses in 2170 medical/surgical units within 487 hospitals across Europe. Most nurses ($n=15930$, 50%) worked *less* than eight-hour shifts, some ($n=9963$, 30%) worked eight to 10 hour shifts, and a few ($n=4314$, 14%) worked 12 or 13-hour shifts. The paper noted considerable variation across Europe with England, Ireland and Poland being the only countries where 12-hour shifts were common.

2.3 Nurse outcome studies

Sixteen studies examined nurse outcomes associated with 12-hour shifts, including fatigue, stress and burnout, job/career satisfaction, musculoskeletal disorders, performance levels and needle stick injuries.

Twelve-hour shifts and fatigue

Four studies explored the relationship between 12-hour shifts and fatigue. Chen et al. (2013) and Geiger-Brown et al. (2012) examined US nurses perceptions of fatigue using the Occupational Fatigue Exhaustion Recovery Scale (OFER), a previously validated tool (Winwood et al. 2005, 2006) used to differentiate between a range of fatigue and inter-shift recovery processes. Gillespie and Curzio (1996) used a self-designed questionnaire and follow up interviews to compare 12 and eight-hour shift systems in UK medical wards. In two of the studies, nurses working 12-hour shifts were found to be fatigued, whereas in one study nurses working 12-hour shifts reported less fatigue.

Geiger-Brown et al. (2012) used sleep actigraphy, sleep scales (Karolinska Sleepiness Scales, KSS), and performance measures (Performance Vigilance Test) to describe patterns of sleep, fatigue and neuro-behavioural performance of 80 general hospital (day and night) nurses over three consecutive 12-hour shifts. OFER was assessed at baseline level. Total sleep time (TST) was assessed for the period prior to the first and following the next three 12-hour shifts. Marginal means for sleepiness were calculated. The day before the first 12-hour shift, some nurses slept for 15 hours (mean 5.9, SD 1.0 for day and 9.1, SD=2.0 for night nurses, $t=8.8$, $p<0.01$). The mean TST after the first 12-hour shift was 5.7 (SD 0.9) for day and 5.2 hours (SD 1.2) for night nurses ($t=2.07$, $p=0.042$), the second shift was 5.7 (SD 0.7) and 5.5 (SD 1.1) hours respectively ($p>0.05$), and after the third shift was 40 minutes longer. Mean KSS scores were significantly higher for each consecutive 12-hour shift worked ($\lambda^2=13.6$, $p<0.01$).

OFER levels varied with high mean scores for inter-shift fatigue (60.1, SD 19.5, range 10-97), followed by acute fatigue (52.1, SD 21.3, range 7-90) and chronic fatigue (31.5, SD 20.3, range 0-80). Thirty six percent of nurses demonstrated a high level of fatigue on one or more of the subscales. Sleep was short between shifts (mean 5.5 h), sleepiness scores were low overall with 45% of nurses having a high sleepiness score of >7 on at least one shift. Nurses were progressively sleepier each shift. One third of nurses showed a high level of fatigue and inter-shift fatigue. The main findings were that nurses who worked *consecutive* 12-hour shifts did not have an adequate amount of sleep between shifts and suffered considerable fatigue.

Chen et al. (2013) undertook a cross sectional survey of 130 nurses working 12-hour shift patterns across three general hospitals. Mean fatigue scores (as measured on the OFER scale) were 65.6 (SD 18.6, moderate to high) for acute fatigue, 47.3 (SD 21.8, nearly moderate) for chronic fatigue and 50.0 (SD 18.5, nearly moderate) for inter-shift recovery. Their results suggest that 80% of nurses experienced 'moderate to high' or 'high' levels of acute fatigue. Lack of exercise and older age were also associated with higher acute fatigue. This was a US study with a typical representation of the nursing workforce, however it is limited to those working 12-hour *day* shifts. The findings of this study support those by Geiger-Brown et al. (2012) and the authors recommend that nurses should work no longer than 12 hours per day.

Conflicting results are presented by Gillespie and Curzio (1996) who compared two medical wards operating 12-hour shifts with two similar medical wards operating conventional eight hour shifts. Nurses working 12-hour shifts were asked to compare the two shift systems and patients were interviewed about their satisfaction levels. Patients were generally satisfied with the care received, irrespective of shift length. Overall results showed that *less* fatigue was reported by those ($n=8$, 80%) working 12-hour shifts compared to those working eight-hour shifts (p values were not reported). The study is limited by a poor response rate (48.5%) and by the fact that the staff surveyed had chosen to work 12-hour shifts, a potential cause of bias.

Lea and Bloodworth (2003) also report high levels of tiredness ($n=13$, 54%) associated with the 12-hour shift. Although mainly evaluating the effect on job satisfaction, this study was a year-long trial of a shift pattern involving two 12-hour and two six and a quarter hour shifts each week. Twenty-four nurses, four night sisters and two therapists were asked to complete a previously tested questionnaire (100% response rate). There were increased levels of fatigue, as thirteen (54%) nursing staff reported feeling tired during the 12-hour shifts.

Twelve-hour shifts and nurses experience of work: job satisfaction, stress and burnout

Seven studies explored the relationship between 12-hour shifts and job satisfaction (Todd et al. 1993, Kundi et al. 1995, Lea and Bloodworth 2002, Hoffman and Scott 2003, Day 2004, Stone et al. 2006, Stimpfel et al. 2012). Four studies found high levels of job dissatisfaction associated with 12-hour shifts, two studies showed conflicting results with greater job satisfaction and preference for the longer shift, and one study was equivocal.

Todd et al. (1993) undertook a two-phase study of 10 hospital wards before and after the introduction of the 12-hour shift. The authors investigated UK nurses satisfaction ($n=234$, phase 1, $n=205$ phase 2) with response rates of 73 and 64% respectively. Significant differences were found between the two shift systems with nurses indicating greater dissatisfaction with the 12-hour shift ($p<0.001$). Personal lives were felt to have suffered and they also reported feeling more tired at the end of a long shift. There was an overwhelming dissatisfaction and most nurses (83%) did not want to continue with the 12-hour shift patterns.

Hoffman and Scott (2003) examined the relationship between shift length on stress and job satisfaction among 500 hospital nurses. The outcome measures were Nursing Stress Scale (NSS), Index of Work Satisfaction (IWS) (Stamps 1997). Although limited by a relatively low response rate (50.4%), nurses working 12-hour shifts experienced significantly more stress ($t=-2.009$, df 185, $p=0.04$) than those working eight-hour shifts. Nurses working 12-hour shifts were also more stressed when caring for the dying patient (F 3.57, $p=0.06$) and managing workloads (F 3.90, $p=0.05$). Job satisfaction was comparable between groups.

More recently, Stimpfel et al. (2012) investigated the effect of shift length on three nurse outcomes; job dissatisfaction, burnout and intention to leave the job. This was an analysis of secondary data from a sample of 22,275 registered nurses. Sixty-five percent of nurses worked 12-13 hour shifts, 26% worked 8-9 hours, and the remaining 9% worked 10-11 or > 13 hour shifts. Job satisfaction was assessed by the Likert scale and levels of burnout by the previously validated Maslach Burnout Inventory. Across all shifts, >80% of nurses were satisfied with their shift patterns but the percentage of burnout and dissatisfaction increased with shift length. Those working 12-hour shifts were up to two and a half times more likely to show stress, burnout and job dissatisfaction.

Kundi et al. (1995) surveyed 1124 nursing staff from 103 departments over nine hospitals. Most participants (65%, $n=570$) worked 12-hour shifts and 35% ($n=301$) worked eight-hour shifts. High proportions of nurses in both groups were dissatisfied with their shift schedule and expressed a desire to change (44% 12-hour, 47% eight-hour). Neither type of shift was more appealing to nurses. Concerns were expressed on work strain, continuity of service, health, and family and leisure time.

As previously discussed, Lea and Bloodworth (2003) evaluated a year-long trial of a shift pattern involving two 12-hour and two six and a quarter hour shifts each week. There were increased levels of fatigue, as thirteen (54%) nursing staff reported feeling tired during the 12-hour shifts, although this was also attributed to factors including patient dependency, workload and personal issues. The findings in relation to sickness absence however present a more mixed picture; levels of sporadic (or short term) sickness dropped during the trial (1072 hours compared to 1911 hours the previous year), whilst long-term sickness increased (2087 hours compared to 938 hours the previous year).

Using a cross-sectional design with data collected from a range of sources (survey, administrative and patient records), Stone et al. (2006) compared levels of burnout (Maslach Burnout Inventory) and job satisfaction with nurses' shift patterns. Nurses working 12-hour shifts were more satisfied with their

jobs, experienced less fatigue, were 10 times more satisfied with their shift patterns, and twice as likely to perceive 12-hour shifts as important.

In a questionnaire survey of 336 registered nurses across five US hospitals, Day (2004) also examined the relationship between shift work and job satisfaction. In relation to 12-hour shifts, 31% felt they were positive in terms of lifestyle, 62% gave a negative or uncertain response, 38% gave a positive response on morale, and 56% a negative or uncertain response. On the question of preference to work 12-hour shifts, 36% strongly agreed, 30% agreed, 9% disagreed, 9% strongly disagreed and 15% were uncertain. The majority of participants (66%) were in favour of the 12-hour shift.

The findings from these studies highlight conflicting evidence relating to job satisfaction and levels of stress and burnout with the 12-hour shift. The settings of all seven studies are general medical and/or surgical hospital wards although the sample by Todd et al. (1993) and Stimpfel (2012) also included some critical care nurses. The sample sizes of most studies were good. The smallest study ($n=30$) was by Lea and Bloodworth (2003). Other studies of survey design had sample sizes that ranged from $n=208$ (Hoffman and Scott 2003) to $n=22,275$ (Stimpfel et al. 2012), although data from this study is taken from three larger surveys.

Twelve-hour shifts and musculoskeletal disorders

Two studies explored the relationship between 12-hour shifts and musculoskeletal disorders (Lipscombe et al. 2002, Trinkoff et al. 2006a).

Lipscombe et al. (2002) investigated the relationship between shift length and musculoskeletal disorders in a sample of 1163 US nurses. Four of the nine work schedule characteristics (working full time, 12-hour shifts, weekends, night work) were associated with musculoskeletal disorders. Specifically for 12-hour shifts, these included disorders of the neck (OR 1.22, 95% CI 0.76-1.97), shoulder (OR 1.42, 95% CI 0.86-2.34) and back (OR 1.61, 95% CI 1.05-2.48). Working long shifts (>12 h/day, >40 h/week) were associated with a 50-170% increase in age-related odds ratio for muscular skeletal disorders in three body sites. The study was limited to the current population of nurses which did not include those who had left the workforce due to musculoskeletal problems.

Trinkoff et al. (2006a) surveyed 2617 nurses as part of a work life and health study. This was a three-wave questionnaire survey, baseline measure of hours worked per day; week and month were recorded alongside reports of musculoskeletal disorders. The cumulative incidence of musculoskeletal disorders was 14% for neck, 17.3% for shoulder and 21.1% for back problems. Analysis of work schedules showed that working >13 hours per day, non-day shifts and weekend working were associated with neck, shoulder and back disorders.

The findings of both studies suggest an association between shift work and musculoskeletal disorders, although it is difficult to identify the specific effect of shift length. Both studies are American and the settings are general medical and/or surgical hospital wards. Both have good sample sizes. However, like many other studies, they are also based on self-report and therefore lack external validity.

2.4 Patient outcome studies

Eleven studies examined patient outcomes associated with working 12-hour or long shifts. These were mainly related to quality of care, patient experience, and the occurrence of untoward incidents such as medication errors and nurses needle stick injuries. One study examined the relationship between shift work and mortality (Trinkoff et al. 2011) and one explored the risks of nosocomial infection (Virtanen et al. 2009).

Twelve-hour shifts and quality of care

Five studies explored the relationship between shift length, quality and amount of patient care provided (Vik and MacKay 1982, Todd et al. 1989, Reid et al. 1993, Fitzpatrick et al. 1999, Griffiths et al. 2014). Three were observational studies, one an evaluation study using MONITOR (a quality of care monitoring index), and one quasi-experimental (observational) study using Qualpacs (Quality of Patient Care scale).

Vik and MacKay (1982) undertook a matched design quasi-experimental study to compare quality of care by nurses working different shift patterns. The authors hypothesised that patients cared for by nurses working 12-hour shifts would receive a higher level of care than those cared for by nurses working eight-hour shifts. There were 60 patients, 30 in each shift group, care was assessed using Qualpacs, a 68 item scale designed to measure quality of care delivered. The items are divided into a) psychosocial: individual, b) psychosocial: group, c) physical, d) general, e) communication and f) professional. A rating scale of five to one is allocated to indicate 'best' and 'poorest' care. The quality of care received by patients on the eight-hour shift was significantly higher than that received by patients on the 12-hour shift (p value not reported). The scores for the last two hours of their shift also indicated a lower quality of care and suggested that nurses working 12-hour shifts may be more fatigued towards the end of their shift.

Todd et al. (1989), in a repeated measure study of 10 hospital wards across two hospitals in Northern Ireland, compared quality of care, measured by MONITOR under eight and 12-hour shifts. Data were collected for one month prior to the introduction of 12-hour shifts and again six months later. Todd et al. (1989) found significant differences in overall MONITOR scores ($p < 0.01$) for the wards operating conventional shifts compared to the 12-hour shift. The wards operating eight-hour shifts had higher scores for planning care ($p = 0.05$), providing psychological care ($p < 0.02$) and evaluating care ($p < 0.01$).

The same authors (Reid et al. 1993) also undertook an observational study to compare eight and 12-hour shift systems in 10 wards across the same two hospitals. Data were collected for one month during the operation of the eight-hour shift. Measures were then repeated six months after the introduction of the 12-hour shift. Nurses were observed using a time-sampling technique; 4232 hours of observational data were recorded alongside 19,434 observations of nursing activities. Categories of care were coded according to i) direct patient care activities, ii) indirect care activities, iii) routine care activities and iv) non-care activities. Five trained fieldworkers carried out the observations. Significant reductions in the

amount of direct patient care were found under the 12-hour shift ($p=0.0125$). This corresponded with an increase in unofficial breaks. These findings were consistent across all 10 wards and suggest that the nurses were pacing themselves throughout their long days on duty.

To further explore shift work and its impact on nurse performance, Fitzpatrick et al. (1999) aimed to refine and validate the King's Nurse Performance Scale (an empirically derived generic instrument). Thirty four purposively selected staff nurses (within one year of registration) from two UK hospitals were observed using non-participant observation. Overall median performance scores were 3.6, with 3.4 for the physical domain, 3.7 for psychological domain, 3.5 for professional domain and 3.6 for communication domain. There was a significant relationship between shift length and overall performance scores ($p=0.04$) and nurses who worked shifts of eight hours or less achieved higher performance scores. Significant differences were found between eight and 12-hour shifts in relation to physical ($p=0.03$) and professional ($p=0.01$) domains of performance with those working eight hours or less achieving higher scores. No significant differences were found between the categories for psychosocial ($p=0.65$) or communication ($p=0.09$) domains. The findings of this study support those by Todd et al. (1989) demonstrating that clinical performance was significantly higher in those working shorter shifts. The focus of this study was refinement and validation of an instrument and not shifts work *per se*. It is also limited by a small sample size and lacks external validity.

As part of the RN4Cast study, Griffiths et al. (2014) undertook a European cross-sectional survey of nurses working in acute general medical and surgical wards. Using the previously validated International Hospital Outcomes Study questionnaire, data were collected from 31,627 nurses in 2170 medical/surgical units within 487 hospitals across Europe. Findings showed a range of shift patterns both across and within countries, with 50% of nurses working less than eight hour shifts, 32% working between 8.1 and 10 hours, and 14% 12 to 13 hours. Only 1% of nurses reported to have worked more than 13 hour shifts. Nurses who worked 12 hours or longer were more likely to report poor quality care (OR 1.30, 95% CI 1.10-1.53), more care left undone (RR 1.13, 95% CI 1.09-1.16) and an adverse effect on patient safety (OR 1.41, 95% CI 1.13-1.76). Poor quality of care (OR 1.32, 95% CI 1.23-1.42), failing patient safety (OR 1.67, 95% CI 1.51-1.86) and more care left undone (RR 1.29, 95% CI 1.27-1.31) were also associated with working overtime. The effect of shift length persisted even when controlling for overtime. The authors recommend caution when implementing 12-hour shifts and suggest that overtime working may pose an additional threat to patient safety.

Many of the studies involve an element of observation which, whilst not without its own pitfalls (for example the *Hawthorne effect*), can be more reliable than self-report which features in many of the large scale surveys. Whilst the sample size of these studies vary and some are small ($n=34$, Fitzpatrick et al. 1999), the hours of observation and nursing activities observed in other studies (Reid et al. 1993) are large (4232 hours).

Twelve-hour shifts and patient safety and adverse events

In a cross sectional survey of US nurses, Rogers et al. (2004) explored the relationship between shift length and patient safety using logbooks to report levels of fatigue, errors and near misses. Logbooks from 5317 shifts revealed that 38.7% of the shifts worked exceeded the planned 12 hours. Data collection also revealed that hospital nurses generally worked more than their scheduled 40 hours per week. In relation to errors, there were 199 incidents and 213 near misses during the data collection period. More than half of these (actual errors, 58%; near misses, 56%) were medication errors. Other errors reported were related to procedures (18%), charting (12%) and transcription (7%), and 30% of nurses admitted to making at least one error. There was a significant relationship between the length of shift worked and the likelihood of making an error, and nurses working >12 hours were three times more likely to make an error than those working eight-hour shifts (OR 3.29, $p=0.001$). Working overtime also increased the risk of errors (OR 2.06, $p=0.0005$), and data suggests that these risks are significantly increased for overtime following a 12-hour shift ($p=0.005$).

Ilhan et al. (2006) explored the incidence of sharp and needle stick injuries in a Turkish hospital. A self-designed questionnaire was sent to all nurses ($n=516$, response rate 87%). The incidence of sharp and needle stick within the past year was 68.4%. The median number of injuries was 2 (SD 1-12). The prevalence of injuries for those who worked >8 hours per day was higher than those worked <8 hours per day (86.5% versus 77.1%, $p<0.05$).

Similar findings are presented by Trinkoff et al. (2007), who examined the association between working conditions and needle stick injuries among US registered nurses. This was a longitudinal questionnaire survey of 2624 nurses conducted over a two-year period (response rate 85 and 86%). Sixteen percent of nurses sustained a new needle stick injury over the 15 month period. The odds of injury increased (OR 1.63, CI 95% 1.17-2.26, $p<0.001$) for those working longer hours, weekends and >13 hours per day.

The same authors (Trinkoff et al. 2011) investigated the effect of shift patterns on patient outcomes and mortality rates. This was a cross sectional survey of 633 RNs from 71 acute US hospitals. Mortality measures were taken from discharge data using the Agency for Healthcare and Quality In-patient Quality Indicators (IQIs). Included IQIs were pneumonia, heart failure, myocardial infarction, stroke, post-operative craniotomy and abdominal aortic aneurysm repair. Long hours (>13 hours per day) were significantly related to mortality. In hospitals where nurses reported working long hours (>13 hours per day), there were significantly more deaths from pneumonia (OR 1.42, CI 1.17-1.73, $p<0.01$).

In a secondary analysis of a large scale ($n=22275$) US survey, Stimpfel and Aiken (2013) analysed the relationship between shift length, work patterns and reports of safety and quality. Nurses gave reports of start and end of shift time; quality of care was measured by a four point Likert scale, ranging from 'excellent' to 'poor' and safety was graded by a 5 point Likert scale ranging from 'A' (excellent) to 'F' (failing). Most nurses ($n=14370$, 65%) worked 12-13 hour shifts, others worked 8-9 hour ($n=5677$, 26%), 10-11 hour ($n=904$, 4%) or >13 hour ($n=991$, 5%) shifts. However, working longer hours were

associated with higher odds of reporting poor hospital safety (12-13 hours; OR 1.18, CI 1.08-1.28, $p=0.0001$, >13 hours; OR 2.38, CI 2.03-2.79, $p<0.0001$) and poor quality of care (12-13 hours; OR 1.26, CI 1.12-1.41, $p<0.0001$, >13 hours; OR 2.69, CI 2.27-3.18, $p<0.0001$). Overall, the results showed that nurses working shifts of >10 hours were more likely to report poor quality of patient care and hospital safety.

Bae (2013) examined the relationship between 12-hour shifts injuries and adverse patient events. 500 nurses were randomly selected from two US hospital sites of West Virginia, where mandatory overtime is prohibited and nurses are not permitted to work more than 16 hours in a 24 hour period and any shift of >12 hours requires at least 8 consecutive hours off. Response rate was low ($n=173$, 29.8%). Self-reported (nurse) injuries were defined as needle stick injuries, back injuries, cuts or lacerations, bruises or verbal abuse from colleagues or patients. Adverse patient injuries were defined as medication errors, falls, pressure ulcers, or nosocomial infection. These were compared to work hours, work patterns and overtime. Approximately 16% of nurses worked >40 hours per week, some reporting needle stick injuries ($n=23$, 13.3%), cuts or lacerations ($n=27$, 15.6%), and sprains ($n=64$, 37%). Verbal abuse ($n=98$, 56.6%) and bruises ($n=86$, 40.7%) were the most reported injuries. In relation to adverse patient events, medication errors ($n=77$, 44.5%) and falls ($n=66$, 38.2%) were the most frequent occurrences reported. Sixty-one percent ($n=106$) of nurses believed that their patients had experienced at least one adverse event during their hospital stay. Nurses working long hours each week were significantly more likely to report verbal abuse (OR 4.45, 95% CI 1.51-13.06, $p<0.01$). There were also significant associations with any nurse reported injury and long working hours (OR 1.47, 95% CI 1.47-10.50, $p<0.01$), as was the reporting of medication errors (OR 3.71, 95% CI 1.16-11.84, $p<0.05$).

The final study (Virtanen et al. 2009) examined the association between work hours, work stress and the risk of infection. This study combined data from two surveys, one examining the risk factors of hospital patients and another investigating the effects of work hours and work stress. One thousand and ninety two patients and 1159 nurses from six Finnish hospitals took part in the survey. Ninety nine (9.1%) cases of hospital acquired infection were found, which the authors report was in line with the national average. However, working long hours (>8.45 hours) were associated with an increased risk of infection (OR 3.74, CI 1.74-8.02, p value not reported).

The findings suggest that there are potential adverse patient events associated with working 12-hour shifts. However, none of the studies are British and most are based on self-report. The findings cannot therefore be generalised. The Finnish study by Virtanen et al. (2009) uses mean shift hours to calculate associations between the length of time worked and outcome measures. According to Finnish legislation, shift length should not exceed 10 hours, except for night duty which can equate to a 14 hour shift. From the data presented, it is not clear proportionately how many worked these shifts since only ward level means were recorded. Nevertheless, in spite of these limitations, the findings from these studies show some evidence to support the suggestion that 12-hour shifts are associated with an increase in incidents such as medication errors and needle stick injuries.

2.5 Summary

The aim of this review was to explore the evidence base for differing shift patterns worked by nurses on general acute hospital wards, exploring associations between 12-hour shifts and reports of quality and safety of patient care. The findings of the studies can be divided into those which have a positive outcome for nurses, patients and organisations, those that show conflicting evidence and those that highlight the risk of errors and hazards to patients and staff. None of the studies included any economic analysis. The majority of studies reviewed are limited in relation to design, sample, methodology, and the potential for bias. Most, but not all, lack external validity and findings cannot therefore be generalised. At best, the level of evidence is weak to moderate.

To help gain an overview of the relationships reported, Table 2.4 lists the studies reviewed according to a thematic analysis of the outcomes examined. To ease interpretation, all the outcomes have been expressed in a negative direction (eg. job dissatisfaction, rather than satisfaction). Thus upward arrows denote an increase in a negative outcome in the 12-hour shift group.

In general, most of the studies appear to show some degree of negativity, either for nurses, patients, or both, towards 12-hour shifts. Many of the adverse outcomes studies relate to fatigue which can also jeopardise patient safety. Other factors can affect the quality and safety of nurses' work, such as shift rotation (Surani et al. 2007), hours and the number of consecutive days worked (Potera 2011), and unplanned or extended shift times (Rogers et al. 2004).

The review has focused on the effects of 12-hour shifts. However, for some of the studies it is not possible to differentiate between working such shifts as part of a planned pattern, working long hours and the total number of hours worked each week, including voluntary or non-voluntary, paid or unpaid overtime. In general the research is focused on registered / licensed nursing staff or does not explicitly define / differentiate the nursing group considered. Therefore it is not possible to make specific conclusions about health care support workers, although there seems no reason to suppose that fatigue related effects are lower in this group although the consequences may differ.

Table 2.4 Thematic analysis of studies evaluating 12-hour shifts

	Country	Nurse Outcomes					Patient Outcomes				Prevalence
		Fatigue	Stress/burnout	Job dissatisfaction	Musculo-Skeletal disorders	Poor Performance	Poor quality of care	Threat to patient safety	Adverse events	Needle stick injuries	
Bae et al. (2013)	US							↑*	↑*		
Chen et al. (2013)	US	↑*									
Day (2004)	US			↑							
Fitzpatrick et al. (1999)	UK					↑*					
Geiger-Brown et al. (2012)	US	↑*				↑*					
Griffiths et al. (2014)	EU					↑*	↑*				15% EU nurses
Gillespie, Curzio (1996)	UK	↓									
Hoffman, Scott (2003)	US		↑*	-							
Ilhan et al. (2006)	Turkey							↑*	↑*		
Kalish, Lee (2013)	US										59% US nurses
Kundi et al. (1995)	Austria			↑*							
Lea, Bloodworth (2002)	UK	↑		↓							
Lipscombe et al. (2002)	US				↑*						
Reid et al. (1993)	UK					↑*					
Rogers et al. (2004)	US						↑*	↑*			
Stimpfell et al. (2012)	US		↑*	↑*							
Stimpfell, Aiken (2013)	US					↑	↑				65% US nurses
Stone et al. (2006)	US			↓					-		
Trinkoff et al. (2006a)	US				↑*						
Trinkoff et al. (2006b)	US							↑*			28% US nurses
Trinkoff et al. (2007)	US									↑*	
Trinkoff et al. (2011)	US					↑*	↑*				
Todd et al. (1989)	UK					↑*					
Todd et al. (1993)	UK			↑*							
Vik, MacKay (1982)	US					↑					
Virtanen et al. (2009)	Finland						↑				

Key: ↑ = increase, ↓ = decrease, - = no difference.

Statistically significant differences, at the 5% level, are marked with an asterisk (*).

3. Profile of nursing shift patterns in the UK: RCN surveys

3.1 RCN employment survey data

In 1987, the RCN commissioned the Institute of Manpower Studies (now the institute of Employment Studies) to research the attitudes, employment and mobility of qualified nurses (Waite and Hutt 1987). This marked the first 'employment survey', which was repeated annually until 2003, when it then became biannual. Surveys of the RCN membership (which covers more than half of all practicing nurses¹) reveal a profile that is closely matched to the nursing workforce as a whole, and thus the results of the surveys of members can be taken to reflect the UK nursing workforce more generally.

Between 2000 and 2009 the surveys were undertaken by Employment Research using a consistent methodology (with many parts of the questionnaire standardised since 1992), which allows comparisons between years to be made. In 2005, 2007 and 2009 the survey included questions relating to nurses' working hours, and specifically to shift length (Ball and Pike 2005, 2007, 2009). Since that time a different approach has been taken by the RCN to surveying its members, relying solely on an online survey. Questions relating to the length of shifts have not been included.

Data on the way in which nurses work, their working hours and shift patterns are not routinely collected in the UK through any other mechanisms. The 2005, 2007 and 2009 RCN Employment Survey datasets therefore offer a unique repeated cross-sectional national view of the prevalence of nurses working 12-hour shifts in different employment settings, and an opportunity to explore changes since 2005.

The 2009 survey covered 9,000 members with a response rate of 54%. In 2007 the sample was 9,000 and response rate 59%, and in 2005 a 56% response was achieved from a sample of 9,000. The samples achieved are sufficient to estimate the prevalence of 12-hour shifts with a precision of less than +/- 2%²

The data are brought together in this report to explore the following:

- How common are 12-hour shifts amongst nurses?
- Who is working them (differences by employer type, setting, specialty)?
- What are nurses' views of their working hours – by shift length?
- Has there been any change over time in the prevalence of 12-hour shifts?

¹ 'Nurses' is used as a shorthand to refer to the whole nursing family who are members of the RCN including healthcare assistants, midwives, district nurses and health visitors.

² Wald 95% confidence interval for the proportion working 12-hour shifts was 42%-46%)

3.2 Overview of nurses' working patterns

Shift length needs to be understood in a broader context of working patterns more generally: how many nurses work shifts as opposed to office hours, how nights are covered (use of systems such as internal rotation), and the relative prevalence of full-time and part-time working.

In the most recent survey in 2009 (Table 3.1), 63% of all nurses surveyed worked full-time (66% NHS), 57% worked shifts (60% NHS) and 36% 'office' hours (34% NHS). The proportion of nurses working full-time was unchanged since 2003. The mean total hours worked by full-time staff nurses in their last full working week was 44 hours (Table 3.1).

Table 3.1. Working patterns and shift length by employer type (percentages)

	Full-time	Pattern of working			Shift pattern			Shift length
	Full-time	Shifts	'Office' hours	Flexi-time	Internal rotation	Daytime shifts	Permanent nights	12-hour ³ (or longer)
NHS hospital	68	76	20	4	69	23	7	50
NHS community	64	17	74	9	15	74	11	10
NHS other	62	28	63	9	59	34	7	16
All NHS	66	60	34	6	65	27	8	45
GP practice	21	6	89	5	-	-	-	-
Independent hospital	59	67	24	9	23	59	18	39
Independent care home	78	80	11	10	22	54	24	66
Other independent	64	26	53	21	27	59	14	22
Bank/agency	27	66	14	20	40	40	20	38
Higher education	71	19	63	19	-	-	-	-
Hospice/charity	52	58	36	6	51	38	11	13
HA/NHS Exec	73	37	57	7	-	-	-	-
Other	69	22	53	24	50	43	7	36
All respondents	63	57	36	7	58	32	10	44
<i>N=</i>	4560			4524				2708

Source: *Employment Research/RCN 2009*

³ Percentage of those who worked shifts. Throughout this analysis, for consistency in comparing results between different surveys, a new category '12-hour shifts or longer' has been used as the reference point. This differs from the previously published '12-hour shift' findings.

Of those nurses working shifts 58% work a form of internal rotation (65% NHS), 32% work daytime shifts only (27% NHS) and 10% work permanent nights (8% NHS). Permanent night shifts are most prevalent in the independent sector and among bank/agency nurses. In care homes one in four (24%) work permanent nights. Internationally recruited nurses in the NHS are more likely to work shifts (92%) and internal rotation (77%) (Table 3.2).

Table 3.2 Shift pattern and length by job title (NHS only, percentages)

	Work shifts		Shift pattern		Shift length
	Shifts	Internal rotation	Daytime shifts	Permanent night shifts	12-hour (or longer)
Staff nurse	87	71	20	9	50
Community nurse	22	10	78	12	3
HCA	74	81	11	8	33
Sister/charge nurse	77	60	36	4	46
Senior nurse	32	65	32	3	40
CNS	5	65	35	0	24
Nurse practitioner	53	43	46	11	35
District nurse	25	0	87	13	4
Health visitor/SCPHN	0	-	-	-	-
CPN	18	31	69	0	10
Midwife	91	75	15	10	58
School nurse	2	-	-	-	-
Manager/director	0	-	-	-	-
Researcher/lecturer/tutor	5	-	-	-	-
Other	42	42	39	19	26
All NHS respondents	60	65	27	8	45
<i>N=</i>	3458				2152

Source: *Employment Research/RCN 2009*

Nurses working shifts were asked to indicate their usual shift length. Across all settings, 45% of respondents reported eight hour shifts (or less), 11% reported working between 8.1 and 11.9 hour shifts and 44% said they worked 12-hour shifts (or more) (Table 3.3). It is worth noting that having a '12-hour shift pattern' may well involve nurses working slightly in excess of that per shift in order to accommodate the overlaps required for handover at the shift start and end.

Working 12-hour shifts varied by employment setting, job title, and specialty (Table 3.1-3.3). Care home nursing staff were more likely to work permanent night shifts and more likely to work 12-hour shifts; 66% of those working in care homes worked 12-hour shifts compared to 50% of NHS hospital nurses and 39% of independent hospital nurses.

Staff nurses and midwives are more likely than staff in other posts to report working 12-hour shifts. 12-hour shifts are most frequently reported by staff working in critical care units (Table 3.3).

Table 3.3 Working patterns and shift length by specialty and pay band (percentages, NHS only)

	Work shifts		Shift pattern		Shift length
	Shifts	Internal rotation	Daytime shifts	Permanent night shifts	12-hour (or longer)
Primary care	29	37	54	9	19
Community care	22	7	73	20	8
Older people's nursing	82	57	34	9	29
Mental health	44	64	28	8	20
Learning disabilities	42	70	23	7	17
Adult critical care	90	80	14	6	64
Adult general	78	64	28	8	42
Rehabilitation/LTC	72	52	36	11	27
Paediatric critical care	92	87	7	6	88
Paediatric general	76	80	11	9	69
Women's health	71	57	28	15	41
Oncology/palliative	38	70	22	7	35
Other	40	38	55	7	26
All respondents	61	65	27	8	45
<i>N</i> =	3385				2110

Source: *Employment Research/RCN 2009*

3.3 Change in 12-hour shift working between 2005 and 2009

The 2005 survey asked respondents to give their shift length in hours, while the 2009 survey gave the two most common responses – 12-hour and eight-hour – and only asked respondents for the exact shift length if it was not eight or 12 hours long. To make the two datasets comparable, and explore changes in the prevalence of long shifts, the open responses (in both years) were regrouped into the following categories: eight hours or less, 8.1 to 11.9 hours and 12 hours or more (up to 17.9 hours). Where length of shift was not stated or was 18 hours or more, these were coded as 'missing'.

As the analysis above has shown, working patterns and the length of shift worked varied between sectors, job title, pay band and setting. To ensure a consistent comparison is made, and minimise the risk of confounding factors related to changes in the mix of respondents between years, staff nurses working in NHS hospitals have been selected, and the shift patterns in different specialties compared (Table 3.4). Between 2005 and 2009 there has been a substantial increase in the proportion of staff nurses in NHS hospitals working 12-hour or longer shifts; 31% in 2005 compared with 52% in 2009. This increase was seen across all specialties, but is particularly marked on adult general medical and surgical wards, where the proportion working 12-hour shifts more than doubled (22% to 47%).

Table 3.4 NHS hospital staff nurses working 12-hour (or longer) shifts by specialty (percentages in 2005 and 2009)

	2005 (%)	Base N=	2009 (%)	Base N=
Older people's nursing	18	69	33	84
Mental health	12	87	21	68
Adult critical care	50	343	66	331
Adult general/medical/surgical	22	456	47	419
Rehabilitation/longer term care	19	43	38	40
Paediatric critical care	48	65	87	69
Paediatric general	54	84	80	116
Oncology/palliative care	56	48	42	31
All respondents	31	1399	52	1310

Source: *Employment Research/RCN 2009 and 2005*

Table 3.5 presents a comparison of the prevalence of staff nurses working 12-hour plus shifts in 2005 compared to 2009 in different employer settings. There has been a steep increase in numbers of staff nurses working long shifts (12-hours plus) in NHS hospitals (from 31% to 52%) and in independent care homes (from 41% to 69%) but there has been little or no change in this form of working in the independent hospitals, bank/agency and hospice/charity sectors.

Table 3.5 Staff nurses working long shifts by sector (2005 and 2009)

	% working 12-hour shifts 2005	Base N=	% working 12-hour shifts 2009	Base N=
NHS hospitals	31	1402	52	1329
Independent hospitals	29	76	30	63
Independent care homes	41	114	69	147
Bank/agency	33	104	41	79
Hospice/charity	19	68	16	63
All respondents	31	1843	50	1749

Source: *Employment Research/RCN 2009 and 2005*

3.4 Nurses views of their working hours by shift length

The 2005 survey explored nurses' views of their shift length and working hours in greater depth than other RCN employment surveys. Having been asked about their normal shift length, respondents were asked a supplementary question on what their 'ideal' shift length would be. More than two-thirds (69%), reported that their current shift length was their preferred choice.

The 2005 survey reported that nurses who qualified in the last five years were more likely to work longer shifts. The survey found that one in four (44%) work shifts longer of 12 hours or more. In this group, mature entrants are more likely to want to work shorter shifts (17% compared to 13% of younger entrants). Younger entrants are more likely to say that their ideal shift length would be longer (16% compared to 8% of mature entrants). Of those who were not working their ideal length of shift at the time of the survey, 23% wanted a shorter shift and 9% wanted a longer shift.

The RCN employment surveys include a set of attitude items to gauge satisfaction with various aspects of work life such as pay, career development, opportunities to progress, nursing as a career, workload, job security, and also working hours. Using the 2009 dataset, the views of NHS hospital staff nurses working 12-hour shifts (or longer) are compared with those working shorter shifts. Statistical significance of differences were tested by comparing mean scores (using ANOVA) and comparing the proportion responding to each category (using Chi square test).

Table 3.6 Views of NHS hospital staff nurses of their working hours (2009) (n=1310 approx.)

Statements	Shorter shifts		12-hour or longer		sig ⁴
	Agree	Disagree	Agree	Disagree	
Working hours statements					
I am happy with my working hours	68%	18%	72%	17%	<i>p=0.03</i>
I am satisfied with the choice I have over the length of shifts I work	60%	18%	60%	22%	<i>Not sig</i>
I feel able to balance my home and work lives	57%	23%	59%	20%	<i>Not sig</i>
I am satisfied with my input in planning off duty and times of work	57%	24%	56%	24%	<i>Not sig</i>

Respondents were presented with 34 statements that covered attitudes to different aspects of working life (such as pay, career opportunities, workload, and job security) and asked to rate their agreement with each on a five point scale. Four items related to views of their working hours. On three of these no difference is found by the length of shift worked. There is however a statistical difference in levels of

⁴ A chi-square test was conducted comparing the views of those working shorter shifts with those working 12 hour or longer shifts (missing cases excluded) – agreed and disagreed are presented to summarise the findings.

agreement with the item 'I am happy with my working hours': 72% of 12-hour shift nurses agreed compared with 68% of those working other shifts.

3.5 Summary

Between 2005 and 2009 there has been a steep increase in numbers of staff nurses working long shifts (12-hours plus) in NHS hospitals (from 31% to 52%) and in independent care homes (from 41% to 69%). Of the 44% of nurses in 2005 working work shifts of 12 hours or more, mature entrants were more likely to want to work shorter shifts (17% compared to 13% of younger entrants), illustrating that views of preferred shift patterns potentially vary between subgroups of nurses.

Those working 12-hour shifts report that they are equally or more satisfied with their working hours than nurses working shorter shifts.

4. Impact of 12-hour shifts: RN4Cast survey analysis

The RCN employment survey dataset provided a breadth of perspective; a cross-sectional national view of nurses working hours in a variety of settings working for different types of employer. It allowed variation in working 12-hour shifts to be explored by specialty and employer, and enabled some comparison between time periods. In contrast, the RN4Cast dataset focuses on a tightly defined group of nurses within a specific setting: registered nurses working on general medical and surgical wards in NHS acute hospitals.

The RN4Cast study was a European funded study of nurse staffing in 12 EU countries. Recent analysis of the RN4Cast nurse survey data from all 12 participating EU countries (31,627 nurses in 2170 medical/surgical units within 487 hospitals) explored variation in the shift length nurses work between and within countries, and within hospitals (Griffiths et al. 2014). Across the EU, most nurses ($n=15930$, 50%) worked less than eight hour shifts, some ($n=9963$, 30%) worked 8 to 10 hour shifts, and with only 14% ($n=4314$) reporting that they worked 12 or 13 hour shifts.

Countries varied in their typical shift length. In Belgium, Germany, Greece, the Netherlands, Norway and Sweden the majority of day shifts were eight hours or shorter, with fewer than 5% of nurses working shifts of 12 hours or more. Shifts of 12 hours or longer were also rare in Finland, Spain and Switzerland. Meanwhile in Ireland and Poland, shifts of 12 hours were the norm. England alone presented a mixed picture, with 32% of day shifts and 36% of night shifts lasting 12 hours or more.

In England, the RN4Cast study involved a survey of registered nurses in medical and surgical wards. The questionnaire covered: practice environment, staffing and patient numbers on the last shift worked, quality and safety measures, frequency of adverse events, care left undone, emotional exhaustion and working hours (including shift length). The survey was administered in spring/summer of 2010, 2568 responded achieving an overall response rate of 39%. The responding sample was more than sufficient to estimate percentages within $\pm 3\%$.

Using these data we can explore how shift patterns vary within hospitals, and examine relationships between shift length and indicators of staff well-being and satisfaction and nurse reports of patient safety and quality.

4.1 Length of shifts worked by RNs on acute NHS wards

Of the 2568 nurses responding to the RN4Cast survey in England, 74% (1898) had worked day shifts and 26% (670) reported night shifts. Staff working night shifts were more likely to be working 12-hour shifts, whilst there was much more variation in the length of shifts worked by nurses on day time shifts (see Figure 4.1). Analysis at the ward level also shows a high degree of variation in day shift durations between wards in the same hospitals.

From these data, we see considerable variation within each hospital in the shift length worked, with most Trusts having a mix of eight hour shifts, 12-hour shifts, and shifts of a variety of other lengths (Figure 4.2). Few Trusts have a single shift length in operation across or within the wards studied. England is unusual in comparison with other countries in the diversity of shift lengths worked (Griffiths et al. 2014).

Figure 4.1: Shift length by day/night

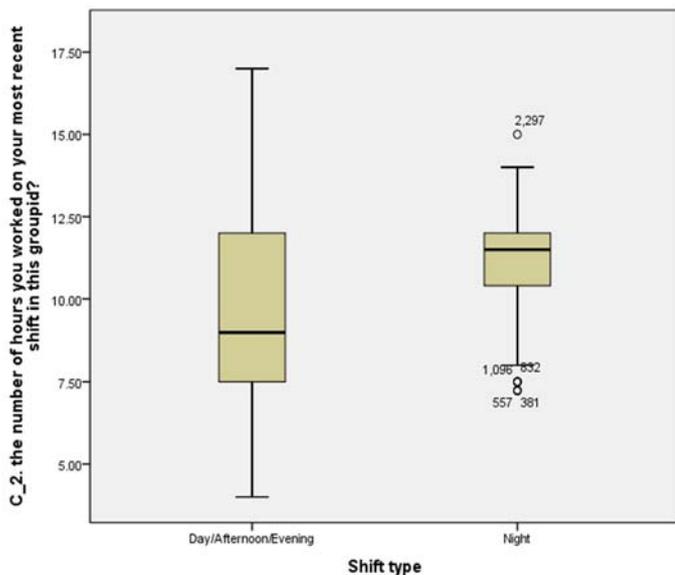
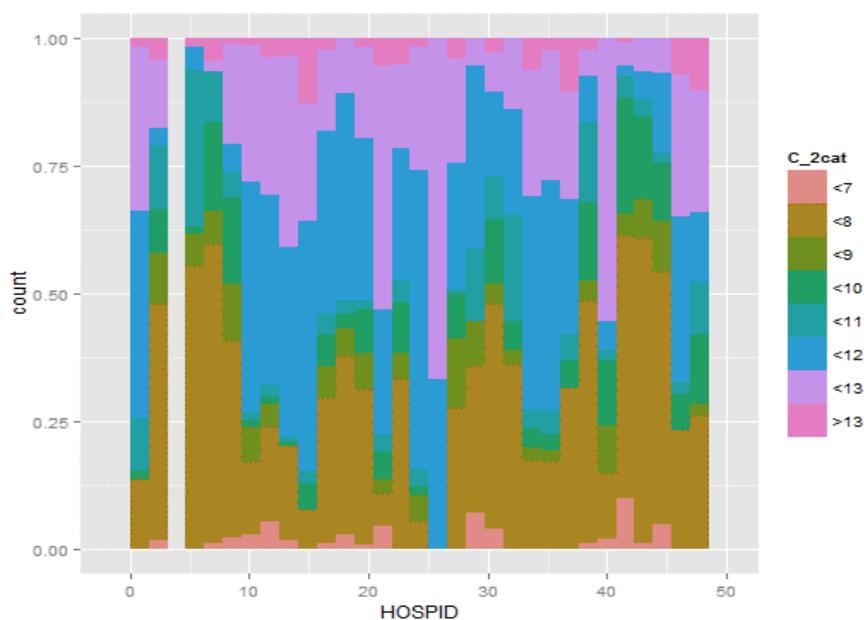


Figure 4.2 Distribution of shift length among hospitals in England



4.2 Analysis using staff and patient outcome indicators

We explored for associations between shift length and a number of measures of nurse outcome and care quality. We also controlled for a number of other factors in order to isolate the effects of shift length. The relationships between the potential predictors [shift length, working beyond contracted hours, day/night shift, medical or surgical unit, patients per nurse (grouped in patient increments of two), patients per HCA (Quintiles), full or part-time work, age (in ten year bands), Trust size, high (or not) technology trust, teaching (or non-teaching) trust], and five self-report measures representing care quality, safety and job satisfaction were tested statistically using a multilevel model with ward nested within trust using IBM SPSS Version 22 GENLIMIXED.

The dependent variables **poor quality of care nurse rating** (*poor/fair*), **poor patient safety rating** (*failing/poor*), **not satisfied with job** (*very dissatisfied/a little dissatisfied*) and **not satisfied with work schedule** (*very dissatisfied/a little dissatisfied*) were modelled assuming the data were generated from a binomial distribution. The care left undone score (thirteen items, range 0-13) was modelled assuming the data were generated from a Poisson distribution.

Because nurses are clustered within wards which are in turn clustered within hospitals, we needed to take account of the tendency for individuals in similar units to give similar responses. To do this we attempted to fit a random intercept both at the level of the trust and the level of the ward to all models. This takes into account any 'clustering' effects. It was not possible to fit a random intercept at both levels for either **poor quality of care nurse rating** or **poor patient safety rating**. In the former case it was possible to fit a model with the random intercepts at either the trust level or the ward level but not both simultaneously. In the latter case it was only possible to fit the trust level random intercept. Both these variables show limited variation at the ward level so for example in some wards none of the respondents indicated failing or poor patient safety.

4.3 Results

Descriptive statistics (percentages, and for 'care left undone' the Poisson mean and 95% confidence interval) for the five self-report measures by the ten predictor variables are presented in Table 4.1.

In Table 4.2 the results from the multi-level regression models are presented. The odds ratios (or in the case of **care left undone** the risk ratios) are given, with 95% confidence intervals comparing each shift length category (8.01-10.00 hrs, 10.01-11.99 hrs, ≥ 12 hrs) with shift length ≤ 8 hour (reference category) adjusting for all other predictor variables (listed in Table 4.1). Statistically significant differences, at the 5% level, between each category and its reference category are marked with an asterisk(*).

Table 4.1 Descriptive statistics: quality of care, patient safety, care left undone, satisfaction with job and work schedule by shifts

	No. in each category	Poor quality of nursing care rating		Poor patient safety rating		Care left undone		Not satisfied with job		Not satisfied with work schedule	
		No.	%	No.	%	Mean	(95% CI)	No.	%	No.	%
≤ 8 h shift	860	136	15.9	49	5.7	3.85	(3.72-3.98)	301	35.1	186	21.8
8.01 - 10.00	356	73	20.6	26	7.3	3.72	(3.52-3.92)	159	45.0	104	29.4
10.01 - 11.99	496	99	20.0	33	6.7	3.80	(3.63-3.98)	194	39.5	116	23.5
≥ 12	856	180	21.1	59	6.9	4.23	(4.09-4.37)	366	42.9	230	27.0
Not overtime	1269	198	15.7	62	4.9	3.24	(3.14-3.34)	412	32.7	253	20.0
Working beyond contracted hours	1289	288	22.5	105	8.2	4.67	(4.55-4.79)	605	47.1	380	29.6
Day shift	1898	340	18.0	116	6.1	4.11	(4.02-4.21)	730	38.5	434	23.0
Night shift	670	148	22.2	51	7.7	3.48	(3.34-3.62)	290	43.8	202	30.4

**Table 4.2 Multilevel regression models: Associations between shift length and outcomes
Odds ratios (95% confidence interval)⁵**

	≤ 8 h shift (reference category)	8.01-10.00 hrs	10.01-11.99 hrs	≥ 12 hrs
Poor Quality of Nursing Care	1.00	1.21 (0.82-1.80)	1.43 (0.96-2.11)	1.64* (1.18-2.28)
Poor Patient Safety	1.00	1.00 (0.56-1.77)	0.99 (0.56-1.75)	1.17 (0.73-1.89)
Care Left Undone	1.00	0.97 (0.90-1.04)	1.05 (0.97-1.14)	1.13* (1.06-1.20)
Not satisfied with job	1.00	1.31 (0.97-1.77)	1.33 (0.98-1.80)	1.51* (1.17-1.95)
Not satisfied with work schedule	1.00	1.08 (0.78-1.51)	0.91 (0.64-1.28)	1.22 (0.92-1.61)

* statistical significance $p < 0.05$

In the following sections we highlight the main findings for each of the outcomes, presenting first the descriptive results, before highlighting the findings from the multivariate regression models (adjusting for the other predictor variables included).

⁵ Controlling for other predictors: working beyond contracted hours, day/night shift, medical or surgical unit, patients per nurse (grouped in patient increments of two), patients per HCA (Quintiles), full or part-time work, age (in ten year bands), Trust size, high (or not) technology trust, teaching (or non-teaching) trust

Poor quality of nursing care rating

The amount of self-reported poor care was lower amongst nurses working eight hours or less (15.9%) compared to those working longer hours (20.0% to 21.1%). Length of shift was significantly associated with poor quality of nursing care in the multilevel model. The odds of poor quality care was 1.64 times higher for nurses working a 12-hour or longer shift compared to those working eight hours or less ($p=0.031$).

Poor patient safety rating

A similar pattern of findings was apparent for safety ratings. A smaller proportion of those working shifts of eight hours or rated the patient safety as poor (5.7%) than those nurses working longer shifts (6.7 to 7.3%).

However, in the multi-level model, this relationship was not significant (OR 8 hour vs 12 hours 1.17 $p=.86$) in the multilevel model, whilst working beyond contracted hours was ($p=.004$). The odds of poor quality care was 1.69 times higher for those working beyond their contracted hours compared to those who did not.

Care left undone

The pattern of 'care left undone'⁶ varied by length of shift: 3.85 (≤ 8 hours), 3.72 (8.01–10.00 hours), 3.80 (10.01–11.99 hours), with highest mean score amongst those working 12 hours or over (4.23).

The relationship was significant in the multi-level model ($p<0.001$). The risk of care left undone was 1.13 times higher for nurses working a 12-hour or longer shift compared to those working eight hours or less

Not satisfied with job

Job satisfaction varied with length of shift: 35.1% satisfied (<8 hour shift), 45.0% (8.01–10.00 hours), 39.5% (10.01-11.99) and 42.9% (≥ 12).

This relationship was significant ($p=.016$) in the multilevel model. When taking the other predictor variables into account, the odds of being dissatisfied were 1.51 times higher for nurses working on shifts of 12 hours or longer compared to those work eight hours or less.

⁶Respondents were asked: 'On your most recent shift, which of the following activities were necessary but left undone because you lacked the time to complete them' and presented with a list of 13 tick box responses.

Not satisfied with work schedule

There was no clear pattern of variation in work schedule dissatisfaction with length of shift: 21.8% (<8 hour shift), 29.4% (8.01–10.00 hours), 23.5% (10.01-11.99) and 27.0% (≥ 12) reported being dissatisfied.

When this relationship was explored in multivariate model, the relationship was not significant ($p=.23$).

4.4 Summary

An analysis of RN4Cast data from England using multilevel regression models has found that the length of shift worked by nurses was a predictor of care being rated as 'poor quality'. Working 12-hour or longer shifts was also significantly associated with a greater risk that necessary nursing care was left undone.

Taking into account other factors (most notably staffing levels and working beyond the scheduled shift), shift length was not a statistically significant predictor of the overall patient safety rating of the ward.

Controlling for the other factors, length of shift was significantly related to differences in nurse job satisfaction; nurses working 12-hour shifts were less likely to report being satisfied with their jobs. However there was no difference by the length of shift worked in nurses' satisfaction with their work schedule.

5. Conclusion

Action area five of the NHS England's 'Compassion in practice' strategy focuses on workforce, and sets out to ensure we have the 'right staff, with the right skills in the right place'. Working patterns and rostering are key factors in achieving this goal. The National Nursing Research Unit (NNRU), King's College London was commissioned by NHS England to undertake research into the use of 12-hour shifts amongst nursing staff.

We have used previously collected data and published research evidence to collate what can currently be known about the prevalence of 12-hour shifts in nursing and the potential impact of long shifts on staff and patient outcomes. Specifically, the study set out to address the following:

1. What is the prevalence of 12-hour shifts and other shift patterns?
2. How much internal variation in shift length is there in NHS hospitals?
3. What impact does shift length have on quality of patient care and staff experience?

1. What is the prevalence of 12-hour shifts and other shift patterns?

Increase in the use of 12-hour shifts in the NHS: The new analysis of the RCN employment survey data provides an indication of the prevalence and change over time in shift length. There appears to have been a big increase in the use of 12-hour shifts in the NHS; 31% of staff nurses on wards in the NHS reported working 12-hour shifts in 2005 compared with 52% in 2009. In 2010, the RN4Cast survey of registered nurses working on general acute wards in 31 NHS Trusts in England found 32% of day shifts and 36% of night shifts were 12 hours or longer.

Whilst these data were collected several years ago, they nonetheless represent the current best estimate of the prevalence of 12-hour shifts as this data is not readily available because it is not routinely collected. The apparent lack of contemporary data on nursing working patterns within and beyond the NHS needs consideration, given the potential importance, not just to decisions about safe and effective deployment of nursing staff, but also to its relevance in planning the future nursing workforce.

2. How much internal variation in shift length is there in NHS hospitals?

Considerable variation in the length of shifts worked within hospitals in the NHS: Analysis of RN4Cast nurse survey data allows a 'system' level view of shift patterns, describing the working patterns of registered nurses (of all grades) working on general wards in a sample of 31 NHS trusts. In contrast to other EU countries participating in the RN4Cast study, in England there is considerable variation in the length of shifts worked within hospital and within units. Across EU, only 15% of nurses on general acute wards worked 12-hour (or longer) shifts, and these are primarily concentrated in three countries: Ireland and Poland, where 12-hour shifts was the 'standard' pattern in use and England, where 50% of nurses reported working shifts of 12 hours or more.

3. What impact does shift length have on quality of patient care and staff experience?

The evidence from the published literature on the effect of 12-hour shifts on nurses (including fatigue, stress, burnout, job satisfaction, safety, and errors) and on patients (including patient satisfaction and experience) is reviewed. Studies can be divided into those which have a positive outcome for nurses, patients and organisations, those that show conflicting evidence and those that highlight the risk of errors and hazards to patients and staff.

On balance, the majority of the studies reviewed showed some degree of negativity, either for nurses, patients, or both, towards 12-hour shifts: Many of the adverse outcomes are fatigue related. For example, nurses working 12-hour shifts are found to be at increased risk of occupational hazards including needle stick injuries and musculoskeletal disorders (Trinkoff et al. 2006). The findings in relation to job satisfaction are more mixed. Other factors can affect the quality and safety of nurses' work, such as shift rotation (Surani et al. 2007), weekly work hours and the number of consecutive days worked (Potera 2011), and unplanned or extended shift times (Rogers et al. 2004). Whilst there is a clear overall pattern of negative findings concerning 12-hour shifts across the studies, we regard the quality of evidence as weak to moderate. Most of the studies had design limitations with the potential for bias, so the findings cannot be generalised with confidence.

UK nurses working 12-hour+ rate care quality as poor and leave more necessary care undone: Our nurse survey data from England and the rest of Europe provides a valuable addition to the work undertaken to date. In the most recent analysis of the EU RN4Cast study, nurses working 12 hours or longer are more likely to rate the quality care where they work as poor, and give a lower patient safety rating to the environment (Griffiths et al. 2014). New analysis of data specifically from England shows that working 12-hour or longer shifts was a predictor of both care being rated as 'poor quality' and that necessary nursing care was left undone.

Nurses working 12-hour shifts are no more or less satisfied with their working hours than those working shorter shifts: While no significant differences are found in satisfaction with working schedule according to the length of shift worked, in our multivariate model nurses working shifts of 12 hours or more did appear to be less satisfied with their jobs. This is an important finding; a simple cross-tabulation of satisfaction by shift length which we examined using the RCN Employment Survey data pointed to a slightly higher level (by 4 percentage points, at significance of $p=0.03$) of satisfaction for those working the long shifts. But the new RN4Cast analysis reveals that when the samples of nurses are more closely matched (all working in same type of ward in NHS acute trusts) and differences in the working context are accounted for in the analysis, nurses working 12-hour shifts are no more or less satisfied with their working hours and may be less satisfied with their jobs than those working shorter shifts.

Anecdotally, nurses' views of 12-hour shifts are nonetheless mixed; many are attracted by 12-hour shifts as it compresses the working week into fewer days, allowing more time off and reducing travel time and costs, but some describe such shifts as exhausting and are concerned about the perceived adverse effect on performance (Calkin 2012). The review of the literature (and our own

analysis) has demonstrated the heavy reliance on cross sectional survey data, with very little qualitative research exploring the use of different shift patterns and nurses' views of them. The picture is likely to be much more complex than a mean satisfaction score can illuminate. Individual nurses may hold a range of views on 12-hour shifts – seeing personal efficiency benefits in working longer shifts whilst nonetheless finding them very tiring and being concerned about the effects of fatigue on their ability to deliver care well.

Research challenges and implications for practice

In weighing up the evidence, the challenge for researchers and managers is to separate out the many related but distinct factors associated with working patterns, to isolate the effects of shift length.

Shift length vs. working long hours: In many of the studies reviewed the evidence on working long shifts (i.e. planned 12-hour shifts) is particularly difficult to distinguish from the evidence on working long hours overall (i.e. working back-to-back shifts or working paid or unpaid overtime), making it difficult to evaluate whether 12-hour shifts are 'better' or 'worse' than conventional shifts. The RN4Cast analysis goes some way forward to addressing this by showing a clear negative effect of 12-hour shifts that is independent of working overtime and total hours worked (shown by full time vs part time).

How 12-hour shifts are operationalised and implemented: A key issue, that is a weakness in trying to review the evidence on 12-hour shifts, is that 'it depends on how it's done'. This is rarely elucidated in the studies reviewed, with little information provided about the practical ways in which a shift system is operated – how many long shifts are worked in a row, number and length of breaks, how much variation in the pattern of shifts worked etc. All of these factors may vary between hospitals and between studies, yet are rarely or held constant, so we have little insight into the possible effect they have, and how this may contribute or mitigate the observed effect of 12-hour shifts on specified outcomes. However, this weakness from a research perspective, may be a critically important to thinking about future policy, practice and research regarding the use of 12-hour shifts. The question we have sought to address has been 'what are the effects of working 12-hour shifts?', controlling for other factors. Future research may be needed to build on the significant 'it depends how its done' aspect of shift systems, to ask 'How can 12-hour shifts be operationalised to minimise the potential risks?'

Different risks and benefits for different staff at different times: We also need to consider that risks and benefits of different shift patterns for individual nurses are not the same (Chen et al. 2011). For example, there may be greater health risks for the older person working long shifts (Chudleigh et al. 2005, Keller 2009). The time of day also makes a difference, the risk of adverse events are greater at night, towards the end of a 12-hour shift, before breaks or after successive shifts (Geiger-Brown and Trinkoff 2010) although shorter shifts may be less feasible at night.

Evaluating what has been lost and what it costs: Despite the lack of robust evidence, for some trusts 12-hour shifts appear to have been widely introduced and accepted as the norm. The decision to introduce, keep, or remove the 12-hour shift is a challenging one for nurse managers. From an

employer's point of view, a move to 12-hour shifts can appear to reduce short term costs by reducing the overlap and enabling a reduction in workforce. But we know very little about the longer terms effects of removing this period of overlap, which traditionally was a key time for learning and mentoring to take place for both staff and students. If 12-hour shifts are associated with increased fatigue and more missed care then productivity is lost. None of the studies reviewed included a review of these effects or provided economic evidence. More research evidence in this area is required.

Can 12-hour shifts reduce costs without any deleterious effects?: There are reports that some NHS trusts have moved away from 12-hour shifts and reintroduced eight-hour shifts, to enable nurses to spend more time with their patients (Sprinks 2012). An evaluation of such moves is imperative and new nurses (who have only ever worked 12-hour shifts) may need re-educating into the purpose and value of the afternoon overlap for this time to be fully utilised. But many Trusts continue to have 12-hour shifts in operation based on an untested assumption that is a cost-effective system. The review and analysis of data presented here raises a significant challenge to the assumption that 12-hour shifts can reduce costs without any deleterious effects.

Our review has pointed towards an increase in needle stick injuries and musculoskeletal disorders with nurses who work 12 hours or longer more likely to rate the quality care as poor, and give a lower patient safety rating to the environment and few reported benefits. A stronger evidence base is required with a fully controlled trial or natural experiment if possible and in depth qualitative work to understand better nurses' needs and preferences in this complex area. Several gaps are identified in the evidence base:

- Research that takes account of the other working pattern variables (eg. choice, shift sequence, breaks, over-time, etc.) that are likely to influence the outcomes examined
- Exploration of how 12-hour shifts may have different effects for different staff (eg. by role/grade of staff, age, or domestic circumstances)
- Absence of specific information about health care support workers
- Little UK based research
- Long term understanding of potential deleterious effects
- No economic analysis

At present however, in the absence of a more complete picture of both the effects and the costs of 12-hour shifts, managers should proceed with caution.

Appendices

A1. References

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A2. Methodological Appraisal of studies included in the review_(after Caldwell et al. 2011)

	Title reflects content	Authors credible	Abstract summarise key contents	Rationale clearly outlined	Literature review comprehensive & up to date	Aim clearly stated	All ethical issues identified & addressed	Methodology identified & justified	Study design clearly defined	Hypothesis clearly stated	Key variables clearly defined	Population identified	Sample adequately described & reflects population	Data collection method valid & reliable	Data analysis valid & reliable	Decision comprehensive	Results generalisable	Conclusion comprehensive	Level of evidence (OCEBM)
Bae (2013)	√	√	√	√	√	√	√	√	√	n/a	√	√	√	√	√	√	×	√	2c
Bloodworth, Lea (2003)	√	√	√	√	×	√	×	×	√	n/a	×	√	√	×	×	?	×	√	3a
Chen et al. (2013)	√	√	√	√	√	√	√	√	√	n/a	√	√	√	√	√	√	×	√	2c
Day (2004)	√	×	×	√	×	√	×	√	√	n/a	×	√	×	×	×	×	×	×	4
Gieger-Brown et al. (2012)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	×	√	2c
Gillespie, Curzio (1996)	√	√	√	√	×	×	×	√	√	×	√	√	√	×	×	?	×	√	2c
Griffiths et al. (2014)	√	√	√	√	×	√	×	√	√	n/a	√	√	√	√	√	√	√	√	2c
Hoffman, Scott (2003)	√	√	√	√	×	√	×	√	√	n/a	×	√	√	√	√	√	×	√	2c
Ilhan et al. (2006)	√	√	√	√	×	√	×	×	√	n/a	×	√	√	×	√	√	×	√	4
Kalisch et al. 2013	×	√	×	√	×	√	√	√	√	√	√	√	√	√	√	√	×	√	3b
Lipscombe et al. (2002)	√	√	√	√	√	√	×	√	√	n/a	√	√	√	√	√	√	√	√	2c
Reid et al. (1989)	√	√	√	√	×	√	×	×	?	n/a	√	√	√	√	×	√	×	√	2c
Rogers et al. (2004)	√	√	√	√	×	√	√	√	√	n/a	×	√	√	√	√	√	×	√	4
Stimpfel et al. (2012)	√	√	√	√	×	√	×	√	√	n/a	√	√	√	√	√	√	×	√	2c
Stimpfel, Aiken (2013)	√	√	√	√	×	√	√	√	√	n/a	√	√	√	√	√	√	×	√	2c
Stone et al. (2006)	√	√	√	√	√	√	√	√	√	n/a	√	√	√	√	√	√	×	√	2c
Todd et al. (1989)	√	√	√	√	√	√	×	√	√	n/a	√	√	×	√	√	√	×	√	2c
Todd et al. (1993)	√	√	√	√	√	√	×	√	√	n/a	√	√	√	√	√	√	×	√	3b
Trinkoff et al. (2006a)	√	√	√	√	√	√	√	√	√	n/a	√	√	√	√	√	√	×	√	2c
Trinkoff et al. (2006b)	√	√	√	√	×	√	√	√	?	n/a	√	√	√	×	√	√	×	√	2c
Trinkoff et al. (2007)	√	√	√	√	×	√	√	√	√	n/a	√	√	√	√	?	√	×	√	2c
Trinkoff et al. (2011)	√	√	√	√	√	√	√	√	√	n/a	√	√	√	√	√	√	×	√	2c
Vik, MacKay 1982	√	√	×	√	×	√	×	√	√	√	√	√	√	√	√	√	×	√	3b
Virtanen et al. (2009)	√	√	√	√	×	√	√	√	√	×	√	√	√	√	√	√	?	√	2c
Kundi et al. (1995)	√	√	√	√	×	√	×	√	√	n/a	√	√	√	×	√	√	×	√	2c
Fitzpatrick et al. (1999)	√	√	√	√	√	√	√	√	√	n/a	√	√	?	√	√	√	×	√	2c

