

# Designing safer rotas for junior doctors in the 48-hour week

Prepared on behalf of a Multidisciplinary Working Group  
by Nicholas Horrocks MSc and Roy Pounder MD, DSc, FRCP

September 2006



Royal College  
of Physicians

Setting higher medical standards

## Acknowledgements

This guide was prepared on behalf of a short-term Working Group that met at the Royal College of Physicians, London, on 4 November 2005. For members of the Working Group, see Appendix 2. The guide was approved by the Council of the Royal College of Physicians on 18 May 2006.

Financial support for the Workshop and for NH was provided by NHS National Workforce Projects. To access more of their materials supporting the European Working Time Directive, and the wider issues around workforce planning and development, visit [www.healthcareworkforce.nhs.uk](http://www.healthcareworkforce.nhs.uk).

## Mission statement

The Royal College of Physicians plays a leading role in the delivery of high quality patient care by setting standards of medical practice and promoting clinical excellence. We provide physicians in the United Kingdom and overseas with education, training and support throughout their careers. As an independent body representing over 20,000 Fellows and Members worldwide, we advise and work with government, the public, patients and other professions to improve health and health care.

## Citation for this document

Royal College of Physicians. *Designing safer rotas for junior doctors in the 48-hour week*. Prepared on behalf of a multidisciplinary working group by Horrocks N and Pounder R. London: Royal College of Physicians, 2006.

ROYAL COLLEGE OF PHYSICIANS OF LONDON  
11 St Andrews Place, London NW1 4LE  
[www.rcplondon.ac.uk](http://www.rcplondon.ac.uk)

**Registered Charity No 210508**

ISBN 1 86016 288 6

Copyright © 2006 Royal College of Physicians of London

Review date: 2009

### Copyright

All rights reserved. No part of this publication may be reproduced in any form (including photocopying or storing it in any medium by electronic means and whether or not transiently or incidentally to some other use of this publication) without the written permission of the copyright owner. Applications for the copyright owner's written permission to reproduce any part of this publication should be addressed to the publisher.

Typeset by Dan-Set Graphics, Telford, Shropshire

Printed in Great Britain by Sarum ColourView Group, Salisbury, Wiltshire

# Contents

Executive summary	iv
<b>1 Introduction</b>	<b>1</b>
<b>2 Problems with night work</b>	<b>2</b>
Why is there a problem now?	2
What are the difficulties with working night shifts?	3
Night shifts and safety	3
Getting home after a night shift	3
The rules for full shift working by junior doctors	5
<b>3 Designing rotas</b>	<b>7</b>
How many doctors are needed to form a good rota?	7
1 The seven-nights-in succession rota	8
2 The four-and-three rota	9
3 The two-two-and-three rota	10
4 The one-night-at-a-time weekday rota	11
5 The three nine-hour shifts rota	12
6 Three nine-hour weekday shifts, with 12.5-hour weekend shifts	14
<b>4 Practical issues</b>	<b>15</b>
Continuity of care and team working	15
How should gaps in a medical team be filled?	16
What about flexible trainees?	16
How many doctors are needed at night to cover an acute service?	16
What is the ideal rota for 2009?	17
<b>Appendix 1</b> Practical tips for designing rotas	<b>19</b>
<b>Appendix 2</b> Members of the Working Group	<b>21</b>
<b>References</b>	<b>22</b>

# Executive summary

Following the implementation of the European Working Time Directive Regulations, the majority of junior doctors in the UK now work full shifts at night. A Royal College of Physicians 50-member working group was established to develop both practical advice for those junior doctors working night shifts, and a guide to help those designing rotas for junior doctors.

The guide, set out in this document, discusses the risks associated with shift work at night and the safety and suitability of possible rotas, in anticipation of the 48-hour week in 2009.

- ▶ Rotas involving seven consecutive 13-hour night shifts may increase risks to patients and staff, and are best avoided.
- ▶ The number of night shifts worked in succession should be limited to a maximum of four, and the length of each night shift should be reduced whenever possible.
- ▶ A 'cell' of 10 junior doctors is necessary for any post that provides 24-hour cover, plus specialty work and training during weekdays.
- ▶ The guide encourages the testing of three nine-hour shifts to cover the 24 hours – to achieve improved health, safety, teaching and supervision, and efficiency.
- ▶ Using this evidence-based approach, hospitals should be able to implement optimal 48-hour rotas by 2009.
- ▶ The guide does not suggest rotas for those junior doctors who are non-resident on call, and they remain at considerable risk of excess fatigue.

It is hoped that the guide, which should be read in conjunction with a previous report, *Working the night shift: preparation, survival and recovery – a guide for junior doctors*,<sup>1</sup> will make the challenge of night shift work not only easier to tolerate, but also safer for both hospital patients and their doctors.

# I Introduction

Healthcare is a 24-hour process, and many hospitals need doctors to be available to provide professional care round-the-clock. However, working at night is different from working in the day, involving additional pressures and risks. Minimising these risks is an essential part of making night work both safe and acceptable to the doctors who must be on duty. One way to do this is for doctors working such shifts to be made aware of the risks involved. Preparation for working a night shift is a key part of this and the booklet, *Working the night shift: preparation, survival and recovery – A guide for junior doctors*,<sup>1</sup> provides guidance on this.

However, with even the best preparation, working at night can still have consequences for the safety of both patients and doctors, as it increases the likelihood of making poor decisions or even mistakes. Rotas that do not consider the sleep requirements and safety of those who work them will only increase the risk.

The aim of this guide is to highlight why certain rotas are more appropriate than others, and to provide suggestions on how to design safe and acceptable work schedules for doctors who must work at night. It has been written in anticipation of the 48-hour working week being undertaken by trainee doctors in 2009, but the advice can be applied to relevant rotas now. Brief examples are included to demonstrate particular points and to provide a basis upon which other rotas can be drawn up.

The guide is not only for hospital administrators who design rotas for medical staff but also for junior doctors. It is imperative that doctors working such rotas get involved in their planning at an early stage – not least because the optimal solutions for every rota, team and hospital will be different.

## 2 Problems with night work

### Why is there a problem now?

Treating sick patients at night is nothing new, and some doctors have always been asked to work at night. So why is there a problem now?

In 2004 the Working Time Regulations (the enactment in UK law of the European Working Time Directive) were applied to junior doctors. In combination with the New Deal, this legislation has reduced the average number of hours that junior doctors can work. While there remain 168 hours in each week, the Working Time Regulations state that by 2009 junior doctors can only be expected to work on average a maximum of 48 of these hours each week. This is a reduction of approximately 15% from the current maximum of 56 hours of weekly work allowed under New Deal rules.

A consequence of these positive steps has been that patterns of working for junior doctors have also changed. The traditional on-call solution to providing care in the hospital at night is no longer workable for the majority of specialties and most junior doctors in the UK now work night shifts – that is, report for work in the evening after a day off, work overnight, and then go off duty in the morning.

Although this change is not in itself necessarily a bad thing, there has often been poor consideration of the safety and sleep requirements of junior doctors when designing new rotas for night shift work. This has resulted in many rotas that are not ideal from a health and safety point of view.

Should junior doctors be treated differently to other NHS night workers? There are a number of important differences:

- ▶ Firstly, junior doctors have been switched from on-call to shift work in the last few years, and the first roster patterns that were implemented were often unsuitable.
- ▶ Secondly, the juniors are subject to the rules of the New Deal with a 48-hour average week for most in 2009, whilst other employees are subject to Agenda for Change with a 37.5-hour week.
- ▶ Thirdly, juniors are still in training and must have a substantial proportion of their working time dedicated to learning.
- ▶ Finally, most junior doctors are rotated from job to job, and many do not live close to their allocated hospital.

Whilst some other NHS workers could also benefit from the type of rota suggested in this guide, almost all would benefit from the advice found in *Working the night shift: preparation, survival and recovery – A guide for junior doctors*.<sup>1</sup>

## What are the difficulties with working night shifts?

Working at night is harder than working during the day, because this is the time when the human body is programmed to be asleep. It also results in loss of sleep and increased fatigue, which directly impacts on performance. Working at night involves trying to function when one's alertness, vigilance and cognitive reasoning are all at their lowest, making it is easier to make mistakes without noticing.<sup>2</sup> Tired junior doctors in the USA and Denmark did exactly this, and were shown to lose concentration more often and make more clinical errors compared to when they were able to get more sleep.<sup>3-7</sup> Of particular relevance to junior doctors in training, exhaustion also impairs recent learning and can decrease their ability to make correct diagnoses and perform technical procedures.<sup>4,8,9</sup>

Importantly, because working a night shift involves trying to sleep in the day, the lack of sleep can quickly become excessive. Sleeping during the day is much harder than sleeping at night, because it is not what humans are designed to do. Bright sunlight, temperature, and noise can all keep night workers awake during the day, but perhaps most importantly, the body's internal clock, which regulates sleep-wake patterns, acts to maintain alertness and wakefulness. This means that daytime sleep is not of such good quality or duration as sleep at night;<sup>10</sup> shift workers who work several consecutive night shifts can become progressively more tired over the course of their duty. Inevitably this can then lead to further reductions in performance and an increased likelihood of accidents or mistakes.

## Night shifts and safety

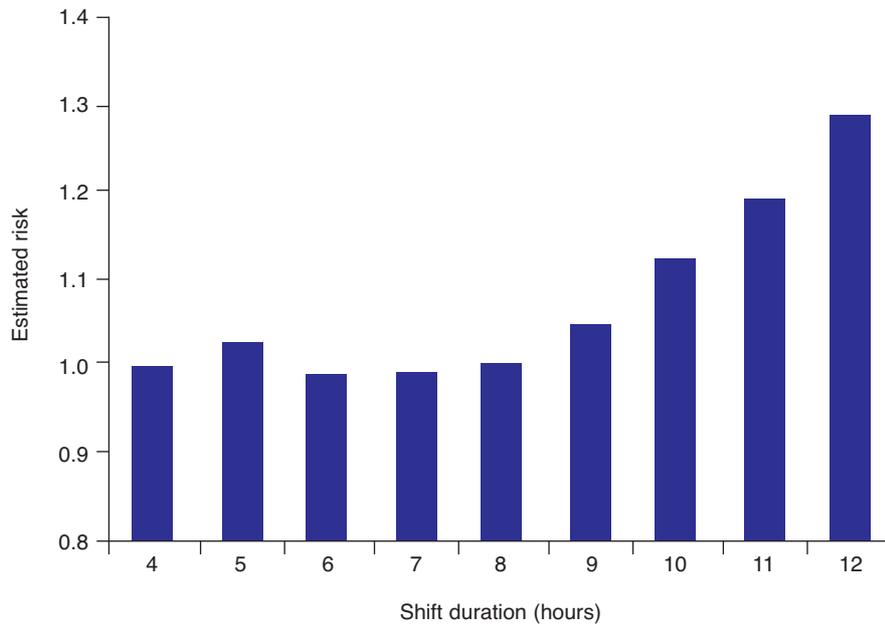
While working at night does contribute to an increased risk of making errors, this is not the only factor to consider. Evidence collected from a range of industries where shift work is common shows that the length of individual shifts and the number of shifts worked in succession are also very important.<sup>11,12</sup> The more shifts that are worked consecutively, the greater the relative risk compared to the first shift worked. Likewise for the length of each shift – the longer each shift lasting more than eight hours, the greater the chance of an accident (Fig 1). Interestingly, if two otherwise identical shifts in terms of length and number of previously worked shifts are compared, the risk of an accident is always greater on the night shift than during the day (Fig 2).

Shift length and the number of consecutive shifts must always be considered when designing new rotas. Furthermore, because of the increased risk with working at night, it is essential to remember that what is an acceptable rota for working during the day may not be sensible when planning night shifts.

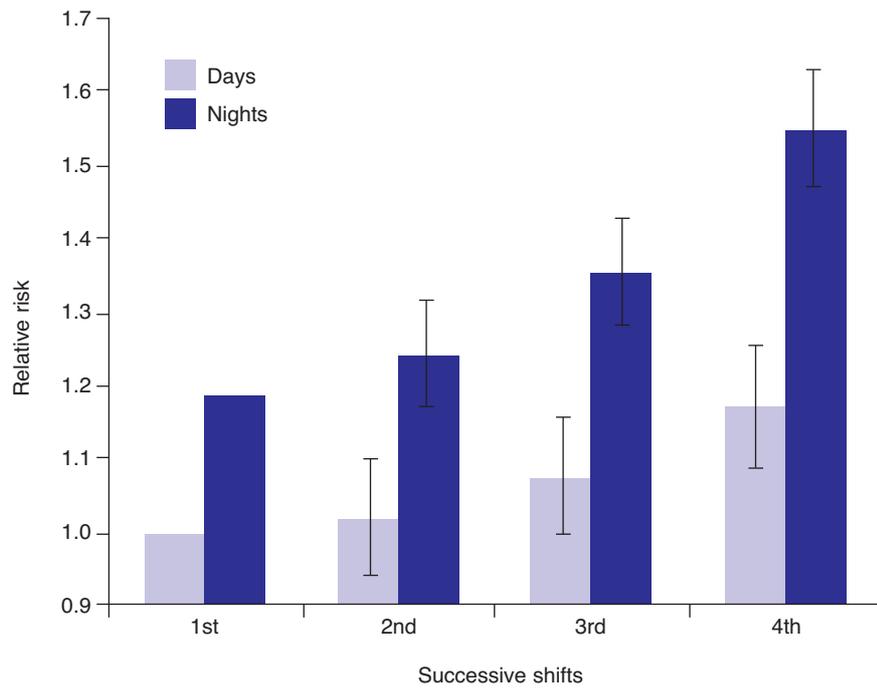
## Getting home after a night shift

Designing safe rotas does not just involve considering the doctor at work. After the shift, doctors must also be able to travel home safely, and often this will mean driving. This is not a problem for those living in hospital accommodation or nearby, or if public transport is available, but many specialist registrars (SpRs) are on rotations and do not live close to where they work. Data collected from medical SpRs in January 2006 indicate that for 46% the daily commute is 30 to 60 minutes, each way and it was greater than one hour for 16%.<sup>13</sup>

Just as with performance on duty, driving ability is strongly affected by fatigue and lack of sleep. While this is less of a problem if doctors work two to three shorter night shifts at a time,



**Fig 1. The estimated risk of accidents in shift workers, related to length of shift.<sup>11, 12</sup>** An eight-hour shift has been set to have an estimated risk of 1.0, with all other shifts relative to this.



**Fig 2. The estimated risk of accidents in shift workers, related to the number of successive shifts and whether they are day or night shifts.<sup>11,12</sup>** The first day shift has been set to have a relative risk of 1.0 and all other shifts are relative to this.

appropriate napping and preparation are nonetheless necessary. Driving while tired becomes an increasing potential hazard as shift length and the number of nights worked in succession rise, particularly if the recommendations in *Working the night shift: preparation, survival and recovery – A guide for junior doctors*<sup>1</sup> are not followed.

Sleepy drivers have been calculated to cause 10% of all UK road crashes, with this percentage rising for accidents on monotonous motorways and similar trunk roads.<sup>14,15</sup> Such crashes are often more serious than non-sleep-related accidents, since the victim may impact at speed, having made no attempt to brake before crashing.

Night workers travelling home at the end of a shift have been identified in international studies as being particularly at risk of sleep-related vehicle accidents.<sup>16–21</sup> To quantify this risk, the performance impairment associated with fatigue has been compared to that produced by alcohol; 20–25 hours without sleep was shown to reduce psychomotor performance to the level of someone with a blood alcohol concentration of 0.10%.<sup>22–25</sup> This is greater than the current maximum level for legal driving in the UK (0.08%). However, a doctor who has worked just one night and was without rest during the day leading into the shift could easily achieve a period of sleep deprivation of this length. This is why doctors reporting for night duty must be fully rested.

If junior doctors continue to be rostered to work long sequences of lengthy night shifts, it may be more appropriate for hospitals to consider providing transport for those who have to travel greater distances to and from work. Although this may at first seem prohibitively expensive, such costs should be considered in light of the alternative options which may include the provision of temporary local accommodation, or indeed doing nothing.

Postgraduate medical training often requires that some junior doctors rotate to posts distant from their homes, and it is essential that hospital managers are fully aware of their duty of care as employers. As such, they should make sure that doctors living at a distance from their workplace take full advantage of the relocation allowances payable on rotation to avoid the need for extended travel.<sup>26</sup> An ideal rota will attempt to minimise fatigue and risk (Table 7).

## The rules for full shift working by junior doctors

The Working Time Regulations are Health and Safety law and the New Deal sets out conditions of service relating to pay, but together they impose strict rules that affect how rotas might be designed for junior doctors in training.

From 1 August 2009, the two standards will underpin the following rules:

- ▶ The maximum average number of hours on duty is 48 per week (averaged over a 26-week period).
- ▶ The minimum break between shifts must be 11 hours.
- ▶ The maximum continuous period of duty is 13 hours - that is, no shift can be scheduled to last longer than 13 hours.
- ▶ The maximum number of consecutive days of duty is 12, with a minimum break of 48 hours in each two-week period, unless compensatory rest is given.
- ▶ There must be 62- and 48-hour breaks every 28 days.

- ▶ There must be 35 hours of continuous rest in 7 days or 59 continuous hours rest in 14 days.
- ▶ There must be at least one 30-minute continuous break after approximately four hours on duty.

A more detailed breakdown and comparison of the New Deal and Working Time Regulations, and how they must be applied together, can be found on the [healthcareworkforce.org.uk](https://www.healthcareworkforce.org.uk) website.<sup>27</sup> Taken together, these standards mean that only certain rotas are permissible.

### 3 Designing rotas

#### How many doctors are needed to form a good rota?

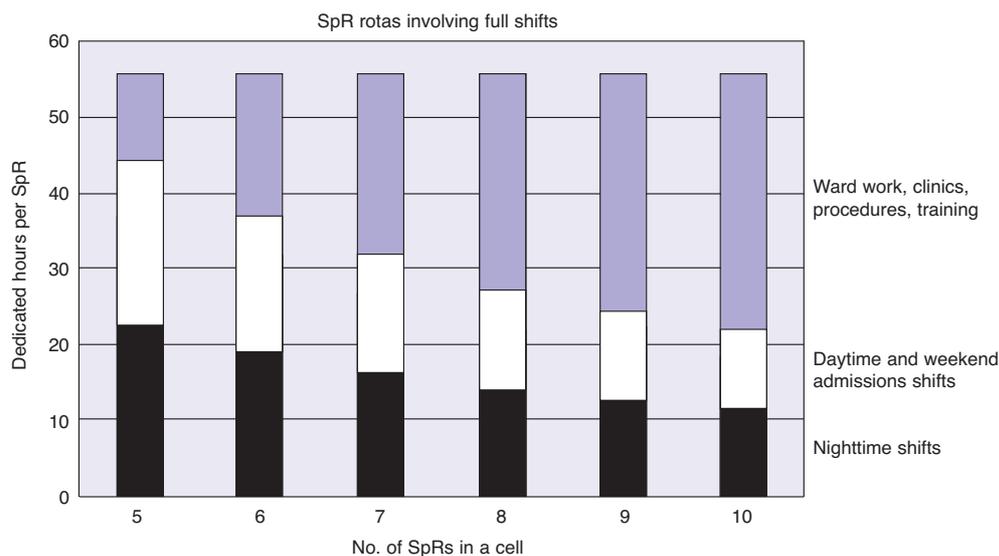
To aid simplicity of presentation, the six example rotas given in this guide all involve a group of junior doctors in training of equivalent experience (called a ‘cell’) who can form a rota to work in a particular post that requires 24-hour on-site cover. The remainder of their time working from Monday to Friday is spent during the day, for example, completing essential clinical work on the ward, in clinics or performing procedures, or receiving training. The ‘daytime’ shifts are fixed in average length but are flexible, such that they can start early or finish late.

Each rota only covers one doctor on call at a time, with some handover; if three doctors are needed on call, each will be part of a different rota, in this case involving three cells of 10, or 30 doctors.

There are 10 doctors in the cell; it is suggested that any fewer makes the rota unacceptable because, depending on the specialty and daytime commitment, the service work will dominate non-clinical work in a way that would be unacceptable in a training post (Fig 3).<sup>28</sup> Constructing a rota becomes progressively easier if there are more than 10 doctors in the cell.

If the post involves periods of duty on call as well as working as part of a specialty firm – for example, SpRs in respiratory medicine who also cover acute medical take – then a cell with fewer than 10 doctors of equivalent experience will be unacceptable. Postgraduate deans and the Postgraduate Medical Education Training Board must review whether such posts can be considered suitable for training junior doctors. A cell of fewer than 10 doctors may be acceptable for some posts that involve only a single type of duty – for example, senior house officers (SHOs) working exclusively in the accident & emergency department (A&E), or others dedicated to a medical admissions unit.

Figure 3 illustrates the distribution of duties in a 56-hour week related to the number of doctors in the cell. In 2009, the 48-hour limit will make no difference to the work needed on the shifts and all the pressure will be on daytime non-shift activity – that is, ward work, clinics, procedures and training.



**Fig 3. The case for a cell of ten to provide 24-hour shift cover by junior doctors who are working a 56-hour week.<sup>28</sup> In a 48-hour week all the savings will have to be made in the daytime non-shift work.**

### (I) The seven-nights-in-succession rota

This rota involves working seven 12.5-hour night shifts in succession (Table 1), and is essentially the worst possible rota that can be devised in terms of safety and sleep requirements. Over the course of the week a doctor working this rota is expected to be on duty for a total of 87.5 hours (7 × 12.5 hours) but only receives 80.5 hours of breaks within that same period. Such a schedule would be daunting in the daytime, but coupled with the inevitable sleep deprivation that results from repeated night work, it is clearly wrong. Table 7 demonstrates that this rota results in the worst fatigue and risk scores, as estimated by the Health and Safety Executive assessment tool. This means that, of all the rotas presented in this guide, this rota is associated with the greatest risk of accident and the highest levels of fatigue (Table 7). Even if a seven-nights-in-succession rota is popular with some junior doctors, the health and safety implications are such that an employer should impose a change to a safer rota.

**Table 1. A seven-nights-in-succession rota.** This example is both New Deal- and EWTD-compliant, and it provides an average 48-hour week. **However, we do not recommend its use in the NHS.** (Ten doctors rotating in one cell; 'Daytime 8h' means that the junior can work for 8 hours on his or her firm, at any time in the day or evening.)

	Mon	Tues	Wed	Thur	Fri	Sat	Sun
1	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30
2	Zero hours						
3	09:00 - 21:30	Daytime 8h	Daytime 8h	Daytime 8h	Daytime 8h		
4	Daytime 8h	09:00 - 21:30	Daytime 8h	Daytime 8h	Daytime 8h		
5	Daytime 8h	Daytime 8h	09:00 - 21:30	Daytime 8h	Daytime 8h		
6	Daytime 8h	Daytime 8h	Daytime 8h	09:00 - 21:30	Daytime 8h		
7	Daytime 8h	Daytime 8h	Daytime 8h	Daytime 8h	09:00 - 21:30	09:00 - 21:30	09:00 - 21:30
8	Daytime 8h						
9	Daytime 8h						
10	Daytime 8h						

## (2) The four-and-three rota

A more acceptable alternative to the seven-nights-in-succession rota is one where the seven night shifts are broken up, typically into blocks of four and three (Table 2). This separates the week into week nights and weekend nights, with Friday night included as a weekend night, because anyone working over Friday night will end their shift on a Saturday morning, which under New Deal rules would count as weekend working. The grouping together of Friday, Saturday and Sunday works well as it improves the efficiency of a rota. It also reduces the number of doctors with disrupted weekends. In addition, because one pair of doctors in this cell is covering the days and the nights over the weekend, continuity of care and handover are improved.

The four-and-three rota has been adopted in most New Zealand hospitals, where junior doctors have worked shorter hours for the last ten years; these doctors work a short night and most of their hospitals have only a small number of trainees. Many British hospitals have already switched to this pattern.

Although the four-and-three solution involves fewer consecutive shifts than the seven-nights-in-succession rota, a doctor will still be working overnight for up to 50 hours in one block. This remains intensive shift work, and requires adequate preparation and recovery. Sufficient days off both before and after the sequence of night shifts should therefore be included in the rota. Doctors should be encouraged to use this time, especially beforehand, to get themselves refreshed and ready to start working at night. A big disadvantage of this rota, which will be discussed later, is that only two doctors cover the weekend and they only have 30 minutes for handover.

**Table 2. A possible four-and-three rota.** This example is both New Deal- and EWTD-compliant, and it provides an average 48-hour week. (Ten doctors rotating in one cell; until 2009, some doctors working the flexible Daytime 8h shifts could work up to a 13-hour day, to provide extra cover at either end of the day.)

	Mon	Tues	Wed	Thur	Fri	Sat	Sun
1	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30	Zero hours		
2	Daytime 8h						
3	Daytime 8h	Daytime 8h	Daytime 8h	Zero hours	09:00 - 21:30	09:00 - 21:30	09:00 - 21:30
4	Daytime 8h	Daytime 8h	Daytime 8h	09:00 - 21:30	Daytime 8h		
5	Daytime 8h	Daytime 8h	09:00 - 21:30	Daytime 8h	Daytime 8h		
6	Daytime 8h						
7	09:00 - 21:30	09:00 - 21:30	Zero hours	Zero hours	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30
8	Zero hours	Zero hours	Daytime 8h	Daytime 8h	Daytime 8h		
9	Daytime 8h						
10	Daytime 8h						

### (3) The two-two-and-three rota

This is simply a variation on the four-and-three pattern, but it breaks up the four nights into two blocks of two (Table 3), thus reducing the risk of exhaustion and improving safety. Interestingly, despite the fact that two doctors are removed from daytime duties for part of the week, the number of unbroken weeks available for daytime clinics remains the same as with the four-and-three rota. For a team of 10 doctors there will be six weeks in the ten-week cycle of the rota where each doctor is theoretically present between at least 09:00h and 17:00h from Monday to Friday without a break. This is an important consideration for the training of junior doctors and for maintaining regular contact with consultants, as well as for planning leave.

Having two doctors covering the week nights increases the number of handovers that must occur between different doctors from five with a four-and-three rota, to seven. However, since the night doctor should be fresher than if they had worked more consecutive nights, it is unclear what potential consequences an additional two new handovers might have for continuity of care.

**Table 3. A two-two-and-three rota.** This example is both New Deal- and EWTD-compliant, and it provides an average 48-hour week. (Ten doctors rotating in one cell; until 2009, some doctors working the flexible Daytime 8h shifts could work up to a 13-hour day, to provide extra cover at the end of the day.)

	Mon	Tues	Wed	Thur	Fri	Sat	Sun
1	21:00 - 09:30	21:00 - 09:30	Zero hours	Zero hours	Daytime 8h		
2	Daytime 8h						
3	Daytime 8h						
4	Daytime 8h	Daytime 8h	Daytime 8h	Daytime 8h	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30
5	Zero hours	Zero hours	Zero hours	09:00 - 21:30	Daytime 8h		
6	Daytime 8h	Daytime 8h	09:00 - 21:30	Daytime 8h	Daytime 8h		
7	Daytime 8h	09:00 - 21:30	Daytime 8h	Daytime 8h	Daytime 8h		
8	09:00 - 21:30	Daytime 8h	21:00 - 09:30	21:00 - 09:30	Zero hours		
9	Daytime 8h	Daytime 8h	Daytime 8h	Daytime 8h	09:00 - 21:30	09:00 - 21:30	09:00 - 21:30
10	Daytime 8h						

#### (4) The one-night-at-a-time weekday rota

In terms of doctor exhaustion and patient safety, working only one night at a time would undoubtedly seem a good solution for provision of cover in the hospital over the night. Because each doctor only works a single night shift, his or her recovery period will be shorter. In addition, during the night shift doctors should be less fatigued and would not suffer from the accumulation of tiredness resulting from working several consecutive night shifts.

The disadvantage of working every night in this way would be that three different doctors would cover one post at night over a weekend, and hence disrupt three weekends for night work in each cycle of the rota. Compliance with the New Deal is also difficult, but a compromise rota can be achieved by planning three successive night shifts over the weekend (Friday to Sunday), but four single night shifts during the week (Table 4).

Another point to consider is that the number of handovers between different doctors is increased to nine, and in this example there are four unbroken weeks of daytime duty within the 10-week cycle of the rota. Again, only two doctors cover each weekend, with little time for handover.

**Table 4. A one-night-at-a-time weekday rota.** This example is both New Deal- and EWTD-compliant, and it provides an average 48-hour week. (Ten doctors rotating in one cell; until 2009, some doctors working the flexible Daytime 8h shifts could work a 13-hour day, to provide extra cover at either end of the day.)

	Mon	Tues	Wed	Thur	Fri	Sat	Sun
1	Daytime 8h	Daytime 8h	Daytime 8h	Daytime 8h	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30
2	Zero hours	Zero hours	Daytime 8h	Daytime 8h	Daytime 8h		
3	Daytime 8h	21:00 - 09:30	Zero hours	09:00 - 21:30	Daytime 8h		
4	Daytime 8h	Daytime 8h	21:00 - 09:30	Zero hours	Daytime 8h		
5	Daytime 8h	Daytime 8h	Daytime 8h	Daytime 8h	09:00 - 21:30	09:00 - 21:30	09:00 - 21:30
6	Daytime 8h						
7	21:00 - 09:30	Zero hours	09:00 - 21:30	Daytime 8h	Daytime 8h		
8	09:00 - 21:30	Daytime 8h	Daytime 8h	21:00 - 09:30	Zero hours		
9	Daytime 8h	09:00 - 21:30	Daytime 8h	Daytime 8h	Daytime 8h		
10	Daytime 8h						

## (5) The three nine-hour shifts rota

*What is the optimum length of each night shift for a junior doctor?*

The relative risk associated with one particular schedule compared to another is dependent on both the number of shifts worked in succession, and the length of each shift. With the maximum shift length being 13 hours, and the minimum break between shifts set at 11 hours, it appears very attractive to design rotas with 13-hour shifts. This allows two different doctors to cover one post for each 24-hour period and also provides an hour at either end for reasonable handovers. However, doctors carrying out work in the late afternoon and evening are doing so when exhausted, towards the end of the daytime 13-hour shift.

In addition, if a junior doctor over-runs a 13-hour shift by one hour, not only will a penalty Band Three payment be triggered under the New Deal, but the Working Time Regulations will be breached, requiring immediate compensatory rest. In a busy hospital, this over-running will occur frequently if there are only 30-60 minutes for handover. No shift should be scheduled to be close to the 13-hour limit.

If the night doctor works less than a 12-hour shift, then there will have to be two doctors working longer daytime shifts. Three nine-hour shifts will provide 24-hour cover (Table 5), and this could be achieved with an early shift from 07:00 to 16:00h, a late shift from 15:00 to 00:00h, and a night shift from 23:00 to 08:00h. The standard day shift could run flexibly from, say, 09:00 to 18:00h. Working until midnight does have safety issues, but of the same order as any shift ending in darkness between 20:00 and 23:00h.

Even with 10 doctors in a cell, it is impossible to devise a rota, within the rules of the New Deal, with only one nine-hour night shift at a time. Hence Table 5 rosters two nights at a time in the week, and three at the weekend.

**Table 5. A rota with three nine-hour shifts per 24 hours.** This example is both New Deal- and EWTD-compliant, and it provides an average 48-hour week. (Ten doctors rotating in one cell; until 2009, some doctors working the flexible Daytime 9h shifts could work a 13-hour day, to provide extra cover at either end of the day.)

	Mon	Tues	Wed	Thur	Fri	Sat	Sun
1	23:00 - 08:00	23:00 - 08:00	Zero hours	Zero hours	Daytime 9h		
2	Daytime 9h	Daytime 9h	Daytime 9h	07:00 - 16:00	07:00 - 16:00		
3	15:00 - 00:00	15:00 - 00:00	23:00 - 08:00	23:00 - 08:00	Zero hours		
4	Daytime 9h	07:00 - 16:00	07:00 - 16:00				
5	Daytime 9h						
6	Daytime 9h						
7	Daytime 9h	Daytime 9h	15:00 - 00:00	15:00 - 00:00	23:00 - 08:00	23:00 - 08:00	23:00 - 08:00
8	Zero hours	Zero hours	Daytime 9h	Daytime 9h	Daytime 9h		
9	Daytime 9h						
10	07:00 - 16:00	07:00 - 16:00	07:00 - 16:00	Zero hours	15:00 - 00:00	15:00 - 00:00	15:00 - 00:00

Three nine-hour shifts per 24 hours have a number of advantages over all the other shifts proposed in this guide:

- ▶ A shorter shift should lead to less doctor exhaustion, with its associated errors and loss of clinical precision, also making working practices more efficient.
- ▶ The change from two 13-hour shifts in 24 hours to three nine-hour shifts also alters the proportion of hours on the night shift from 50% to only 33% of the time 'on duty'. This also provides fresher doctors in the late afternoon and early evening, at the peak of demand for most acute specialties.<sup>29</sup>
- ▶ This rota introduces a regularity to juniors' work – that is, on average each week is made up of five nine-hour shifts.
- ▶ Working alongside the two nine-hour day shifts may be more acceptable for consultants, with increased opportunities for teaching and supervision.
- ▶ Nine-hour shifts are particularly suited to those posts with almost continuous intensive work – for example, juniors in A&E, the junior doctors during an acute medical take, trainees working in an intensive treatment unit/critical care unit or a neonatal unit.
- ▶ They are suitable for surgical specialties, where the 23:00 to 08:00h shift could be covered by less experienced staff, with expert assistance on call at home for rare surgical interventions.
- ▶ A nine-hour shift is extremely unlikely to over-run to more than 13 hours; hence the Band Three penalty payment is not likely to be triggered, nor a breach of the Working Time Regulations.
- ▶ On Saturday and Sunday the daytime shifts could be lengthened by a few hours, to provide extra 'non-acute' medical cover in the afternoon and early evening (with compensatory shorter days during the week).

Crucially, a rota of three nine-hour shifts per 24 hours, seven days a week, provides the lowest levels of estimated fatigue and risk of all the six specimen rotas (Table 7).

Lines 5, 6 and 9 in Table 5 can individually (or all) be eliminated to construct 9- to 7-cell rotas. With minor adjustment, all the new rotas are Band 1A under the New Deal; however, less and less time is allocated to daytime clinical work and training, and they become progressively more unacceptable.

Finally, the three nine-hour duty shifts can be adjusted in length to suit local activity, as long as the total hours for the three shifts add up to 27 hours. Thus the morning shift could start at 07:00h and last 10 hours; the second shift could start at 16:00h and finish after seven hours at 23:00h; the night shift could start at 22:00h and finish the next morning 10 hours later at 08:00h.

### (6) Three nine-hour weekday shifts, with 12.5-hour weekend shifts

An obvious drawback to scheduling nine-hour shifts is the need for three doctors to cover a weekend. A mixed rota, however, with standard 12.5-hour shifts on Friday, Saturday and Sunday, would overcome this problem (Table 6). This solution would also mean that at 21:00h on a Friday three doctors would still be on duty, and at 23:00h two doctors, potentially providing more opportunity for any ‘left-over’ jobs to be completed before handing over entirely to the weekend team. This compares very favourably to rotas with only 12.5-hour shifts, where cover on a Friday evening has dropped to just the night doctor by only 21:00h (Tables 1 to 4). This immediately places additional pressure on this doctor who can be expected to finish off jobs that the daytime team have not completed, as well as covering any other duties that are required throughout the night. However, the rota demonstrated in Table 6 has the major disadvantage of the long weekend shifts, with insufficient time for handover, and the risk of breaching the 13-hour time limit.

**Table 6. A rota with three nine-hour shifts on weekdays (Monday to Friday) and 12.5-hour shifts over the weekend (Friday to Sunday).** This example is both New Deal- and EWTD-compliant, and it provides an average 48-hour week. (Ten doctors rotating in one cell; until 2009, some doctors working the flexible Daytime 9h shifts could work a 13-hour day, to provide extra cover at either end of the day.)

	Mon	Tues	Wed	Thur	Fri	Sat	Sun
1	23:00 - 08:00	23:00 - 08:00	Zero hours	Zero hours	09:00 - 21:30	09:00 - 21:30	09:00 - 21:30
2	Daytime 9h						
3	15:00 - 00:00	15:00 - 00:00	23:00 - 08:00	23:00 - 08:00	Zero hours		
4	Daytime 9h	Daytime 9h	Daytime 9h	07:00 - 16:00	07:00 - 16:00		
5	Daytime 9h	Daytime 9h	Zero hours	Daytime 9h	21:00 - 09:30	21:00 - 09:30	21:00 - 09:30
6	Zero hours	Zero hours	15:00 - 00:00	15:00 - 00:00	15:00 - 00:00		
7	Daytime 9h						
8	07:00 - 16:00	07:00 - 16:00	07:00 - 16:00	Daytime 9h	Daytime 9h		
9	Daytime 9h						
10	Daytime 9h						

## 4 Practical issues

### Continuity of care and team working

Despite the need for 24-hour care, the Hospital at Night project showed that work activity in acute hospitals is not constant at all times, with a crescendo in the early evening in many specialties. Workload falls away to a variable extent after midnight.<sup>29</sup> The three nine-hour shift schedule would be a better way of dealing with this type of workload, but it is essential to remember that continuity of care and daytime team working are also important. In some cases both may have suffered from ineffective implementation of the Working Time Regulations, with associated impacts on patient safety and doctor training.<sup>30–32</sup>

Therefore, although most of the focus of this guide has been on covering the night, any solution must also remember the constitution of the day team. One way to take account of this is to try to design rotas with each level in a team matched against a partner or duplicate, so that at any one time at least half the team remains intact. Whenever one member of the pair is engaged in night work, the other should always be free for day duties. This can have the effect of appearing to split any team in two, since the two halves will almost never cross paths, so some leeway to allow both members of a pair to have at least one day together may be advisable.

It is also important to check parallel rotas of each grade of junior within each daytime firm, to ensure there is no fluctuation from feast to famine. If at all possible, the rotas of junior doctors in a firm should be synchronised and running on the same cycle, otherwise incompatibilities and crises will recur time and again. This may be impossible, however, if the numbers of doctors in each cell, working at different levels, are different.

More advice on maintaining continuity of care can be found in the Royal College of Physicians' *Continuity of care for medical inpatients: standards of good practice*<sup>33</sup> and also in *Safe handover: safe patients – Guidance on clinical handover for clinicians and managers*<sup>34</sup> written by the BMA Junior Doctors Committee.

Another important point to consider is the level of experience and skill that is available to call upon during a night shift. While overall work activity drops away after midnight, this does not mean that the level of practice or knowledge required by a doctor also falls after this time. Incidents where a more experienced doctor is required will still occur overnight. If there is only one higher-grade doctor on duty then they are likely to be tied-up dealing with this type of patient. Inevitably, with no other senior staff available the remainder of the patients in the hospital are then left under the care of less qualified staff. When thinking about the levels of cover in the hospital at night it must not be forgotten that there may well be times when not everyone on duty will be available at the same time, and so the quality and depth of cover if a key member of the night team is removed by an emergency should be considered.

Finally, the successful implementation of cross-disciplinary team working, as developed by Hospital at Night, can provide effective support for junior doctors when working out of normal hours.<sup>29</sup>

## How should gaps in a medical team be filled?

Predictable gaps in the make-up of medical teams will occur because members work night shifts – with less predictable absences due to holidays, study leave, sick leave, maternity or paternity leave and professional leave. It is important to consider that, when added together, all the possible reasons for absence mean that the average junior doctor may be away from his or her day team for nearly half of the year.

If rotas are designed with doctors paired-up, as described above, this can make it easier to cope with absences from the day team caused by members working at night. Prospective cover should also be factored in when designing rotas to give an idea of what additional hours of cover in the evening or at weekends can be provided from within the team. Such calculations provide only an indication and may not be possible in reality.

Most trusts do not have enough trainees to provide duplicate medical cover, so if a doctor is away when rostered for day or night work, no substitute is available. In New Zealand, each junior doctor spends about 20% of a post as a ‘night reliever’ – that is, as a general locum for the hospital covering absences due to leave. Thus, if a junior rotates every 10 weeks during a year, one of the 10-week posts would be as a general locum. In the UK, a trust could adopt such a policy, but it will interfere with training. Alternatively, a trust could appoint a full-time non-training grade junior doctor, who could cover the leave of four to five juniors, and avoid the cost and inefficiency of prospective cover or locums.

## What about flexible trainees?

Creating a workable rota with full-time employees is difficult, and the addition of flexible trainee posts will usually add asymmetry to a pattern that rotates according to a regular cycle. The ideal solution is for several flexible trainees to be responsible for one or more posts in the rota – thus the overall rota pattern will continue undisturbed, and the shorter working hours should be accommodated with some adaptability between the flexible trainees.

One criticism of the rota in Table 5 is that the standard working day for all doctors, even if not on call, is 9 hours – which could make childcare difficult. However, it should not be impossible for those who need to work a shorter day to negotiate less hours each routine work day, with less pay.

## How many doctors are needed at night to cover an acute service?

There are obvious pressures (in terms of stress, training and economics) to roster the least number of doctors necessary to cover the night shift. Furthermore, the optimal ratio of staff to patients will vary from discipline to discipline and hospital to hospital.

A survey of junior medical staffing in England, carried out between January and March 2006, revealed that the most common staffing pattern for general medical care at 02:00h was one SpR, and either two SHOs or one SHO and one Foundation year 2.<sup>35</sup> These three doctors cover a hospital admitting an average of 32 medical patients per 24 hours, and are responsible for 227 medical inpatient beds. Clearly, these doctors will be very busy, and each must also be allowed a break of at least 30 minutes duration after every four hours of work. There is no scope for economising on this level of staffing in the future – indeed economies in medical time in

anticipation of the 48-hour week in 2009 must take place in the daytime rather than by cutting staff numbers at night. More efficient use of all hours of daytime and evening working, such as would be possible with weekday nine-hour shifts, is likely to be the best way to achieve compliance in 2009.

### What is the ideal rota for 2009?

It is beyond the scope of this guide to proclaim an ideal rota because local circumstances and needs will inevitably have a part to play. Designing a rota is always a compromise, and must encompass many variables – for example, there are significant differences between how teams of anaesthetists and other doctors deliver clinical care compared with physicians. All the 10-in-a-cell rotas shown in this guide are compliant for the New Deal and Working Time Regulations as they will stand in 2009, and so all could be worked within a 48-hour week. Until that time it is possible for those doctors, who are presently rostered to work 8- to 10-hour daytime shifts, to work additional hours – providing extra cover at either the beginning or the end of the day. This might, however, alter the banding status of the rotas, which are currently all either 1A or 1B; all the rotas in this guide have been checked using Doctors Rostering System, North Central London Strategic Health Authority, London, England; [www.drusers.com](http://www.drusers.com).

The Fatigue and Risk Indices are the latest tools prepared for the Health and Safety Executive.<sup>36,37</sup> The Fatigue Index uses an arbitrary scale of 0–100, and values above about 65–70 are seldom seen in any industry. The Fatigue Index estimates the average and maximum Fatigue Index values to be 23.1 and 44.8, respectively, for the common 12-hour industrial shift system – namely, DDNN— (day-day-night-night-off-off-off-off); this system averages a 42-hour week, and provides a constant level of manning, 24/7, using four teams. The Risk Index average value has been set at 1.000 for the DDNN— system.

Table 7 provides a summary of all the rotas in this guide for easy comparison. Assessment of the estimated fatigue and the risk of accident for each rota shows that the ‘worst’ rota is seven 13-hour nights in succession, and the best is three nine-hour shifts. Using the same tools, a five-day week, made up of entirely daytime shifts of 0900–1830h, would yield values for the Fatigue Index of an average 3.90 and a maximum of 6.20, and for the Risk Index an average 0.890 and a maximum of 0.983. The average Risk Index values for other schedules indicate whether (and by how much) the risk varies from that of the DDNN— system. Thus working the 7 × 13-hour night rota (Table 1) the average risk is only 4% higher than on the DDNN— system, reflecting the fact that there is only a single span of 7 × 13-hour nights per 10-week period. Perhaps more importantly, the maximum risk on the 7 × 13-hour night rota is 1.74 (on the last night shift), which represents a 41% increase over the maximum risk value of 1.23 obtained on the last (second) night on the DDNN— system.

As preparations for 2009 continue, trusts may need to alter rotas more than once to meet changing needs and no rota should be considered fixed in stone. Three years is too long to leave unchanged those rotas involving seven 13-hour night shifts in succession, but leaves little time for getting new rotas right. There is an urgent need for prospective research, testing one or more of the rotas demonstrated in this guide, to determine the optimal rota system for implementation in 2009.

In the meantime, it is our hope that the ideas and suggestions provided in this guide may ease the transition to a 48-hour working week for junior doctors and, at the same time, make working conditions safer and more pleasant for these doctors, preserve medical training, and maintain high standards of patient care.

**Table 7 A summary of the different rotas provided in this guide, with assessments of fatigue and risk.<sup>36,37</sup>**

<b>Name of rota</b>	<b>Seven-nights-in-succession</b>	<b>Four-and-three</b>	<b>Two-two-and-three</b>	<b>One-night-at-a-time weekday</b>	<b>Three nine-hour shifts</b>	<b>Nine-hour weekday shifts with 13-hour weekend shifts</b>
<b>Table no.</b>	1	2	3	4	5	6
<b>Maximum no. of consecutive night shifts worked</b>	7	4	3	3	3	3
<b>Maximum no. of consecutive night shift hours worked</b>	91	52	39	39	27	39
<b>Maximum no. of consecutive days worked</b>	12	8	12	12	12	8
<b>Maximum no. of consecutive days off</b>	7	3	3	3	3	3
<b>No. of unbroken weeks of daytime work on base team</b>	3	4	3	2	4	4
<b>No. of weekends worked within cycle</b>	2	2	2	2	3	2
<b>Average fatigue<sup>36,37</sup></b>	14.7	14.3	14.2	14.5	9.6*	11.7
<b>Maximum fatigue<sup>36,37</sup></b>	57.5	53.7	52.2	51.8	37.0*	51.3
<b>Average risk<sup>36,37</sup></b>	1.04	1.01	1.03	1.00	0.93*	0.93*
<b>Maximum risk<sup>36,37</sup></b>	1.74	1.53	1.56	1.44	1.38*	1.42

\* Best rota.

## Practical tips for designing rotas

### Basic principles

- ▶ Involve the staff who will be working a rota in its design. A rota that is forced upon reluctant workers is unlikely to be successful.
- ▶ Remember that increased time working a shift is associated with an increased risk of accident or injury. Working at night further increases this risk.
- ▶ Three nine-hour shifts to cover 24 hours should improve health, safety, teaching and supervision, and efficiency.
- ▶ Allow sufficient time off after night shifts to allow proper recovery and to allow doctors to catch up on sleep. For every two nights on duty, at least one whole day off should be scheduled.
- ▶ Remember that working more than four nights in a row is neither pleasant nor, in our view, advisable.

### Drawing up the rotas

- ▶ Consider what the minimum medical staffing requirements for a smoothly running rota are likely to be, and then try to include more doctors than this minimum.
- ▶ Do not design rotas that involve working right up to the maximum allowable number of hours per week. Doctors will almost inevitably end up on occasion being on duty for longer than they are scheduled to be, so take this into account when deciding the length of shifts.
- ▶ Thirteen-hour shifts will almost always overrun, threatening to trigger Band Three payments and, unless compensated, a breach of the Working Time Regulations.
- ▶ Start by plotting out the night shifts, and then add in the necessary days off.
- ▶ Group night shifts together on Friday, Saturday and Sunday nights; this makes the most efficient use of a doctor's time. Working on just a Saturday or Sunday night will increase the number of doctors needed to cover a weekend, and will also make it more difficult to comply with the New Deal rules.
- ▶ Once you have filled in the nights and days off, fill in the gaps with days.

### Continuity of care

- ▶ Make sure that the rota includes sufficient time for a comprehensive handover (up to an hour, depending on the specialty) and that the rota allows all members of the team to be present.

- ▶ Try to design rotas with doctors in pairs, so that when one is on night duty another in the same team is still available for day work.
- ▶ Consider matching-up doctors so that handovers maintain continuity. For example, run blocks of days and nights together, so that the same doctors are handing over to each other more than once.
- ▶ Do not forget the balance between continuity of care, the safety of any rota, and how disruptive the rota is for the doctors being asked to work it.

## APPENDIX 2

# Members of the Working Group

## Speakers

Professor Simon Folkard, Université René Descartes, Paris  
Dr Christopher P Landrigan, Brigham & Women's Hospital & Harvard Medical School, Boston  
Dr Steven W Lockley, Brigham & Women's Hospital & Harvard Medical School, Boston  
Dr Deborah Powell, New Zealand Resident Doctors Association  
Dr Barbara Stone, Centre for Human Sciences, QinetiQ

## Members of the Working Group and contributors

The following people were members of the Working Group or contributed to the development of this guide.

Dr Peter Alexander, Intensive Care Society Trainees Committee  
Dr Mary Armitage, Clinical Vice-President, Royal College of Physicians  
Professor Michael Bannon, Postgraduate Dean, Oxford PGMDE  
Mr Mike Beattie, Senior Business Manager, Doctors Team, NHS Employers  
Professor Dame Carol Black, President, Royal College of Physicians  
Mr Stuart Blackwell, Royal College of Physicians, Patient and Carers Forum  
Dr Declan Chard, Chair, Trainees Committee, Royal College of Physicians  
Ms Sarah Connelly, Head of Medical Workforce Development, North Central London SHA  
Dr Robert Coward, SpR Advisor, Royal College of Physicians  
Professor Sir Alan Craft, President, Royal College of Paediatrics & Child Health; Chairman, Academy of Medical Royal Colleges  
Dr John Curran, Royal College of Anaesthetists  
Mr Roger Currie, Royal College of Surgeons (Edinburgh)  
Ms Lindsey Dawson, Health & Community Care Research Unit, University of Liverpool  
Ms Sue Dean, Associate Director, NHS Workforce Projects  
Mr Andrew Drakeley, Chair, Academy of Medical Royal Colleges Trainee Doctors Group  
Professor Bill Dunlop, Chair, Joint Consultants Committee  
Mr Simon Eccles, National Clinical Lead for Hospital Doctors, NHS Connecting for Health  
Mr Martin Else, Chief Executive, Royal College of Physicians  
Mr Paul Evans, NHS patient  
Dr Sara Fairbairn, Trainees Committee, Royal College of Physicians  
Dr Anna Forrest-Hay, Faculty of Accident & Emergency Medicine  
Dr Ashley Fraser, Medical Director, NHS Employers  
Dr Clive Lewis, Deputy Chair, Trainees Committee, Royal College of Physicians  
Dr Richard Long, Censor, Royal College of Physicians  
Professor John Lowry, Royal College of Surgeons (England)  
Dr Andrew Mitchell, Royal College of Paediatrics & Child Health  
Ms Alice Murray, Medical student, UCL  
Dr Mike Page, Consultant Physician, Royal Glamorgan Hospital  
Dr Amit Patel, Trainees Committee, Royal College of Physicians  
Dr Jane Pateman, Associate Dean, London Deanery  
Dr Dilip Raje, Patient and Carer Network, Royal College of Physicians  
Miss Wendy Reid, Postgraduate Dean, London Deanery  
Dr Mark Roberts, SpR in Respiratory Medicine, Derbyshire Royal Infirmary  
Dr Andrew Rowland, Deputy Chairman, UK Junior Doctor's Committee, BMA  
Mr Dean Royles, Head of HR Capacity & Employment, NHS Workforce Directorate  
Ms Joan Russell, Safer Practice Lead, National Patient Safety Agency  
Dr John Scarpello, Deputy Medical Director, National Patient Safety Agency  
Dr Mark Simmonds, SpR in Medicine, Queen's Medical Centre, Nottingham  
Mr Dominic Slade, Secretary, Association of Surgeons in Training  
Dr David Snashall, President, Faculty of Occupational Medicine  
Mrs Elaine Stevenson, Safer Practice Lead, National Patient Safety Agency  
Dr Arvindan Veiraiah, SpR in Clinical Pharmacology, Llandough Hospital  
Dr Chandi Vellodi, Councillor, Royal College of Physicians  
Mr Jim Wardrope, President Elect, Faculty of Accident & Emergency Medicine  
Mr Richard Warren, Honorary Secretary, Royal College of Obstetricians & Gynaecologists  
Mr David Wells, WTD Lead, Maternity & Paediatrics, Care Services Improvement Partnership  
Miss Melissa Whitten, Chair, Royal College of Obstetricians & Gynaecologists, Trainees Committee  
Dr Martha Wyles, Chair, Trainees Committee, Royal College of Paediatrics & Child Health  
Mr Robert Wykes, Royal College of Physicians, Patient and Carers Forum  
Dr Sashidhar Yeluri, SHO Surgical Rotation, St James' University Hospital, Leeds

## References

- 1 Horrocks N, Pounder R; RCP Working Group. Working the night shift: preparation, survival and recovery – a guide for junior doctors. *Clin Med* 2006;6:61–7. Also available at: [www.rcplondon.ac.uk/pubs/books/night\\_shift/night\\_shiftbooklet.pdf](http://www.rcplondon.ac.uk/pubs/books/night_shift/night_shiftbooklet.pdf)
- 2 Van Dongen HP, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioural functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep* 2003;26:117–26.
- 3 Lockley SW, Cronin JW, Evans EE *et al.* Effect of reducing interns' weekly work hours on sleep and attentional failures. *N Eng J Med* 2004;351:1829–37.
- 4 Landrigan CP, Rothschild JM, Cronin JW, *et al.* Effect of reducing interns' work hours on serious medical errors among interns in intensive care units. *N Eng J Med* 2004;351:1838–48.
- 5 Friedman RC, Bigger JT, Kornfeld DS. The intern and sleep loss. *N Eng J Med* 1971;285:201–3.
- 6 Grantcharov TP, Bardram L, Funch-Jensen P, Rosenberg J. Laparoscopic performance after one night on-call in a surgical department: prospective study. *BMJ* 2001;323:1222–3.
- 7 Eastridge BJ, Hamilton EC, O'Keefe GE *et al.* Effect of sleep deprivation on the performance of simulated laparoscopic surgical skill. *Am J Surg* 2003;186:169–74.
- 8 Stickgold R, James L, Hobson JA. Visual discrimination learning requires sleep after training. *Nature Neurosci* 2000;3:1237–8.
- 9 Stickgold R. Sleep-dependent memory consolidation. *Nature* 2005;437:1272–8.
- 10 Knauth P, Rutenfranz J. Duration of sleep related to the type of shift work. In Reinberg A, Vieux N, Andlauer P (eds), *Advances in the biosciences, Vol 30. Night and shift work: biological and social aspects*. New York: Pergamon Press, 1980: 161–8.
- 11 Folkard S, Tucker P. Shift work, safety and productivity. *Occup Med* 2003;53:95–101.
- 12 Folkard S, Lombardi DA, Tucker PT. Shift work: safety, sleepiness and sleep. *Ind Health* 2005;43:20–23.
- 13 Coward R. Fifth specialist registrar survey. London: RCP, 2006.
- 14 Department of Transport, Local Government and the Regions. Sleep-related vehicle accidents on sections of trunk roads and motorways in the UK (1995-1998). Road Safety Research Report No. 22. London: DTLR, 2001.
- 15 Horne JA, Reyner LA. Sleep related vehicle accidents. *BMJ* 1995;310:565–7.
- 16 Gold DR, Rogacz S, Bock N *et al.* Rotating shift work, sleep, and accidents related to sleepiness in hospital nurses. *Am J Public Health* 1992;82:1011–14.
- 17 Ohayon MM, Lemoine P, Arnaud-Briant V, Dreyfus M. Prevalence and consequences of sleep disorders in a shift worker population. *J Psychosom Res* 2002;53:577–83.
- 18 Stutts JC, Wilkins JW, Scott Osberg J, Vaughn BV. Driver risk factors for sleep-related crashes. *Accid Anal Prev* 2003;35:321–31.
- 19 Steele MT, Ma OJ, Watson WA, Thomas HA Jr, Muelleman RL. The occupational risk of motor vehicle collisions for emergency medicine residents. *Acad Emerg Med* 1999; 6:1050–53.

- 20 Barger LK, Cade BE, Ayas N *et al.* Extended work shifts and the risk of motor vehicle crashes among interns. *N Eng J Med* 2005;352:125–34.
- 21 Åkerstedt T, Peters B, Anund A, Kecklund G. Impaired alertness and performance driving home from the night shift: a driving simulator study. *J Sleep Res* 2005;14:17–20.
- 22 Dawson D, Reid K. Fatigue and alcohol performance impairment. *Nature* 1997;388:235.
- 23 Lamond N, Dawson D. Quantifying the performance impairment associated with fatigue. *J Sleep Res* 1999;8:255–62.
- 24 Williamson AM, Feyer A-M. Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occup Environ Med* 2000; 57: 649–55.
- 25 Arnedt JT, Owens J, Crouch M, Stahl J, Carskadon MA. Neurobehavioral performance of residents after heavy night call vs after alcohol ingestion. *JAMA* 2005;294:1025–33.
- 26 NHS Employers. *Removal and associated expenses guidance for doctors in training*. www.nhsemployers.org
- 27 NHS Healthcare workforce. *Hours of work and rest requirements – a comparison*. www.healthcareworkforce.org.uk/C16/WTDHistoric/default.aspx
- 28 Pounder RE. The case for a ‘cell of ten’ to provide 24/7 cover by junior doctors. London: RCP College Statement, 2003. [http://www.rcplondon.ac.uk/college/statements/ewtd\\_caseforten.asp](http://www.rcplondon.ac.uk/college/statements/ewtd_caseforten.asp).
- 29 Modernisation Agency. *Findings and recommendations from the Hospital at Night project*. London: Modernisation Agency, 2004. www.modern.nhs.uk/hospitalatnight.
- 30 Coward R. Medical SpRs and the European Working Time Directive. Results of a survey in December 2004. www.rcplondon.ac.uk/professional/spr/spr\_ewtd04.htm.
- 31 Stephens MR, Pellard S, Boyce J *et al.* Influence of EWTD compliant rotas on SHO operative experience. *Ann R Coll Surg Eng (Suppl)* 2004;86:120–21.
- 32 Marron CD, Byrnes CK, Kirk SJ. An EWTD-compliant shift rota decreases training opportunities. *Ann R Coll Surg Engl (Suppl)* 2005;87:246–8.
- 33 Royal College of Physicians. *Continuity of care for medical inpatients: standards of good practice*. London: RCP, 2004. www.rcplondon.ac.uk/members/library/books/ContinuityOfCare.pdf.
- 34 British Medical Association. *Safe handover: safe patients - Guidance on clinical handover for clinicians and managers*. London: BMA, 2004. www.bma.org.uk/ap.nsf/Content/Handover/\$file/Handover.pdf
- 35 Coward R. Hospital at night and medical staff on call. *College Commentary* May/June 2006:12–13.
- 36 Spencer MB, Robertson KA, Folkard S. *The development of a fatigue/risk index for shift workers*. RR446. Report to the UK Government’s Health and Safety Executive, 2005. www.hse.gov.uk/research/rrhtm/rr446.htm
- 37 Folkard S, Lombardi DA. Towards a ‘Risk Index’ to assess work schedules. *Chronobiol Intl* 2004;21:1063–72.