

A Rude awakening – quality of sleep and excessive daytime sleepiness in  
internal medicine registrars

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## **DECLARATION**

I, Tanja Nell, declare that this research report is my own work. It is being submitted for the degree of Masters of Medicine (in the submissable article format with my protocol and an extended literature review) in the branch of Internal Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

.....

.....day of .....2017

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## **ABBREVIATIONS**

EDS – excessive daytime sleepiness

EEG- electroencephalography

ESS – Epworth Sleepiness Score

FSS – Fatigue Severity Scale

HPCSA – Health Professions Council of South Africa

MVAs - Motor vehicle accidents

NREM – non-REM

REM - Rapid Eye Movement

SD – Standard deviation

WITS – University of the Witwatersrand



## **CHAPTER 1: PROTOCOL WITH EXTENDED LITERATURE REVIEW**

### **Introduction – normal sleep**

Sleep is a state of normal mental and physical inactivity from which a person can be roused. Sleep is required on a regular basis as it preserves memory, refreshes emotional and cognitive equilibrium and it avoids neurotransmitter depletion (1, 2).

Sleep can be divided into rapid eye movement (REM) sleep and non-REM sleep (non-REM). Most adults will enter sleep from the drowsy state through NREM sleep. NREM sleep has three stages (2).

N1 is a transition from wakefulness to sleep, it is the lightest stage of sleep and people awakened from this stage might not perceive that they were asleep. On the EEG stage 1 (N1) sleep is represented by theta range waves (4-7Hz). Stage 2 (N2) sleep comprises the largest percentage of total sleep time typically 45-55 % of the night. On an EEG it has two identifying waveforms, sleep spindles (12-14Hz) and K-complexes. Slow wave sleep (stages 3 and 4 or N3) are referred to as slow wave sleep or deep sleep, and on the EEG it is characterised by delta waves (0.5-2Hz). This stage accounts for 10-20 percent of total sleep time and decreases with age (2). REM sleep is associated with vivid dreaming and accounts for a quarter of total sleep time. The function of REM sleep is still under debate but it is believed to consolidate memories and allow for pruning of neural connections (2).

Sleep is not a homogenous process and goes through multiple cycles during the night. These cycles last 90-120 minutes and contains periods of NREM and REM. Thus, in a period of an eight hour sleep there would be 4-5 sleep cycles. The amount of REM sleep increases with each sleep cycle across the night and the amount of NREM N3 sleep decreases with each successive sleep cycle (2).

Young adults and middle aged adults typically sleep between five and eight hours per night. An appropriate quantity of sleep makes a person feel refreshed and capable of functioning well without effort. As people age both the total sleep time as well as the percentage of NREM N3 decreases and there is an increase in wake time and NREM 1. REM sleep is fairly stable throughout adulthood (2).

The true function of sleep is poorly understood and there are multiple theories. The restorative theory proposes that sleep restores general body tissues and efficient synaptic transmission that helps the body and brain prepare for the next day. Sleep also plays a role in brain plasticity by promoting learning dependant synapse formation and maintenance. Memory and cognitive function are also impacted by sleep and if deprived of sleep people learn less well (2). Another function of sleep is to clear metabolites and restore them back to normal levels, thereby restoring general body tissue which with efficient synaptic transmission helps the body and brain to prepare for the next day (3).

Quantitative sleep loss can be due to acute continuous loss or chronic partial loss. Acute sleep loss happens when a person does not sleep for an extended period of time (3) Chronic partial sleep loss occurs when insufficient sleep is obtained over a long period of time. Medical professionals are likely to be subjected to both types of sleep deprivation.

### **Circadian and homeostatic regulation of sleep and wakefulness**

Falling asleep as well as duration and quality plus level of waking cognition depend on both circadian and homeostatic processes. From a circadian point of view, cognition is optimal during the internal biological day and sleep is optimal during the internal biological night. From the homeostatic point of view sleep drive increases with the duration of prior wakefulness, whether due to an acute sleep deprivation state or chronic short sleep schedules. Sleep propensity, or ability to fall asleep, also depends on the amount of sleep in the prior sleep episode resulting in a cumulative effect during chronic partial sleep loss. Higher homeostatic sleep drive results in impaired cognition, increased

sleepiness and increased propensity to sleep. The circadian and homeostatic processes interact and therefore influence the quality of waking cognition and of sleep (4). A decreased amount of sleep will lead to sleep deprivation.

## **Sleep Deprivation**

Adults are typically awake for sixteen hours of the twenty-four hour day. Lack of sustained sleep at night leads to symptoms of sleep deprivation, which is usually expressed as excessive daytime sleepiness. Excessive daytime sleepiness is sleepiness in a situation when an individual would be expected to be awake and alert (3). The word sleepiness traditionally means drowsiness, the intermediate state between alert wakefulness and sleep. In sleep medicine it is synonymous to sleep propensity – the probability of making the transition from alert wakefulness, through drowsiness, to sleep (5).

This excessive sleepiness may be particularly important and have the most consequences in the work place. Factors that lead to EDS in the work situation are long work hours, altered schedules and on call periods to name but a few (4). These factors are common in shift workers and in the medical profession particularly. Shift work usually requires work to occur during the biological night when both the circadian and homeostatic systems are promoting sleep and sleep to occur in the biological day when the circadian system is promoting wakefulness. The sleep that does occur during the day is known to be shorter and lighter than nocturnal sleep. These factors contribute then to daytime sleepiness and disturbed sleep (4).

Symptoms of sleep deprivation (apart from the sensation of tiredness or sleepiness), also includes fatigue, poorer daytime performance and measurable effects on the immune system. Measuring the levels of these functions then serves as a measure of the amount of sleep deprivation. Although often occurring together excessive daytime sleepiness and fatigue have separate measuring systems.

## **Measuring daytime sleepiness**

There are a number of scales that can measure current sleepiness but very few that can measure daytime sleepiness over a period of time. The most commonly used validated questionnaire is the Epworth Sleepiness Scale (ESS). Dr Murray Johns first developed the ESS for adults in the early 1990s and it was modified in 1997 (6). He developed the scale so he could assess the daytime sleepiness for patients in his own practice of sleep medicine. The questionnaire was named after the Epworth Hospital in Melbourne, Australia.

The ESS is a self-administered questionnaire with eight questions. People completing this questionnaire are asked to rate, on a 4-point scale (0-3), their chances of dozing off or falling asleep during eight different activities. The ESS score can range from 0 to 24. The higher the score the sleepier the person. The normal score range is 0 to 10 and an ESS score of 10 or more usually represents significant sleepiness (6).

The ESS has been used in numerous studies to measure sleep deprivation, both in shift workers in general and in healthcare professionals including nurses and doctors. The most recent study was conducted in Saudi Arabia between December 2015 and April 2016 (7). Their study population consisted of a group of health care professionals from different specialities such as nurses, physicians and technicians. They found a significant difference in daytime sleepiness between shift workers and non-shift workers but neither group had a mean ESS over the pathological level. They did, however, suggest that the ESS may not be the best tool to study sleep quality and daytime sleepiness in health care professionals performing shift work.

## **Measuring fatigue**

Fatigue is difficult to measure separate to sleepiness. Fatigue is very common as a symptom of chronic medical conditions and numerous scales have been developed to measure fatigue in specific medical conditions. One scale that has been validated and may be useful for shift workers is the Fatigue Severity Scale (FSS) devised by Krupp in the 1990s (8). The scale has nine items measuring fatigue levels over the last week with 7 options ranging from strongly disagree to strongly agree. The numbers selected are added together and divided by 9 to get an average score for the whole test. The test overall has good internal consistency, reliability and construct and criterion validity but one criticism is that it may measure fatigue impact rather than severity (9). Levels of fatigue in Multiple Sclerosis and Systemic Lupus erythematosus (SLE) have been shown to reach over 4 points on average versus 2 in healthy adults (8,9)

## **Effects of hospital shift work on sleepiness and fatigue**

Shift work refers to a schedule not conforming to standard office hours of 9am to 5pm daytime (4). Shift work has a significant negative impact on quantity and quality of sleep and subsequent daytime sleepiness as well as loss of work performance. Sleepiness can also be caused by a misalignment of sleep time with the normal circadian rhythm resulting in less hours and poorer quality of sleep in shift workers. Working longer hours, habitual napping and the feeling of not getting enough sleep also correlates with daytime sleepiness (10).

A specific population that works long hours and shift work is the medical profession – both doctors and nurses and allied health professionals. A large number of studies have been published on the impacts of long working hours, and by extension shorter sleep duration, in various medical professional groups including interns and other junior doctors. All of them show sleep debt which impacts on daytime sleepiness and fatigue as well as job performance. These studies have led to changes both in Europe and the United States of America (USA) in the working hours of doctors –

making them shorter with more time off not without some concerns as to doctor and patient safety (11,12).

A particular medical population at risk are registrars who are post graduate students, studying to become specialists. The standard registrar time spans over four years and includes two exams. The training process require a combination of patient care and procedural experience in hospitals, and any further knowledge that is expected from registrars is obtained from studying books and research articles. Thus not only do they work long and unconventional hours they also have to maintain a highly methodical work performance and study for exams which is fairly unique among shift workers and which adds to the sleep debt.

Even without the long working hours, being a registrar is very stressful. Registrars feel insecure about their competence, they assume a lot of responsibility and at times have to make decisions even though their knowledge is not adequate at that point. So long work hours add to the stresses of an already demanding job. It is very difficult to fulfil a normal life with extended work hours and being a registrar. As registrars are usually young they also have young families with all the energy that requires. The time spent on working and studying takes away from time spent with family, building relationships, spending time with spouse and kids, and sleeping (13). Thus, in the registrar context sleepiness may be caused by reduced sleep time either due to work, family or studying demands, by fragmented and disrupted sleep or by taking sedating drugs (5).

The effects of sleep loss and fatigue on registrars can be divided into learning and cognition, job performance and personal life. Learning and cognition are described as the ability to learn and think. Job performance can include ability to perform the job required as well as the tendency to make mistakes. Components of the personal life of registrars include marriage, children and wider social life.

Sleep loss and fatigue have an adverse effect both on the motivation to learn as well as difficulty in the acquisition of cognitive and non-cognitive material. Formal and informal learning opportunities such as learning from reading, tutorials, lectures and other structured learning activities are compromised by sleep loss (14, 15). Recent studies suggest that sleep loss and fatigue result in neurobehavioral impairment in healthy young adults (15). Changes in cognition with sleep deprivation can be profound. After 24 hours consecutive hours without sleep, cognitive psychomotor function declines to a level that is equal to a blood alcohol level of 0.1 percent (16).

### **Job performance**

Work performance can be divided into professionalism and task performance. Both of these can be influenced by sleep loss and thus a lack of empathy and concern for their patients may lead to a drop in professionalism and medical errors are more likely to occur when a registrar is sleep deprived (14). Not only is the sleep deprived registrar at risk whilst at work but outside of the work environment as well. Sleep loss and daytime sleepiness affect vigilance, cognitive functions, reaction time and mood, all of which have been shown to increase the risks while driving (17).

Sleep loss and fatigue influences the personal life, including personal wellbeing and relationships, of registrars. It causes registrars to be inattentive and abrupt in their relationships with their spouse or significant other, children and extended family. Their personal wellbeing is affected in terms of their physical health, psychological health and mood, leisure time, driving ability and activities of daily living.

## **Sleep deprivation in the registrar population**

It is difficult to compare studies done in other countries to the South African situation because the conditions of service and training are often very different. Generally the patient load in South Africa is much higher than in European or USA hospitals leading to an increased work load.

In studies that can be compared the level of sleep loss experienced by registrars is severe. In a study done by Nojomi et al it was shown that sleep loss is a considerable issue among registrars. Registrars at the University of Iran, ranging from first to final year of study, completed a questionnaire. The level of sleep deprivation was found to be near or below levels associated with some clinical sleep disorders including insomnia and parasomnias. They found that the mean insomnia score was higher among females, subjects with noise in their living area, and was less in those that did exercise (18).

The effect of being on-call was investigated in Internal medicine registrars at the University of Western Ontario. Due to their on-call responsibilities internal medicine registrars are subjected to regular sleep restrictions. Subjective assessment by internal medicine registrars suggested fatigue levels equivalent to that found in patients with serious sleep disorders such as sleep apnoea and narcolepsy. In driving- simulation experiments it was found that post-call response times were equivalent to the response times produced in normal subjects with a blood alcohol level of 0.05 (19).

A more complete understanding of the effects of sleep loss, quality of sleep and daytime sleepiness during registrars training can lead to new strategies to minimise the effects of sleepiness and fatigue on patient care and registrars' safety in South Africa. While there have been editorials lamenting the level of sleepiness among registrars in South Africa no formal descriptive studies have been done on registrars in South Africa, to investigate the extent of the sleepiness in this population. It is thus the



aim of this study to describe the quality and quantity of sleep and daytime sleepiness in Internal Medicine registrars at the Faculty of Health Science.

## **Study aims and objectives**

### **Aims**

The aim of this study is to describe the quality of sleep and daytime sleepiness in Internal Medicine Registrars at the Faculty of Health Sciences.

### **Objectives**

- To describe the characteristics of quality of sleep and the extent of sleep loss amongst Internal Medicine registrars.
- To describe the level of daytime sleepiness and the consequences on daytime functioning of Internal Medicine registrars.
- To correlate the extent of sleep loss with excessive daytime sleepiness.
- To describe the factors influencing quality of sleep, sleep loss and daytime sleepiness in Internal Medicine registrars.
- To compare the quality of sleep and daytime sleepiness of male and female registrars.
- To compare the quality of sleep and daytime sleepiness of registrars writing the exams in the next six months to those not writing the exams.
- To compare the quality of sleep and daytime sleepiness in the different rotations.

## **Methods**

### **Study design**

A prospective observational study design will be used.

## **Study population**

### **3.3.2.1 Site of study**

The Internal Medicine registrars in all four years of study on the Wits circuit were used. The Wits circuit included all three hospitals on the Internal Medicine circuit - Chris Hani Baragwanath Academic Hospital, Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital. The research took place over the period of one year.

### **Sample size**

There are 100 Internal Medicine registrars on the University of the Witwatersrand (WITS) circuit.

### **Inclusion criteria**

All the Internal Medicine registrars on the WITS circuit at the time of the study will be included.

### **Exclusion criteria**

Any registrar with a pre-existing sleep disorder will be documented but excluded from the study on level of daytime sleepiness.

### **Data collection**

A questionnaire will be handed out at the Internal Medicine Academic meetings at the various hospitals. The questionnaire includes the Epworth sleepiness scale and the Pittsburgh sleep quality index as well as a few other questions. (Appendix A). The questionnaire was returned by placing it in a box at the entrance of the Internal Medicine meeting venue or by placing it in a box situated at the Internal Medicine secretary's office. The boxes were collected after each meeting and emptied at the end of each week.

### **Confounding variables/problems**

- Not all registrars completing the questionnaire
- The questionnaire was based on subjective reports

**Data Analysis:**

The demographics of the sample size will be summarised using descriptive statistics. Mean and standard deviations as well as percentages will be used to describe numerical and categorical data respectively. For the correlations a Spearmans correlation will be used. To compare genders, circadian rhythm types and proximity to exams unpaired t-tests or Mann-Whitney tests will be used for numerical data (parametric and non-parametric respectively) and Fishers exact test to compare categorical data.

**Ethics:**

The research proposal was submitted to the WITS HREC for approval. All the Information collected in the questionnaire was treated as confidential.

**Timing:**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Literature review												
Preparing Protocol												
Protocol Assessment												
Ethics Application												
Data Collecting												
Data Analysis												
Writing up - MMed												

**Funding:**

The costs are minimal as this study only used questionnaires. The costs include stationery and printing costs. These costs were covered by the principal investigator.

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## **Appendix A – Questionnaire for registrars**

Please answer the following questions as accurately as you can. All answers are confidential.

- |  |                             |
|--|-----------------------------|
| 1. Age:                                  | 2. Gender:                  |
| 3. Year of study:                        | 4. Rotation:                |
| 5. Married / single / in a relationship: |                             |
| 6. Do you have children?                 | Yes                      No |
| 7. Do you have pets?                     | Yes                      No |
| 8. Any pre-existing sleep disorders?     | Yes                      No |

### **9. Epworth sleepiness scale:**

Over the last month how likely were you to doze off or fall asleep in the following situations after you've had your usual nights sleep: (circle one number for each)

	Would never doze	Slight chance	Moderate chance	High chance
a. Sitting and reading	0	1	2	3
b. Watching TV	0	1	2	3
c. Sitting inactive in a public place	0	1	2	3
d. Passenger in a car for an hour without a break	0	1	2	3
e. Lying down to rest in the afternoon	0	1	2	3
f. Sitting and talking to someone	0	1	2	3
d. Sitting quietly after lunch with no alcohol	0	1	2	3
e. In a car, while stopped for a few minutes in the traffic	0	1	2	3

The following statements refer to how you usually feel. For each statement you can choose one out of five answers as indicated below. Please circle the correct number for each statement.

During the past week I have found that;

	Disagree ↔ Agree						
1. My motivation is lower when I am fatigued	1	2	3	4	5	6	7
2. Exercise brings on my fatigue	1	2	3	4	5	6	7
3. I am easily fatigued	1	2	3	4	5	6	7
4. Fatigue interferes with my physical functioning	1	2	3	4	5	6	7
5. Fatigue causes frequent problems for me	1	2	3	4	5	6	7
6. My fatigue prevents sustained physical functioning	1	2	3	4	5	6	7
7. Fatigue interferes with carrying out certain duties and responsibilities	1	2	3	4	5	6	7
8. Fatigue is among my three most disabling Symptoms	1	2	3	4	5	6	7
9. Fatigue interferes with my work, family or social life	1	2	3	4	5	6	7

Registrar specific supplementary items:

10. Please tick the most appropriate answer.

- |  |     |    |
|--|-----|----|
| a. My thinking generally is unaffected by sleep loss                             | Yes | No |
| b. My work is generally unaffected by sleep loss and fatigue.                    | Yes | No |
| c. Sleep loss and fatigue have an impact on my personal life                     | Yes | No |
| d. I am worried about making errors in writing prescriptions on post call days   | Yes | No |
| e. I have heard about others making medical errors due to sleep loss and fatigue | Yes | No |

f. I am worried about having a car accident driving home postcall	Yes	No
g. Sleep loss and fatigue affect the way I speak to my colleagues	Yes	No
h. Sleep loss and fatigue affect my studying for exams	Yes	No
i. I am worried that I will write an incorrect order because of sleepiness	Yes	No
j. I can tell when I am too tired to drive home	Yes	No
k. My family understands my demanding job and sleep needs	Yes	No
l. I am worried that I might fall asleep while examining a patient	Yes	No
m. I have made an error in prescribing medication because I was tired	Yes	No
n. I have made an error in judgement because I was tired	Yes	No
o. Post call I have been too tired to drive home	Yes	No

General questions:

11. On average how many hours do you sleep per week? \_\_\_\_\_
12. How many of these hours do you sleep at night i.e between 10 pm and 6 am? Please indicate as a percentage.  
\_\_\_\_\_
13. What is your longest working shift per week? \_\_\_\_\_
14. Do you find it easy or hard to sleep outside the sleeping hours 10pm to 6am?  
\_\_\_\_\_
15. What is your usual number of hours you sleep a night? \_\_\_\_\_
16. Have you had a worse working hours than your current rotation? If yes, please state which rotation.  
\_\_\_\_\_
17. How easy/hard is it for you to catch up on sleep? \_\_\_\_\_
18. If you answered hard to the above question, please state why?  
\_\_\_\_\_
19. When did you write / are planning to write the part 1 exam? \_\_\_\_\_



20. When did you write/ are planning to write the part 2 exam? \_\_\_\_\_

21. Have you ever taken medication to help you sleep? If you answered yes how often and what medication did you take?

\_\_\_\_\_

## **CHAPTER 2: SUBMISSIBLE ARTICLE**

**Title:** A Rude awakening – Quality of sleep and excessive daytime sleepiness in Internal Medicine Registrars

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**Short title:** Sleep deprivation and daytime sleepiness in internal medicine registrars

**Conflict of interest:** Nil

**Keywords:** Sleep deprivation, daytime sleepiness, Registrars, shift work

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## **ABSTRACT**

### **Background:**

Insufficient quantity and quality of sleep among Internal Medicine Registrars is believed to be commonplace. This could influence patient and registrar safety, as well as the registrars personal lives, work performance and work satisfaction. No studies have been published looking at the problem of sleep among registrars at the University of the Witwatersrand.

### **Methods:**

A prospective observational study design was used. Internal Medicine Registrars on the WITS circuit were asked to complete a questionnaire including demographics, sleep behaviours, the Epworth Sleepiness Scale (ESS), the Fatigue Severity Scale as well as specific questions regarding function.

### **Results:**

Of the 100 registrars on the circuit 72 registrars completed the questionnaire. The mean (SD) age was 30.7 (2.45) years. The majority (80.6%) of registrars found it difficult to catch up on sleep. There was a negative correlation between sleep need and sleep obtained and the ESS score ( $p = 0.0057$ ). More than half (61.1%) of the registrars scored higher than 10 on the ESS, indicating pathological sleepiness. Registrars were aware of significant dysfunction in many areas of functioning due to sleepiness.

### **Conclusion:**

The majority of registrars in Internal medicine at Wits were excessively sleepy and felt compromised during the day due to the lack of sleep.

## **Introduction**

Lack of sustained sleep at night leads to symptoms of sleep deprivation (sensation of tiredness or sleepiness), which is usually expressed as excessive daytime sleepiness (EDS), poorer daytime performance and measurable effects on immune system. Memory and cognitive function are also impacted by sleep and if deprived of sleep people learn less well. Another function of sleep is restoration of general body tissue and efficient synaptic transmission in order to prepare the body and brain for the next day <sup>1,2</sup>.

A reduction in the amount slept below that of sleep need leads to sleep deprivation and excessive daytime sleepiness. Excessive daytime sleepiness is sleepiness in a situation when an individual would be expected to be awake and alert <sup>2</sup>. Factors that lead to EDS in the work situation are long work hours, altered schedules and on call periods to name but a few <sup>3,4</sup>. These factors are common in shift workers and in the medical profession particularly.

A specific group of medical professionals at high risk of disrupted sleep are registrars as they work both long and unconventional hours as well as having to study for exams. In the registrar context sleepiness can be caused by reduced sleep time, fragmented and disrupted sleep or by taking sedating drugs <sup>5</sup>. Sleepiness can also be caused by a misalignment of work time with the normal circadian rhythm <sup>4</sup>.

The effects of sleep loss and fatigue on registrars are divided into learning and cognition, job performance and personal life. Sleep loss and fatigue have an adverse effect on the motivation to learn and difficulty in the acquisition of cognitive and non-cognitive material <sup>6</sup>. Formal and informal learning opportunities are affected, such as learning from reading, tutorials, lectures and other structured learning activities.

Sleep loss and fatigue affects the personal life of registrars including personal wellbeing and relationships. It causes registrars to be inattentive and abrupt in their relationships with their spouse or significant other, children and extended family. Their personal wellbeing is affected in terms of their physical health, psychological health and mood, leisure time, driving ability and activities of daily living <sup>6</sup>. These changes may extend to a lack of empathy and errors when dealing with their patients.

International studies have highlighted the level of sleep loss experienced by registrars and other medical personnel. Registrars' daytime sleepiness was found to be near or below levels associated with some clinical sleep disorders <sup>7</sup>. In South Africa various articles have suggested that sleep deprivation was a feature of the intern program <sup>8</sup>. However, there are no published research data on sleep, sleepiness or mistakes made in the Internal medicine registrar group. Therefore the aim of this study was to evaluate the quality of sleep and daytime sleepiness in Internal Medicine Registrars at the Faculty of Health Sciences at the University of the Witwatersrand and how sleepiness affects patient and registrar safety.

## **Methods**

### **1. Study population**

The 100 Internal Medicine registrars in all four years of study on the University of the Witwatersrand (Wits) circuit were invited to participate in the study. The Wits circuit for Internal Medicine includes the following hospitals Chris Hani Baragwanath Academic Hospital, Helen Joseph Hospital and Charlotte Maxeke Johannesburg Academic Hospital. The research took place over the period of six months between June 2013 and January 2014.

Any registrar with a pre-existing sleep disorder was documented but excluded from the study as a confounder to the level of daytime sleepiness. Ethics approval was obtained from the Human Research Ethics committee of the University of the Witwatersrand (M130436).

## **2. Data collection**

A questionnaire was handed out at the Internal Medicine Academic meetings at the various hospitals. The questionnaire asked for details of demographics, the Epworth Sleepiness Scale <sup>9</sup>, the Fatigue Severity scale <sup>10</sup> and some specific questions related to how the registrars coped with the sleep patterns they worked. The questionnaire was returned by placing it in a box at the entrance of the Internal Medicine meeting venue or in a box situated at the Internal Medicine secretary's office. The boxes were collected after each meeting and emptied at the end of each week.

## **3. Statistical analysis**

Scores for the Epworth scale were added. Scores for the Fatigue Severity scale were added and then the average score was obtained by dividing by 9. Data was entered onto a Microsoft Excel spreadsheet for analysis. Numerical values are presented as means (SD). The unpaired t-test or the Mann-Whitney test were used to compare numerical data between groups as appropriate. The Fishers Exact test was used to compare categorical data between sleepy and non-sleepy registrars.

## **Results**

A total of 72 registrars completed the questionnaire between the three academic hospitals between June 2013 and January 2014.

### **Demographics**

The mean (SD) age of the participating registrars was 30.7(2.45) years. Most of the participants (65.3%) were female. The numbers of registrars in each year of study is indicated in figure 1.

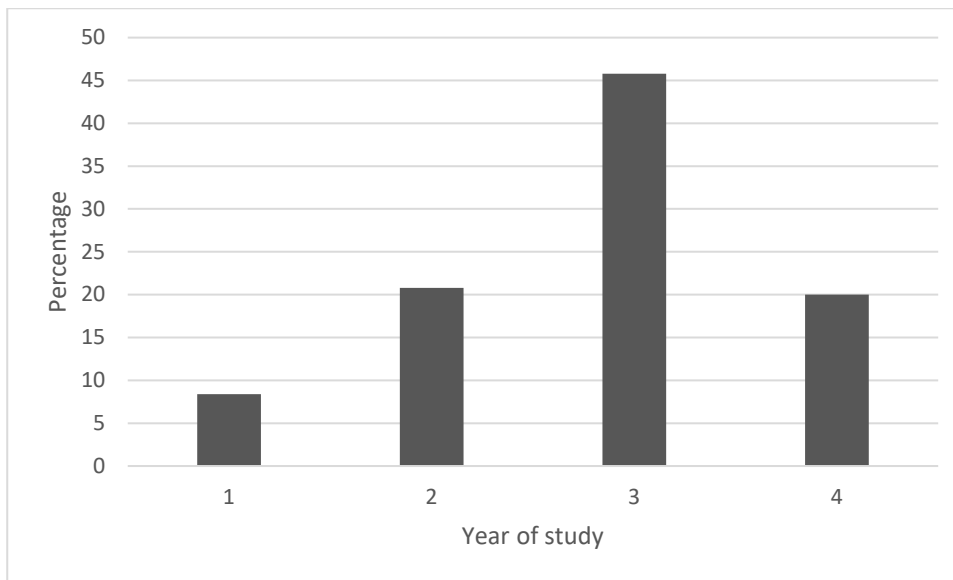


Figure 1. Distribution of registrars by year of training

63.9% of the registrars were in a general medicine rotation when completing the questionnaire

Most of the registrars (56,9%) were married with equal numbers in a relationship and single. Only 30.6% of the registrars had pets. Only 5.6% of the registrars reported having a sleep disorder.

### **Epworth sleepiness score and fatigue severity scale**

The mean score for the Epworth was 10.4 with 61.1% of registrars scoring higher than 10 on the Epworth sleepiness score, indicating pathological sleepiness. The mean (SD) score for the Fatigue Severity scale was 4.75 (0.95)

### **Questions 1 – 15: (Registrar specific supplementary questions)**

Eight questions focused on patient care and errors in the workplace and the results of these questions are indicated in figure 2.

In most (95.8%) of the registrars sleep loss and fatigue had an impact on their personal lives while only 69.4% of registrars felt that their families understood their demanding job and sleep needs.

Three questions focused on the issue of driving home whilst tired. The majority of registrars (86.1 %) were worried about having a car accident whilst driving home post call. Although 52.8 % couldn't tell that they were too tired to drive home 58.3 % stated that they have been too tired to drive home postcall.

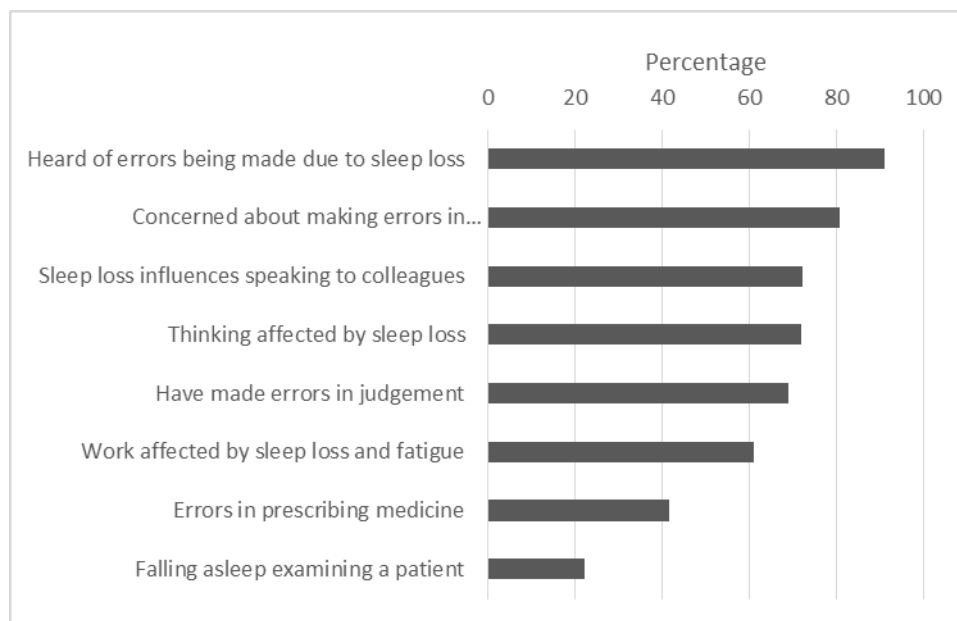


Figure 2. The daytime effects for registrars of sleep loss

One question focused on fatigue and writing exams - 98.6% of the registrars found that sleep loss and fatigue affected their studying for exams

### General questions

The mean (SD) amount of sleep per week per registrar was 41.5 (7.1) hours. The mean (SD) numbers of hours slept per night was 6.38 (1.3) hours. Only 12.5% registrars had 50% or less sleep between 10 pm and 6 am. The longest work shift experienced ranged from 8-36 hours with a mean (SD) of 20.3 (7.7) hours. A quarter of registrars felt they were currently in their worst rotation. Nearly half (44.4%) of the registrars found it easy to sleep outside the hours of 10 pm – 6 am but 80.6 % of registrars found it difficult to catch up on sleep. A minority (11.1%) of the registrars had used sleep



medication to help them sleep. Registrars were asked when they were writing final exams and the largest group (38%) wrote in 2014.

The difference between sleep need and sleep obtained per week ranged from -20 hours (in deficit) to 10 hours in surplus. There was a moderate, but significant, negative correlation ( $p= 0.0057$ ,  $r = -0.3229$ ) in the difference between sleep need and sleep obtained versus the score on the ESS.

The comparison between sleepy registrars and not sleepy registrars are indicated in Table 1.

Table 1. Characteristics of sleepy versus non-sleepy Internal Medicine registrars

<b>Variable</b>	<b>Sleepy (n=44)</b>	<b>Not sleepy (n=28)</b>	<b>P value</b>
Age (years) Mean(SD)	30.9 (2.4)	30.4 (2.6)	0.1583
Fatigue score mean (SD)	47.5 (6.9)	35.5 (5.3)	<0.0001
Sleep need – sleep obtained (median – range)	-2 (-25 to 7)	0.0 (-14 to 10)	0.0331*
Sleep need (hrs per week) median(range)	42 (28-63)	42 (35-63)	0.8257*
Children yes / no %	18.1/81.9	39.3/60.7	0.0589**
Pets yes / no %	34.1/65.9	25/75	0.4458**
Length of shift (hours) Mean(SD)	21.0 (8.4)	19.1 (6.3)	0.3001
Gender f/m %	81.8/18.2	39.3/60.7	0.0003
Easy / hard to catch up on sleep %	13.7/86.3	28.6/71.4	0.1375

All comparisons done using an Unpaired t-test except for \* by Mann-Whitney and \*\* by Fishers Exact test

The most significant findings here were that the sleepy registrars were more likely to be female, score higher on the fatigue scale and have a negative difference in sleep need versus sleep obtained (table

2). None of the other variables including sleep need, having pets or children contributed to the difference between sleepy and not sleepy registrars.

## **DISCUSSION**

The majority of registrars on the Internal Medicine circuit at Wits University are sleepy and fatigued. In many of their functional areas, they feel as though they are underperforming, this includes their professional and personal lives, i.e. driving and learning abilities. Pathologically sleepy registrars were more likely to be female, with a high fatigue score and have a high sleep debt but did not have an increased sleep need versus non sleepy registrars

There are very few articles on quality of sleep and excessive daytime sleepiness in Internal medicine registrars in Sub-Saharan Africa. To the best of our knowledge, our study is the first study focusing on the quality of sleep and daytime sleepiness of Internal medicine registrars in South Africa. High levels of sleepiness and fatigue have been shown before in studies outside South Africa <sup>3</sup>. As the working conditions are likely to be very different it is important to do studies in the South African context as well. The sleepiness scores on the ESS were similar to patients with obstructive sleep apnea <sup>9</sup> and the fatigue scores similar to those found in patients with multiple sclerosis and Systemic Lupus Erythematosus (SLE) – both of which have fatigue as a defining and debilitating characteristic <sup>10</sup>.

Our study showed that the majority of the registrars were female and that the female registrars were more likely to be sleepy. Generally the literature would confirm that sleep difficulties are more common in females for many various reasons. Our data are similar to a study conducted in Iran <sup>11</sup>. In their study females represented 55.8% of the sample and they found that sleep disturbances were greater in females. In contrast to what we have found some studies reported no difference between males and females in terms of their reported quota of sleep loss and fatigue <sup>6</sup>.

In our study 56.9% of the registrars were married and they felt that sleep loss and fatigue negatively influenced their relationships. This was similar to a study of resident physicians where 46% of participants were married and also found a negative impact on their relationship with their spouses <sup>6</sup>.

A small percentage of the registrars in our study were aware of the fact that they had a sleep disorder and our study did not identify what kind of sleep disorder they had. A study done in Iran found that insomnia and parasomnia were the most prevalent sleep disorders and the use of medication to assist sleep in our group may confirm insomnia <sup>7</sup>. This is an area that needs further research in the South African setting.

At least half of our sample couldn't tell that they were too tired to drive home yet in a contradicting statement over half stated that they had been too tired to drive home postcall. They were also worried about having a car accident whilst driving home post call. An increased risk of accidents and traffic citations in medical staff has been shown in a number of studies previously <sup>6, 12-14</sup>.

In our study the majority of registrars felt their work was affected by sleep loss and fatigue. This included things like making errors in writing scripts, medical errors and attitudes toward colleagues. This was also found in a number of other studies which found that registrars with sleep loss and fatigue had concerns about medical errors occurring post call, that it negatively impacted on their relationships with colleagues, that misdiagnoses were more often reported when fatigued and that "cutting corners" or taking the easy way out mostly happened secondary to sleep loss and fatigue <sup>6, 12, 15</sup>.

Modification of working schedules to lessen consecutive duty hours and redistribute workloads more evenly results in fewer medication errors <sup>16</sup>. Based on the many studies showing the deficits in medical personnel working long hours many countries have changed the working hours of interns

and registrars. New York state changed their registrar work hours to limit their work hours to 80 hours per week, they restricted their shifts to 24 hours and they required at least 10 hours between their shifts <sup>17</sup>. After the death of an intern in the Paarl in June 2016 there was a lot of media attention on the long working hours of doctors with the resulting sleep loss and fatigue and the effects on doctor safety and patient safety. The HPCSA was petitioned at this point to reduce working hours to no longer than 24 hours per shift and agreed that shifts would be limited to 26 hours.

The majority of registrars in our program found it difficult to study whilst fatigued and having sleep deprivation. A Brazilian study found that first year Brazilian internal medicine registrars have worse cognitive functioning after a night on call than after a night off which they believed should be taken into consideration when planning registrar training programs <sup>18</sup>.

The limitations of our study include the focus on registrars in Internal Medicine only as the pattern and intensity of night work may be different in different specialities. Also the study was limited to Gauteng department of Health conditions of service and these may change in different provinces of South Africa. Finally the ESS and FSS may not be the most appropriate measures to use when assessing sleepiness and fatigue in this group of people.

### **Conclusion and recommendations:**

Despite the limitations of this study, our findings add valuable information to the paucity of data that exists on the daytime sleepiness and quality of sleep, which are both significant, in Internal Medicine Registrars in South Africa. Changes to physician training should address both registrar fatigue and distress in an effort to improve registrar and patient safety. A starting point might be to look at well-designed interventions to decrease fatigue and sleepiness, including education on sleep and the dangers of sleepiness. These interventions need to target the identification, prevention and treatment of inadequate sleep in the registrars identified. Research of sleep problems in other sections of

medical professions in South Africa is strongly encouraged, for example, additional research to determine the most effective strategies to attain these goals.

**Lessons learned:** Internal medicine registrars at the University of the Witwatersrand are significantly sleepy and fatigued which affects their professional and personal life and ability to study for their exams.

### **Acknowledgements**

Thanks to the registrars for taking even more of their precious free time to answer the questionnaire

### **Disclosure statement**

The authors have no conflict of interest to declare

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## Appendix 1: Guidelines for authors for Journal: Occupational Health Southern Africa

[www.occhealth.co.za](http://www.occhealth.co.za)

(revised 13 November 2015)

Occupational Health Southern Africa is the official journal of the South African Society of Occupational Medicine (SASOM), the South African Society of Occupational Health Nursing Practitioners (SASOHN), the Southern African Institute of Occupational Hygiene (SAIOH) and the Mine Medical Professionals' Association (MMPA). It is accredited by the South African Department of Higher Education and listed on African Index Medicus. Appropriate articles of academic merit are accepted for publication, subject to the guidelines set out below.

The journal adheres to the guidelines of the following organisations: the International Committee for Medical Journal Editors (the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (<http://www.icmje.org/#author>), the Committee on Publication Ethics (COPE) (<http://publicationethics.org/>), and the South African National Health Research Ethics Council (<http://www.doh.gov.za/nhrec/>).

### **Review process**

All manuscripts (except correspondence) are sent for peer-review, unless they do not comply with the **Guidelines for authors**, or are not relevant for the journal. The review is blinded, meaning that neither the referees nor the authors are informed of each other's' identities. Authors are informed of the outcome of the review process by the Editor.

### **Ethics**

In accordance with stipulations of COPE (<http://publicationethics.org/>) and the South African National Health Research Ethics Council (<http://www.doh.gov.za/nhrec/>), **the journal requires evidence of ethical approval of all research studies involving human subjects or animals, by an accredited research ethics committee before an article can be published.**

### **Authorship, factual accuracy and copyright**

Authors are solely responsible for the factual accuracy of their work and must ensure that their work does not infringe copyright. Submission of the completed **Statement of acceptance of conditions and responsibilities pertaining to the publication of a manuscript** (available at <http://www.occhealth.org.za>) by all authors is required prior to the review of the manuscript. All and only the legitimate authors must be listed.

The journal subscribes to the criteria for authorship of research articles, developed by the International Committee of Medical Journal Editors (<http://www.icmje.org/#author>). In order to be acknowledged as an author, individuals must have satisfied the following three criteria:

1. Substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data;
2. drafting the article or revising it critically for important intellectual content; and
3. final approval of the version to be published.

"Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship."

### **Medical writer**

The use of a medical writer must be acknowledged. Both the corresponding author and the medical writer must provide a signed declaration agreeing to the inclusion of the medical writer's name in the acknowledgements section at the end of the paper.

### **Statement of acceptance**

Before the paper can be sent for review, all the authors are required to acknowledge and agree to the following conditions pertaining to ethical issues related to the publication of a paper (see the **Statement of acceptance of conditions and responsibilities pertaining to the publication of a manuscript**).

1. Authors are required to declare any potential conflict of interest. These can include financial or personal relationships in the form of dual commitments, competing interests or competing loyalties (<http://www.icmje.org/#author>).
2. Authors are advised that it is their responsibility to determine whether agreement is required from any parties for the use of material in their article, and to ensure that such permission is obtained, so that copyright is not infringed.
3. Authors are required to give the assurance that the content of the manuscript is their own work and, where it is not, that appropriate acknowledgement is given.
4. Authors are responsible for ensuring that statistical analyses contained within the manuscript have been checked for appropriateness and accuracy by a person with a sound knowledge of statistics.
5. Authors must inform the Editor of the existence of any other papers that they have submitted to, or had published by, other journals, or that are in the public domain, and that overlap with this manuscript. Copies of such papers must be supplied to the Editor.
6. The publishers, editors, SASOHN, SASOM, SAIOH and MMPA are not liable for any damages or loss incurred as a result of any statement contained in this publication. Whilst every effort is made to ensure accuracy of this publication, neither the publishers, editors, SASOHN, SASOM, SAIOH or MMPA accept any responsibility for the errors or omissions in the content and reserve the right to edit all contributions. The views expressed in this publication are not necessarily those of the publishers, editors, SASOHN, SASOM, SAIOH or MMPA, neither do these societies, publishers or editors endorse or guarantee the products advertised or claims made by the manufacturers.
7. Copyright assignment: Once a paper is accepted for publication, the exclusive copyright of the paper is assigned to the journal. Material from the paper may subsequently be used by the authors, provided that the wording is different.

### ***Requirements and format for submission of a manuscript***

In addition to complying with the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (<http://www.icmje.org/#author>), all articles should conform to the style requirements for publication in the journal, which are indicated hereafter.

### **General requirements**

- ☐ Scientific writing style, as well as good grammar, must be used.
- ☐ Content must be organised in a logical sequence.
- ☐ Articles must be relevant and scientifically significant.
- ☐ In the case of research and review articles, the methodology must be sound.

### **Style requirements**

- ☐ The manuscript must be written in MSWord format.
- ☐ Use arial, size 11 font and 1.5 line spacing.
- ☐ Margin widths should be 2.54 cm all around.
- ☐ Round percentages accurately to 1 decimal point.
- ☐ Include leading zeros, e.g.  $p < 0.05$ , not  $p < .05$ .
- ☐ Scientific measurements must be expressed in SI units.
- ☐ Abbreviations and acronyms should only be used if absolutely necessary and must be defined on first use, but preferably not in the abstract.
- ☐ Only proper names should have capital letters.
- ☐ Quotation marks should only be used for direct quotes.
- ☐ Footnotes must not be used.
- ☐ Pages should be numbered consecutively.

### **References**

- ☐ All statements should be appropriately referenced.



- ☐ References should be set out in the **Vancouver style** according to the International Committee of Medical Journal Editors: [http://www.nlm.nih.gov/bsd/uniform\\_requirements.html](http://www.nlm.nih.gov/bsd/uniform_requirements.html).
- ☐ References should be inserted in the text as superscript numbers and listed at the end of the article in numerical order (not alphabetically).
- ☐ Only approved **abbreviations** of journal titles should be used.
- ☐ References must be of good quality (use primary sources from peer reviewed journals wherever possible).
- ☐ Personal communication and unpublished observations may be cited in the text, but not in the reference list.
- ☐ The accuracy of references is the author's responsibility.

## Content

### Title page:

- ☐ This page should contain the title, the author(s)' full names, all the author(s)' position(s) in public sector departments and/or affiliations to academic institutions (if relevant), and the physical address and contact details (telephone number and e-mail address) of the corresponding author.
- Authors who are members of MMPA, SAIOH, SASOHN or SASOM must indicate this membership.***
- ☐ The title must reflect the contents of the manuscript, without being overly long.
  - ☐ A word count should be included on this page.

### Abstract page:

- ☐ Abstract: see article categories for detailed instructions.
- ☐ Provide a maximum of five keywords or terms that will be used for searches for electronic retrieval of information. They must be specific, and reflect what is essential about the paper. It is preferable to use keywords that do not appear in the title of the manuscript.

### Main body of paper:

- ☐ This should include Introduction, Methods, Results, Discussion, and Conclusions and recommendations sections.
- ☐ *Introduction*: see article categories for detailed instructions.
- ☐ *Methods*: see article categories for detailed instructions.
- ☐ *Results*: see article categories for detailed instructions.
- ☐ *Discussion*: see article categories for detailed instructions.
- ☐ *Conclusion and recommendations*: This section must be logical, reasonable and practical, supported with evidence. Do not start a new topic, present new information that is not in the discussion, or repeat the Introduction. Conclusions must relate to the findings, whilst recommendations should be logical and feasible. Areas for further study and implications for practice must be indicated in the recommendations.

### Acknowledgements and Declaration

- ☐ Acknowledgements should be indicated after the Conclusions and recommendations. All sources of funding must be declared and the role of the funding source must be described, where applicable (e.g. costs of specimen analysis, data analysis, manuscript submission, etc.).
- ☐ Declarations of conflict of interest and affiliation, and funding, should be indicated after the Conclusions and recommendations. Any affiliations to commercial organisations or conflicts of interest should be declared, in accordance with the policy on conflict of interest provided by the World Association of Medical Editors (<http://www.wame.org/about/conflict-of-interest-in-peer-reviewed-medical>).

### Lessons learned

- ☐ Lessons learned: A text box with a maximum of five points drawn from the study which practitioners can apply in their practice, must be provided.

### **Statistical analysis of results:**

- ☐ When comparing groups or samples, measures of the estimated magnitude of effect or association, such as rate ratios or differences in means, should be used;
- ☐ Comparisons of disease or injury frequency should use epidemiologic measures of association such as the rate ratio, odds ratio or risk difference;
- ☐ Where possible, provide confidence intervals and/or p values for measures of association.

### **Tables and figures**

Tables and figures should be understandable without having to consult the text. They should be numbered using Arabic numerals.

Tables: The caption should go above the table.

Figures: The caption should go below the figure.

### **Illustrations and photographs**

Photographs (without identifying details of patients, products or places) must be submitted as images of at least 300 dpi.

Photographs must include the name of the photographer to be credited in the published paper.

Illustrations should be submitted separate to text, in electronic format

All these accompanying materials should be clearly identified by means of captions that are also indicated in the text of the manuscript.

### **Supplementary materials**

Additional materials to accompany articles, which can be published online, must be clearly labelled as such. These materials must not be essential for understanding the paper; they are intended to complement the paper. These materials will be included with the manuscript for peer review.

### **Submission**

All pages of the manuscript must be submitted as a single document, in MS Word format, including figures and tables.

However, illustrations and photographs must be submitted as individual documents.

Submission must be made online at [www.occhealth.co.za](http://www.occhealth.co.za).

### **Article categories**

#### **Original research**

Articles reporting original, relevant research with sound methodology are welcomed. Studies with poor methodology, such as quantitative studies with small sample sizes, non-probability sampling designs, short intervention follow-up times and inadequate control, are likely to receive adverse peer reviews. Similarly, qualitative studies with poor methodology, such as incongruence between the research tradition and the data collection and analysis methods, inappropriate sampling strategy, and inadequate measures for trustworthiness, will also lead to poor reviews. Original research articles should not exceed 3 000 words (excluding the title, author's details, abstract, keywords, acknowledgments, declaration, references, tables and figures).

The following elements must be included:

#### *Title page*

#### *Abstract page*

- ☐ The abstract must be structured wherever possible (Background, Objectives, Methods, Results, Conclusion), and be less than 250 words. It should be a concise summary of the essential aspects of the article. As this may be published on its own, it should be understandable without the need to read the main text.

#### *Introduction*

- ☐ This should clearly indicate the main issues to be covered, the definition and delimitation of the research problem, the need for the study (i.e. the gap in knowledge), the importance of the study, and the purpose/aim and objectives/ hypotheses of the research. The cited literature (which may

be part of the introduction or a separate section) must be relevant, of good quality, critically discussed and correctly acknowledged.

### *Methods*

□ The date when the research was conducted must be provided. The research design and methodology employed must be clearly described and justified. The latter includes a description of the study site, the study population, sampling strategy (method, selection criteria and size), and data collection (type of data, type of tool and its development and testing, if relevant). In the case of intervention studies, the protocol or intervention must be clearly described. Results for randomised trials must be reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) available at <http://www.consort-statement.org/consort-statement/overview0/>. For quantitative studies, validity and reliability issues must be described and the statistical tests for analysis must be relevant and appropriately interpreted. For qualitative studies, the trustworthiness of the findings must be described and the analytical methods must be appropriate. A brief description of how ethical issues were addressed as well as evidence of ethical clearance by an accredited research ethics committee must be provided (the name of the organisation and an Ethics Clearance Number).

### *Results*

□ These must be accurate, comprehensive, unbiased and relate to the purpose and objectives/ hypotheses of the research. For quantitative studies, authors may be requested to obtain statistical assistance at their own cost if reviewers are concerned about the accuracy and appropriateness of the statistical analyses. For qualitative studies, quotes must be provided to support conclusions. Provide the results for all measures stated in the Methods section. Present detailed data in tables and figures. Report the results in the same order as the research questions/ objectives/ hypotheses and measures. Do not include discussion, explanation or references. Avoid reporting results that are not part of the study's research questions/ objectives/ hypotheses.

### *Discussion*

□ The findings should be discussed in the light of the literature, in relation to the purpose and objectives/ hypotheses, and should indicate how the paper has contributed to the body of knowledge. Compare the results with other studies. Acknowledge study limitations which might have influenced the results. Avoid repetition of the results, the introduction of new or irrelevant information, and discussion of results that are not part of the study's research questions/ objectives/ hypotheses.

### *Conclusions and recommendations*

#### *Lessons learned*

#### *Acknowledgements*

#### *Declaration*

#### *References*

## Appendix 2: Ethics approval certificate



R14/49 Dr Tanja Nell

### HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

#### CLEARANCE CERTIFICATE NO. M130436

NAME:  
(Principal Investigator)

Dr Tanja Nell

DEPARTMENT:

Department of Internal Medicine  
CM Johannesburg Academic Hospital

PROJECT TITLE:

A Rude Awakening-Quality of Sleep and  
Excessive Daytime Sleepiness in Internal  
Medicine Registrars

DATE CONSIDERED:

26/04/2013

DECISION:

Approved unconditionally

CONDITIONS:

SUPERVISOR:

Dr Alison Bentley

APPROVED BY:

  
Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 29/05/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

#### DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. I agree to submit a yearly progress report.

Principal Investigator Signature \_\_\_\_\_

Date \_\_\_\_\_

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES