# THE EFFECTS OF ON-CALL DUTIES ON COGNITIVE FUNCTIONS IN ANAESTHESIA RESIDENTS HUSM

*by*

**DR. AZILA BINTI AHMAD**

Dissertation Submitted In Partial Fulfilment Of The

Requirements For The Degree Of

Master Of Medicine

( Anaesthesiology )

UNIVERSITI SAINS MALAYSIA

NOVEMBER 2010

## ACKNOWLEDGEMENTS

**Bismillahirrahmanirrahim**

I would like to take this opportunity to extend my utmost appreciation and gratitude to the following persons who have helped me right from the beginning till the completion of my dissertation:

- A.P Dr Shamsul Kamalrujan Hassan, Head and Lecturer of Anaesthesiology and ICU, HUSM for his support.
- A.P Dr Wan Aasim Wan Adnan, Senior Lecturer of Anaesthesiology and ICU, HUSM for his initiation, pertinent guidance, on-going support and advice towards the progress of this study as supervisor.
- Dr Nikman Ahmad, Lecturer of Anaesthesiology and ICU, HUSM for his guidance and valuable comments as co-supervisor for this study.
- Dr Aisai Abdul Rahman, Head of Department Aneasthesiology and ICU, HSNZ as a supervisor out-campus for his support.
- All the lecturers of the Department of Anaesthesiology and ICU, HUSM for their helpful assistance.
- All medical officers of the Department of Anaesthesiology and ICU, HUSM who were involved and contributed as participants in this study.
- Yang Suan Ai, a staff of Brain Network, PPSK for guidance and helpful assistance in statistics.
- Last but not least, to my dearest husband Shamsuri Johari, my children; Muhammad Khairul Ikhwan and Aira Fitriya who inspired me with their endless support and love in ensuring the completion of this study.

# TABLE OF CONTENTS

## TABLE OF CONTENTS *( continued)*

## TABLE OF CONTENTS *( continued)*

## TABLE OF CONTENTS *( continued)*

## TABLE OF CONTENTS *( continued)*

# LIST OF TABLES

# LIST OF TABLES (*continued*)

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

| | |
|---|---|
| A.P | Associate Professor |
| ACGME | Accreditation Council for Graduate Medical Education |
| BS | Busy Score |
| CT | Concentration Test |
| GPs | General Practitioners |
| HSNZ | Hospital Sultanah Nur Zahirah |
| HUSM | Hospital Universiti Sains Malaysia |
| ICU | Intensive Care Unit |
| MMed | Master of Medicine |
| MMSE | Mini-mental State Examination |
| MO | Medical Officer |
| OT | Operation Theatre |
| PSY | Psychological Stress Score |
| RTT | Reaction Time Test |
| SCWT | Stroop Color-word Test |
| SD | Standard Deviation |
| SSS | Standford Sleepiness Scale |
| UK | United Kingdom |

# ABSTRAK

## KESAN BERTUGAS DI ATAS PANGGILAN KE ATAS FUNGSI KOGNITIF PARA DOKTOR ANESTHESIA DI HOSPITAL UNIVERSITI SAINS MALAYSIA

PENGENALAN

Fungsi kognitif doktor anaesthesia adalah sangat penting dalam menjalankan tugas-tugas harian dan terdapat pelbagai faktor yang mempengaruhi fungsi tersebut.

OBJEKTIF

Objektif utama kajian ini adalah untuk mengkaji kesan fungsi kognitif ke atas doktor anaesthesia yang bertugas atas panggilan dan membezakan di antara pelbagai faktor demografi serta ciri-ciri tugas atas panggilan dengan fungsi kognitif.

METODOLOGI

Kajian ini melibatkan semua doktor anaesthesia di Jabatan Anaesthesiologi, HUSM yang bertugas atas panggilan dan diberi kebenaran bertulis. Data yang dikumpul bermula selama dua bulan iaitu dari 1hb Januari 2010 sehingga 28hb Februari 2010.

Empat ujian kognitif digunakan di dalam kajian ini iaitu Mini Mental State Examination (MMSE), Stroop Color Word Test (SCWT), Concentration Test (CT) and Reaction Time

Test (RTT). Faktor-faktor lain yang mempengaruhi ketika bertugas atas panggilan seperti tahap mengantuk (Stanford Sleepiness scale), tahap kesibukan ( Busy scale) dan tahap stress (Psychological Stress score) juga direkodkan.

KEPUTUSAN

Sejumlah 45 orang responden yang telah terlibat di dalam kajian ini dan majoriti adalah doktor lelaki (62.6%), kaum Melayu (77.8%) dan telah berkahwin (77.8%). Kebanyakan daripada doktor anaesthesia (82.2%) adalah dlm pertengahan umur (30-39 tahun) dan sebahagian besarnya (66.7%) berpengalaman di dalam anaesthesia selama 5-10 tahun. Majoriti doktor anaesthesia yang bertugas atas panggilan adalah di ICU (46.7%) manakala majoriti yang bertugas atas panggilan adalah pegawai perubatan (75.6%). Ketika bertugas atas panggilan, 11.1% orang doktor anaesthesia tidak dapat tidur langsung dan sebahagian besar hanya dapat tidur selama kurang 4 jam (75.6%). Kebanyakan mereka (60.0%) memberi markah sederhana dalam SSS (3-4) dan PSY (4-6) manakala untuk BS, sejumlah 62.2% juga memberi markah sederhana (4-6). Tiada perbezaan yang signifikasi di antara tiga kumpulan skor (SSS, PSY dan BS) tersebut dengan data demografi dan cirri-ciri bertugas atas panggilan ($p>0.05$). Terdapat penurunan dalam keputusan ujian-ujian kognitif dan secara analisisnya, hanya dua ujian yang menunjukkan perbezaan yang signifikasi iaitu ujian SCWT ($p=0.011$) dan CT ($p=0.001$). Namun tiada perbezaan yang signifikasi ($p>0.05$) di antara penurunan fungsi kognitif dengan data demografi, ciri-ciri tugas atas panggilan dan tiga kumpulan skor (SSS, PSY and BS). Tiada juga kaitan yang signifikasi di antara tiga kumpulan skor tersebut dengan data demografi dan ciri-ciri tugas atas panggilan ($p>0.05$). Terdapat hubungkait di antara kumpulan SSS dengan PSY ($p=0.001$), SSS dengan BS ($p=0.011$) dan PSY dengan BS ($p=0.001$).

## KESIMPULAN

Kesimpulannya, fungsi kognitif doktor anaesthesia terutamanya dalam SCWT dan CT berubah secara signifikasi selepas bertugas di atas panggilan.

# ABSTRACT


## THE EFFECTS OF ON-CALL DUTIES ON COGNITIVE FUNCTIONS IN ANAESTHESIA RESIDENTS HUSM

INTRODUCTION

Cognitive functions play a vital role in safe anaesthetic practice and there are various factors that affect the cognitive functions.

OBJECTIVES

The aim of this study is to determine the effects on cognitive functions in anesthesia residents doing on-call duty in HUSM and to compare between demographic factors and on-call features with cognitive functions.

METHODOLOGY

This study includes all the anesthesia residents in the Department of Anaesthesiology, HUSM after written informed consent was obtained. The data was collected from 1$^{st}$ January until 28$^{th}$ February 2010. Four cognitive tests were used in this study which were Mini Mental State Examination (MMSE), Stroop Color Word Test (SCWT), Concentration Test (CT) and Reaction Time Test (RTT). Other associated factors affected by on-call such as Stanford Sleepiness Scale (SSS), Busy Score (BS) and psychological Stress Score (PSY) were also recorded.

## RESULTS

There was 45 respondents contributing in this study and majority were males (62.6%), Malays (77.8%) and married (77.8%). Most of the anaesthetist residents (82.2%) were in the middle age group (30-39 year-old) and they had working experiences in anaesthesia between 5-10 years (66.7%). The major type of on-call duty was ICU call (46.7%) and most of the on-call duties were as a medical officer (75.6%). There were 11.1% of the residents had no sleep at all during on-call and majority sleep less than 4 hours (75.6%). Most of the anaesthesia residents (60.0%) scored moderate in SSS (3-4) and PSY (4-6). Majority of them (62.2%) also scored BS as moderate (4-6). The relationship between the three groups score (SSS, PSY and BS) with various demographic data and on-call features were not significant (p>0.05). There were decreased in cognitive test post-call and was significantly difference in SCWT (p=0.011) and CT (p=0.001). However, there was no significant difference between various demographic data, on-call features and all three score groups (SSS, PSY and BS) with cognitive functions (p>0.05). There was a significant correlation between SSS with PSY group (p=0.001), SSS with BS group (p=0.011) and PSY with BS group (p=0.001).

## CONCLUSION

We conclude that the cognitive functions of anaesthesia residents particularly in SCWT and CT were significantly altered after on-call duties.

# CHAPTER 1: INTRODUCTION

Anaesthetists are qualified medical doctors who specialize in anaesthesia, intensive care medicine and pain management. Their major role is in providing anaesthesia during surgery, however they often deal with emergency situations by providing advanced life support, the ability to breathe and resuscitation to the heart and lungs. They are increasingly involved in other aspects of pain management, include working with people who are recovering from surgery, giving birth or suffering from conditions that cause long-term pain, such as cancer.

Cognitive functions play a vital role in safe anaesthetic practice. Cognition is an intellectual process by which one becomes aware of, perceives, or comprehends ideas. It involves all aspects of perception, thinking, reasoning and remembering. In neurology, any mental process that involves symbolic operations, e.g. perception, memory, creation of imagery and thinking; cognitive function encompasses awareness and capacity for judgment (McGraw-Hill Concise Dictionary of Modern Medicine, 2002). There were many tests that were used to measure or assess cognitive functions. The tests used in those studies include Trail making task, Digit symbol test, Letter comparison test and Standard progressive matrices.

Anesthetists generally work in long shifts and in many countries continue to work 'on call' and do night shifts. A nationwide survey among anaesthetists in 1997, found that 50% of trainees and 27% of specialists reported that their average work week exceeded what they felt they could work on an ongoing basis while maintaining patient safety

(Gander *et al.*, 2000). In addition, 63% of trainees and 40% of specialists indicated that their average work week exceeded what they felt they could work on an ongoing basis while maintaining their personal well-being. This is consistent with an in-depth U.S. study of anaesthesia residents, which indicated that they were chronically sleepy (Howard *et al.*, 2002). Among the New Zealand anaesthetists, 32% could recall a fatigue-related clinical error in the past six months (Gander *et al.*, 2008).

There were many studies that examined the association between long working hours and cognitive functions. The cognitive effects could be short-term and long term . For the long term effects, some prospective studies had showed that long working hours may be one of the risk factors that have a negative effect on cognitive performance in middle age, including dementia (Virtanen *et al.*, 2009). Morris *et al.*, (2001) had clearly established the link between cognitive impairment and later life dementia.

Anesthetists' stress during on-call may be caused by several reasons: sleep deprivation, excessive volume of work, requirement to work quickly, unpredictability of the nature of work, and lack of opportunity for consultation. A significant relationship was determined between night-long sleeplessness, reduction in attention and performance decrease in cognitive functions (Leproult *et al.*, 2003). It was concluded that acute sleep deprivation adversely affect cognitive functions. If healthy adults sleep less than a mean of 5 hours a night, their cognitive performances began to decrease. As a consequence of both short-term and long-term sleep disorders, expressing and problem solving abilities deteriorate. Learning skills may decrease to 50% in sleep disorders

(Veasey *et al.*, 2002). During on-call, both the burden of work and the need to sleep may lead to reduction in attention, disorders in judgment and delays in decision making.

Being on-call is the greatest reason for their perceived sleep deprivation and is significantly correlated with various, even severe, stress symptoms. These symptoms are associated with sick leave and may lead to severe and chronic sleep loss and sleep disorders. Anesthesia residents were reported to be sleepy like narcolepsy patients during day-time. It was emphasized that this condition did not improve after sleeping, sleeps were disturbed many times and there was reduction in deep sleeping (Howard *et al.*, 2002). A study done to 40 anesthesia residents in India had shown that there was a statistically significant decrease in the performance scores after sleep deprivation (Kannan, 1997).

A prospective study of 30 participants who were members of the obstetrics and gynecology house staff and medical students at Emory University School of Medicine was done in 2003. Two cognitive function tests ( the Grooved Pegboard and California Verbal Learning Test II ) were administered to the participants twice, before and after on-call duty. From the results, cognitive function test scores do decrease after on-call duty (Halbach *et al.*, 2003).

There was a statistically significant deterioration in speed of performance for detection and identification tasks at the end of night shift as the week progressed. Anaesthetic registrars demonstrate a significant decline in cognitive performance after a series of night shifts. In this study the cognitive performance was tested in participants before and after seven consecutive night shifts and compared this with performance before and after seven consecutive day shifts. Cognitive function was measured using a computerized assessment tool. The study was conducted by Griffiths et al., 2006 and published in Anaesthesia Intensive Care, 2006 Oct.

Thus, it is important to examine risk factors for poor cognition in anesthesia medical officers. However there is insufficient number of in-depth research on the various determinants that contribute to these potential effects of on-call duty on cognition among medical officers. There are several factors that may contribute to the impairment of cognitive function such as burden of works during on-call, psychological stress factors, long working hours and sleep disturbances. Also there were many different tests that were used for the assessment of cognitive functions that the conclusions derived from such studies were rather confusing and complicated. However such studies are important and may be necessary to bring about changes for example to suggest scheduling change in on-call duties.

The purpose of this study is to determine the changes in cognitive functions after on-call duty, especially the effects of the following factors: the amount of sleep that is obtained, the duration of on-call duty, the psychological stress score and the busy score during the on-call duty. Hopefully the result obtained from this study would be able to contribute to improve the overall cognitive status of residents doing on-call duties.

## 1.1 Objectives

### `1.1.1 *General Objectives:*

To determine the effects of on-call duties on cognitive functions in Anaesthesia residents HUSM.

### 1.1.2 *Specific objectives:*

i. To determine the effects of on-call duties on psychological stress, sleepiness and degree of business.
ii. To determine the effects of various demographic parameter and on-call features on post-call psychological stress, sleepiness and degree of business.
iii. To compare the changes of cognitive functions between pre and post on-call duties.
iv. To determine the effects of various demographic parameters and on-call features on cognitive functions changes between pre and post on-call duties.
v. To compare cognitive effects between three difference groups of SSS, BS and PSY.
vi. To determine the correlation between psychological stress, degree of sleepiness and business with post-call cognitive functions.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Cognitive Functions

### 2.1.1 *Definition*

Cognition is the scientific term for " the process of thought " . In a large systemic perspective, cognition is a faculty for the processing of information, applying knowledge and changing preferences. Cognition or cognitive processes can be natural or artificial, conscious or unconscious. These processes are analyzed from different perspectives within different contexts, notably in the fields of linguistics, anesthesia, neurology, psychology, philosophy, systemic and computer science. Cognition is an intellectual process by which one becomes aware of, perceives, or comprehends ideas. (Mosby's medical dictionary, 8$^{th}$ edition, 2009). It involves all aspects of perception, thinking, reasoning and remembering. In neurology, any mental process that involves symbolic operations, eg; perception, memory, creation of imagery and thinking; cognitive function encompasses awareness and capacity for judgment (McGraw-Hill Concise Dictionary of Modern Medicine, 2002).

### 2.1.2 *Cognitive Tests*

Cognitive tests are assessments of the cognitive capabilities of humans and animals. Tests administered to humans include various forms of IQ tests; those administered to animals include the mirror test (a test of visual self-awareness) and the T maze test (which tests learning ability). Normally, tests are designed to assess a single or only a few aspects of cognition. This means that multiple tests must be administered to get an overall ‘picture' or ‘map' of an individual's cognitive ability. Cognitive tests can be categorized according to the aspect or "domain" of thinking that they aim to assess. The three most commonly cited domains of cognition are attention, memory and executive function. The earliest cognitive tests were developed over 100 years ago, and some of these are still in use today. Throughout the 20th century "paper-and-pencil" cognitive tests were used commonly to measure intelligence, assist with the diagnosis of brain disorders such as Alzheimer's disease, and measure recovery from brain disease or injury. The first computerized cognitive tests were developed in the 1970s and 1980s. Computerized testing offers accurate recording of reaction times, electronic capture and processing of data (minimizing human error) and standardization of test administration (minimizing sources of response bias). Modern cognitive tests originated through the work of Sir Francis Galton who coined the term "mental tests". Consistent with views of the late nineteenth century, most of his measurements were physical and physiological, rather than "mental". For instance he measured strength of grip and height and weight. He established an "Anthropometric Laboratory" in the 1880's where patrons paid to have physical and physiological attributes measured to estimate their intelligence.

McGraw Hill dictionary Cambrige Cognition has produced the computerized neuropsychological tests (CANTAB® cognitive test) which are outstandingly sensitive and extensively validated, with a bibliography of over 600 peer-reviewed journal papers. CANTAB’s Core Cognition battery provides a very broad assay of cognitive functioning from the use of only three CANTAB tasks. The measures (Paired Associates Learning, Simple & Choice Reaction Time, and Spatial Working Memory) are ideally suited to gauging proof of concept cognitive effects in Phase I, early Phase II trials and beyond, providing platform-wide and cross-platform opportunities for CNS and non-CNS programmes.

In this study, four tests were delivered to the anaesthesia residents to assess the cognitive functions pre- and post-call :

a) *Mini-Mental State* (Appendix B)

The mini-mental state examination (MMSE) or Folstein test is a brief 30-point questionnaire test that is used to screen for cognitive impairment. It is commonly used in medicine to screen for dementia. It is also used to estimate the severity of cognitive impairment at a given point in time and to follow the course of cognitive changes in an individual over time, thus making it an effective way to document an individual's response to treatment. In the time span of about 10 minutes it samples various functions including arithmetic, memory and orientation. It was introduced by Folstein *et al.* in 1975. This test is not the same thing as a mental status examination. The standard MMSE form which is currently published by Psychological Assessment Resources is based on its original 1975 conceptualization, with minor subsequent modifications by the authors.

The MMSE test includes simple questions and problems in a number of areas: the time and place of the test, repeating lists of words, arithmetic such as the serial sevens, language use and comprehension, and basic motor skills. Although consistent application of identical questions increases the reliability of comparisons made using the scale, the test is sometimes customized (for example, for use on patients that are intubated, blind, or partially immobilized. Also, some have questioned the use of the test on the deaf. However, the number of points assigned per category is usually consistent. Any score greater than or equal to 25 points (out of 30) is effectively normal (intact). Below this, scores can indicate severe ($\leq 9$ points), moderate (10-20 points) or mild (21-24 points). The raw score may also need to be corrected for educational attainment and age. Low to very low scores correlate closely with the presence of dementia, although other mental disorders can also lead to abnormal findings on MMSE testing. The presence of purely physical problems can also interfere with interpretation if not properly noted; for example, a patient may be physically unable to hear or read instructions properly, or may have a motor deficit that affects writing and drawing skills. This test is used in this study because it is a standard to test for cognitive function, simple, easy to understand, quick assessment and practical.

*b) Stroop Word-Color Test* (Appendix C)

In psychology, the Stroop effect is a demonstration of the reaction time of a task. When the name of a color (e.g., "blue," "green," or "red") is printed in a color not denoted by the name (e.g., the word "red" printed in blue ink instead of red ink), naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color. The original paper has been one of the most cited papers in the history of experimental psychology, leading to more than 700 replications. The effect has been used to create a psychological test that is widely used in clinical practice and investigation.

The effect is named after John Ridley Stroop, who published the effect in English in 1935 in an article entitled Studies of interference in serial verbal reactions this includes three different experiments. However, the effect was first published in 1929 in German, and its roots can be followed back to works of James McKeen Cattell and Wilhelm Wundt in the nineteenth century. In his experiments, J. R. Stroop administered several variations of the same test for which three different kind of stimuli were created. In the first one, names of colors appeared in black ink. In the second, names of colors appeared in a different ink than the color named. Finally in the third one, there were squares of a given color.

The Stroop effect has been used to investigate the psychological capacities of a person since its discovery while during the twentieth century it also became a popular neuropsychological test. There are different test variants commonly used in clinical settings, with differences between them in the number of subtasks, type and number of stimulus, times for the task, or scoring procedures. Regarding the number of subtasks, all versions have at least two: there are written color names differing from the ink used and in the first trial the participant has to say the written word and the ink in the second. However, there can be up to four different subtasks adding in some cases stimulus consisting of groups of letters "X" or dots printed in a given color with the participant having to say the color of the ink, or names of colors printed in black ink that have to be read. The number of stimulus varies between less than twenty items to more than 150, being closely related to the scoring system used. While in some variants the score is the number of items from a subtask read in a given time, in others it is the time that it took to complete each of the trials. The number of errors and different derived punctuations are also taken into account in some versions.

This test is considered to measure selective attention, cognitive flexibility and processing speed, and it is used as a tool in the evaluation of executive functions. An increased interference effect is found in disorders such as brain damage, dementias and other neurodegenerative diseases, attention-deficit hyperactivity disorder, or a variety of mental disorders such as schizophrenia, addictions, and depression.

*c) Reaction Time Test* (Appendix D)

Reaction time (RT) is the elapsed time between the presentation of a sensory stimulus and the subsequent behavioral response. RT is often used in experimental psychology to measure the duration of mental operations, an area of research known as mental chronometry. In psychometric psychology it is considered to be an index of speed of processing. That is, it indicates how fast the thinker can execute the mental operations needed by the task at hand. In turn, speed of processing is considered an index of processing efficiency. The behavioral response is typically a button press but can also be an eye movement, a vocal response, or some other observable behavior.

RT is fastest when there is only one possible response (simple reaction time) and becomes slower as additional response options are added (choice reaction time). According to Hick's law, choice reaction time increases in proportion to the logarithm of the number of response alternatives. The law is usually expressed by the formula $RT = a + b\log_2(n + 1)$, where $a$ and $b$

are constants representing the intercept and slope of the function, and *n* is the number of alternatives. Reaction time is quickest for young adults and gradually slows down with age. It can be improved with practice, up to a point, and it declines under conditions of fatigue and distractions.

The Persian scientist, Abū Rayhān al-Bīrūnī was the first person to describe the concept of reaction time. Not only is every sensation attended this by a corresponding change localized in the sense-organ, which demands a certain time, but also, between the stimulation of the organ and consciousness of the perception an interval of time must elapse, corresponding to the transmission of stimulus for some distance along the nerves. The first scientist to measure reaction time in the laboratory was Franciscus Donders. Donders found that simple reaction time is shorter than recognition reaction time, and that choice reaction time is longer than both. Donders also devised a subtraction method to analyze the time it took for mental operations to take place. By subtracting simple reaction time from choice reaction time, for example, it is possible to calculate how much time is needed to make the connection. There are four basic means of measuring RT given different operational conditions during which a subject is to provide a desired response ;

i) S*imple* reaction time is the time required for an observer to respond to the presence of a stimulus. For example, a subject might be asked to press a button as soon as a light or sound appears. Mean RT for college-age individuals is about 160 milliseconds to detect an auditory stimulus, and approximately 190 milliseconds to detect visual stimulus.

ii) *Go/No-Go* reaction time tasks require that the subject press a button when one stimulus type appears and withhold a response when another stimulus type appears. For example, the subject may have to press the button when a green light appears and not respond when a blue light appears.

iii) *Choice* reaction time tasks require distinct responses for each possible class of stimulus. For example, the subject might be asked to press one button if a red light appears and a different button if a yellow light appears. The Jensen Box is an example of an instrument designed to measure choice reaction time.

iv) *Discrimination* reaction time involves around Natwain comparing pairs of simultaneously presented visual displays and then pressing one of two buttons according to which display appears brighter, longer, heavier, or greater in magnitude on some dimension of interest.

Researchers have reported medium-sized correlations between reaction time and measures of intelligence: There is thus a tendency for individuals with higher IQ to be faster on reaction time tests. Research into this link between mental speed and general intelligence (perhaps first stimulated by Charles Spearman, was re-popularised by Arthur Jensen, and the "CHoice reaction

Apparatus" associated with his name became a common standard tool in reaction time– IQ research.

The strength of the RT-IQ association is a subject of research. Several studies have reported association between simple reaction time and intelligence or around ($r$=−.31), with a tendency for larger associations between choice reaction time and intelligence ($r$=−.49). Much of the theoretical interest in reaction time was driven by Hick's Law, relating the slope of reaction time increases to the complexity of decision required (measured in units of uncertainty popularized by Claude Shannon as the basis of information theory). This promised to link intelligence directly to the resolution of information even in very basic information tasks. There is some support for a link between the slope of the reaction time curve and intelligence, as long as reaction time is tightly controlled.

As with fluid intelligence, RT increases in old age, and these increases are systematically associated with changes in many other cognitive processes, such as executive functions, working memory, and inferential processes. In the theory of Andreas Demetriou, one of the neo-Piagetian theories of cognitive development, change in speed of processing with age, as indicated by decreasing reaction time, is one of the pivotal factors of cognitive development.

*d) Concentration Test* (Appendix E)

This is a brief, yet very powerful, section. Its' purpose is to test and develop our concentration. Our ability to concentrate intently on a given task is a doorway to the state of “flow”. The very act of placing our attention on a single moment or an object, at the exclusion of everything else, is itself a heightened state of awareness. This isolation of attention magnifies the state we are in and intensifies it. Exactly what creates optimal performance states. The following process is designed to test and increase our focus. It is a great way to test ourselves as to how developed our attention is relative to other peak performers. On the following page we'll find a grid filled with numbers beginning with 00 and going to 99. What we do is begin crossing off the numbers in the grid starting at 00 and continuing in order until we are finished with crossing off number 99. The numbers are arranged randomly. Yet we have only one minute. Concentration is a mental game skill that is acquired with practice to improve our scores on this grid and definitely increased attention, focus and reduced mental distractions.

## 2.2 Types of On-call Duties

The implementation of on-call schedules varies. For many occupations, workers leave their place of employment and are placed "on-call" on evenings and weekends, which means they can be called back to work during these periods. For many professions this form of scheduling is a normal component of the occupation, for example, marine pilots can spend up to 60% of their working time on-call. However, for a limited number of occupations such as airline pilots, on-call hours are reduced with seniority. The on-call experience of these workers includes aspects of interruption, either of sleep or family or social life.

Other forms of on-call include work done by doctors during their medical practice in each departments of all hospitals. Medical residents spend periods of time "on-call" at a hospital, where space may be provided for them to sleep. This form of on-call work is distinct because workers remain at work to undertake their call duty. During these periods, anesthetist staff often put in more than 12 hours shifts with little to no sleep, resulting in a combination that is both a night shift and an overtime shift. Because of this group has received a fair amount of research attention, new working regulations have to be introduced in an attempt to deal with what is considered, by many, to be harsh and unacceptable working conditions.

In HUSM, on-call duty was started from 0900 am and all the on-call doctors must stay in hospital. There were variable of on-call duration ranging from 12 hours to 48 hours. The on-call duration during weekdays is between 12 to 16 hours and during weekend is 24 to 48 hours. They are divided into four types of on-call everyday which is in operation theatre, intensive care unit, third call and general on-call. Average on-call for every anesthetist staff is about four to five times monthly.

Anesthetist on-call in operation theatre have to run the emergency operation cases during the on-call time whereas anesthetist on-call in the ICU need to take care of patients in ICU and accept the referral cases from outside of the ICU. Third call was the anesthetist on-call for 12 hours and require to stay in operation theatre to help the anesthetist on-call in operation theatre. Registrar anesthetists do the general on-call because they have to cover all cases in operation theatre and in ICU including management for referral cases.

## 2.3 On-call Effects

Anaesthesiology is a specialty with a need for on-call duty and long working hours. On-call duty is often characterized by a need for sustained vigilance, excessive workloads and a feeling of insufficiency. These working patterns decrease the standard of care and increase health care expenses.

The potential impact of stress, sleep loss and fatigue, specifically among anesthesiologists, has received only sporadic attention. Sleep loss and disruption of circadian rhythm that result from arduous work schedules can lead to reduced anesthetists' safety, performance and health (Howard *et al.*, 2002). The cognitive demands of intra-operative patient care requires an iteration of data collection, evaluation of its relevance to patient status, development and implementation of plans to maintain the desired patient status and monitoring the outcome of interventions. These complex tasks require sustained attention or "vigilance" and are particularly vulnerable to the effects of fatigue. Beyond the effects on performance and patient safety associated with sleep deprivation, there is strong evidence linking shift work to gastrointestinal (Vener *et al.*, 1989) and cardiovascular diseases (Alfredsson *et al.*, 2002).

### 2.3.1 *Anesthetists' Safety risk.*

There have been several high-profile accidents where fatigue was identified as either causal or contributory. Fatigue-related accidents have been identified in every mode of transportation and can be found in many around-the-clock operational settings. Clearly, there are a variety of adverse outcomes such as economic costs, disrupted service, injuries and even fatalities that result from these accidents. In a pilot study (Murray & Dodds, 2003), they used a driving simulator to display the deterioration in vigilance in anesthetists on-call after a single night of disrupted sleep because many staff drive home after work.

Fatigue-related safety risk affects us at both individual and societal levels. A recent poll by the National Sleep Foundation indicated that one of two drivers reported having driven while drowsy in 2001 and one of five, acknowledged having “nodded off” while driving. Fatigue contributes to 100,000 crashes annually that result in 76,000 injuries and 1,550 fatalities, according to estimates by the National Highway Traffic safety Administration (Stutts *et al.*, 2003). An international group of scientists estimated that fatigue is causal in 15-20% of all transportation accidents, that official statistics underestimate the scope of the problem and that fatigue exceeds the combined contribution of alcohol and drugs in transportation accidents (Akerstedt & Ficca, 1997).

### 2.3.2 *Patient safety risk*

Several studies show that our performance becomes significantly impaired if we work through the whole night or if we obtain fragmented sleep due to being on-call. The documentation consists of studies on both residents and specialists of various specialities: anaesthesia residents carry out endotracheal intubation slower and with more errors, university hospital anaesthesiologists have six times more dural punctures when performing epidurals, surgical residents perform laparoscopic procedures slower and with more errors (Grantcharov *et al.*, 2001), and senior cardiologists have a higher failure rate and patient mortality when they dilate coronaries in acute myocardial infarction (Henriques *et al.*, 2002), when the procedures are carried out at night or immediately after a long period on-call.

The study that helped re-shape the policy of the American Accreditation Council for Graduate Medical Education (ACGME) found that intensive care unit residents made significantly more severe medical, medication and diagnostic errors if their working schedules entailed a maximum of 34 consecutive working hour instead of 16 (Landrigan *et al.*, 2004). The ACGME has subsequently decreased the maximum weekly working hours and the number of hours for each work shift for residents.

A recent meta-analysis showed that the clinical performance of residents was less than minus 1.5 standard deviations from normal, when they work 30 consecutive hours (Philibert, 2005). Normal Gaussian distribution curves clarify the result clearly: half the residents who worked excessive hours performed at a lower level normally extended only in 6% of the residents. The result also indicates that after an extended work period, half of all individuals' performance are as poor as normally only six percent of their performances would be. These and numerous similar studies give cause to ask why we, as physicians, accept this kind of poor performance produced by lack of rest. Our patients and hospitals, as well as ourselves, expect that physicians offer safe and effective care 24 hours a day, and so we should vigorously fight to avoid fatigue and to organize night work and night duties properly (Iglehart *et al.*, 2008).

A great deal of research has demonstrated that fatigue related to sleep loss may cause a variety of deficits, including lack of innovation and creativity, increased distractibility, an inability to deal with unexpected events or to deviate from previous problem-solving strategies, unreliable temporal memory, impaired language skills, and negative mood (Harrison & Horne, 1997, Bonnet, 2000, Harrison & Horne, 2000).

Furthermore, sleep deprivation impairs cognitive performance and hand-eye coordination (Dawson & Reid, 1997), altering at the same time the behavioral status of the individual toward depression, aggressiveness, anxiety, anger, and decreased vigilance (Ford & Wentz, 1984). Studies have also shown that 24 hour without sleep is equivalent to a blood alcohol level of 0.10% on a hand-eye coordination task (Dawson & Reid, 1997).

A recent randomized, controlled trial of interns working shifts of 24 continuous hour or longer documented more serious medical errors and more attentional failures (measured by polysomnography) when compared with those working shifts of 16 hour or less (Landrigan *et al.*, 2004, Lockley *et al.*, 2004). Subsequently, the same team conducted a national longitudinal web-based survey of almost 3,000 interns, who reported an approximately sevenfold higher incidence of fatigue related medical errors or preventable adverse events (and significantly more attentional failures) during months when they worked more than five extended duty shifts than during months with no extended duty shifts (Barger *et al.*, 2006).

## 2.4 On-call Duty And Stress

### 2.4.1 *Sources of on-call stress*

On-call stressors need to be identified before they can be dealt with. There are several elements contributing of stress. These include the challenges of defining an emergency, dealing with patients whose conditions are outside our area of expertise and our comfort zone, allocating on-call duties among the physicians in a group practice and coping with reimbursement issues.

Every surgeon and every specialty has a different definition of “emergency,” so competition over the operating theatre schedule is often fierce. Conflicts over whose emergency takes priority regularly occur. To further complicate matters, although a group may have assigned one doctor to cover emergencies, patients may insist on seeing “their” doctor. Even overscheduled colleagues may insist on seeing “their” patients. Because “call” is an add-on episode, it can create anxiety, fear and irritability. When subspecialists are on call, their stress levels increase as they anticipate having to deal with skills and decision-making in areas where they are no longer competent or comfortable. Orthopaedists who are part of a large practice with several subspecialists may have less recent fluency in general orthopaedics. Anticipatory anxiety (often unacknowledged), as well as stress during call and afterwards, amplifies this situation.

Medical physicians also have varying levels of competency in different areas of appropriately referring for anaesthetists expertise. Anaesthetists may be concerned about the medical physician's use, referral and "inappropriate" (aggressive or perceived incompetent) practice in boundary areas of anaesthetists and medical physicians. Medical physicians differ in their propensity to call for help, as well as their ability to "hold the fort" until that help arrives. Attending to emergencies not only exposes the anaesthetists to the risks of transmissible diseases, but also increases the risk and stress of medical liability litigation on two fronts. Having no prior relationship with these emergency cases immediately places the anaesthetists at higher risk for litigation and possible slips. Post-call emotional exhaustion is commonly reflected as irritability with staff, family and colleagues. Inadequate sleep, increased fatigue, inadequate pay, and unavailability of resources all increase a surgeon's aversion to on-call duty.

Most of the studies pertaining to on-call and stress all focus on the General Practitioners (GPs) as their subject. In these studies, the relationship between on-call work and stress was measured through self-report and perceived stress. Three of the studies were part of a major UK study carried out from 1989 to 1998.

In the first two studies, GPs ranked working on-call at night as one of the top two most stressful aspects of their work situation (Cooper *et al.*, 1989, Sutherland & Cooper, 1992). However results from the third study in 1998 revealed that night call was no longer a major source of stress, dropping to 12th in a ranking of 14 major stressors. They believed this reduction in the