Junior doctors’ extended work hours and the effects on their performance: the Irish case

FIONA FLINN 1,† AND CLAIRE ARMSTRONG 2, †

1Department of Personnel and Employment Relations, Kemmy Business School, University of Limerick, Castletroy, Limerick, Ireland, and 2Graduate Entry Medical School, University of Limerick, Castletroy, Limerick, Ireland

Address reprint requests to: Claire Armstrong, Graduate Entry Medical School, University of Limerick, Castletroy, Limerick, Ireland.
Tel: +353-61-202679; Fax: +353-61-234251; E-mail: claire.armstrong@ul.ie

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Abstract

Objective. To explore the relationship between junior doctors’ long working hours and their performance in a variety of cognitive and clinical decision-making tests. Also, to consider the implications of performance decrements in such tests for healthcare quality.

Design. A within-subject design was used to eliminate variation related to individual differences. Each participant was tested twice, once post call and once rested. At each session, participants were tested on cognitive functioning and clinical decision-making.

Setting. The study was based on six acute Irish hospitals during 2008.

Participants. Thirty junior hospital doctors, ages ranged from 23 to 30 years; of them, 17 of the participants were female and 13 were male.

Measures. Cognitive functioning was measured by the MindStreams Global Assessment Battery (NeuroTrax Corp., NY, USA). This is a set of computerized tests, designed for use in medical settings, that assesses performance in memory, executive function, visual spatial perception, verbal function, attention, information processing speed and motor skills. Clinical decision-making was tested using Key Features Problems. Each Key Features Problem consists of a case scenario and then three to four questions about this scenario. In an effort to make it more realistic, the speed with which participants completed the three problems was also recorded.

Results. Participants’ global cognitive scores, attention, information processing speed and motor skills were significantly worse post call than when rested. They also took longer to complete clinical decision-making questions in the post-call condition and obtained lower scores than when rested.

Conclusions. There are significant negative changes in doctors’ cognitive functioning and clinical decision-making performance that appear to be attributable to long working hours. This therefore raises the important question of whether working long hours decreases healthcare quality and compromises patient safety.

Keywords: health policy, health care system, medical errors, patient safety, human factors, hospital care, setting of care, workforce and workload, human resources

Introduction

Worldwide, the hours worked by doctors are causing grave concern. Specifically, in hospitals, these long hours are often worked in a demanding, stressful environment in which there is a necessity to make critical decisions within a limited time frame. In such an environment, it is unsurprising that mistakes occur. Indeed, medical errors are by no means rare; for instance, it is estimated that 44 000–98 000 patients die in US hospitals each year as a result of medical errors, numbers far in excess of deaths due to motor vehicle accidents, breast cancer and AIDS [1].

Medical errors have led to many calls for reduced working hours for doctors. In Europe, the European Working Time
Directive (EWTD) was introduced in 2004, according to which, by August 2009, junior doctors should have been working an average maximum of 48 h a week. Though it is now illegal, many doctors still work longer hours. One work practice that appears to be in direct violation of the EWTD and contributes substantially to doctors’ long working hours and sleep deprivation is that of working ‘on-call’ shifts. In Ireland, such shifts involve working through the night, having already worked all day. Junior doctors must then continue working through the next day. All junior doctors work on-call shifts but the frequency varies with hospital and specialty and ranges from once to six times per month. Such a shift involves working for ~30 consecutive hours, with little or no sleep. In Ireland, in 2007, it was reported that most junior doctors worked in excess of the weekly limit; for example, interns worked, on average, 65 h per week. If the legal requirement for junior doctors to take frequent compensatory rest breaks were included, <5% of interns were complying with the EWTD’s 56 h limit introduced in 2007 [2].

Night shifts longer than 12 h and daytime shifts longer than 16 h are consistently found to be associated with increased accidents [3]. The cognitive psychomotor impairment after 24 h of sustained wakefulness is equivalent to a blood alcohol concentration of 0.1% [4]. It has been empirically demonstrated that long working hours for doctors have a negative impact on patient health. To illustrate, a US study of junior doctors found that 45% of respondents reported medical errors, 41% of which were attributed to fatigue. Disturbingly, 31% reported that the mistake resulted in the death of the patient [5]. A UK study that involved reading ECG printouts reported that significantly more arrhythmic episodes were missed in the sleep-deprived state [6]. Another UK study found that surgeons who had been awake all night made 20% more mistakes and took 14% longer to complete tasks than those who had a full night’s sleep [7].

A limitation with previous research in this area is that many studies do not include medically related tests, and those that do, tend not to include tests of cognitive functioning. By using both in this study, a more comprehensive and inclusive assessment of the effects of lack of sleep on doctors’ performance can be gained. Thus, this research aims to objectively measure junior doctors’ performance, specifically cognitive functioning and clinical decision-making, once when rested and once immediately after working an on-call shift. Any changes in performance in these areas from the ‘rested’ condition to the ‘post-call’ condition are, therefore, reasonably attributable to working an on-call shift, allowing us to investigate the effect working extended hours has on doctors’ performance and subsequently surmise the potential effects on patient safety.

Methods

Research design

This quantitative study used a within-subject design so that variation in terms of individual differences was eliminated (e.g. differences in cognitive abilities). All participants were tested twice: once rested and once post call. Twelve of the participants completed testing in the order of rested and then post call; 18 completed testing in the opposite order. At each session, participants were tested on cognitive functioning and clinical decision-making. At the post-call testing session, participants also recorded how many hours they had worked on that shift, total number of hours slept and longest period of consecutive sleep they had while on-call.

Sample

Thirty junior doctors from six Irish hospitals were surveyed during the summer of 2008. The mean age of the group was 26.1 and ranged from 23 to 30 years. Seventeen of the participants were female, while 13 were male. Participants were selected on the basis of being a junior doctor and available to participate in both stages of testing. The sample size estimation calculations were carried out for two important variables: global cognitive score and clinical decision-making score. The levels of power associated with these variables for a sample size of 30 using a paired t-test with a 0.05 two-sided significance level are 84 and 93%, respectively.

MindStreams Global Assessment Battery. Participants’ cognitive functioning was measured by the MindStreams® Global Assessment Battery, developed and provided by NeuroTrax Corp. (Fresh Meadows, NY, USA). The Global Assessment Battery is a set of computerized tests that assesses performance in memory, executive function, visual spatial perception, verbal function, attention, information processing speed and motor skills. This battery has established reliability and validity, and the psychometric properties of the tests exploit the advantages of computerized testing, providing precise accuracy, and reaction time measurements [8–12]. The Global Assessment Battery assesses mild impairment in cognitive functioning and contains 10 different tests (see Appendix 1 for test descriptions).

Key Features Problems. Clinical decision-making was tested using Key Features Problems (KFPs). KFPs [13, 14] test clinical decision-making skills. They are based on the concept of critical steps in decision-making and provide a flexible approach to testing clinical decision-making skills with demonstrated validity and reliability. Each problem consists of a case scenario and three to four questions about this scenario. The KFP format allows more than one correct answer, which often mirrors real-life practice. Participants were provided with three different problems at each time of testing. To make it more realistic, the speed with which participants completed the three problems was recorded. Participants were instructed to answer the questions as quickly as possible, but appropriately and adequately (see Appendix 2 for example).

Statistical analysis strategy

At the end of data collection, each participant had ‘rested’ and ‘post-call’ scores for the following variables: global cognitive score, memory, executive function, visual spatial perception, verbal function, attention, information processing speed, motor skills, clinical decision-making and time taken.
to complete clinical decision-making. Total number of hours worked, total number of hours slept and longest period of consecutive sleep were also recorded for each participant. As appropriate, the Wilcoxon signed-rank test and paired sample t-test were used to test for significant differences across conditions. To examine the relationship between cognitive functioning and clinical decision-making, ordinary least-squares regression was used.

Results

The average number of consecutive hours worked was 32.75, with a maximum of 39 h. The average number of hours slept during this period was 2.6 h, and the average length of the longest period of consecutive sleep during the on-call shift was 2.09 h. Total number of hours slept and longest period of consecutive sleep ranged from 0 to 4 h.

Significant differences across the conditions ‘rested’ and ‘post-call’ were found for global cognitive score, information processing speed, attention and motor skills, such that all were lower post call than rested (Fig. 1). Also, participants scored significantly lower on and took significantly longer to complete clinical decision-making questions post call than when rested. See Tables 1 and 2 for descriptive statistics and results.

Global cognitive scores were, on average, 3.9% (3.94 points) lower post call than in the rested condition. The average change in attention scores from rested to post call was 5.03 (254.1 to 9.3), with a statistical difference of 2.921**. Information processing speed decreased by 7.63 (227.4 to 11.2), with a statistical difference of 4.3***. Motor skills decreased by 5.67 (223.7 to 43.8), with a statistical difference of 3.918***.

Table 1 Descriptive and difference statistics for cognitive functioning variables (n = 30)

<table>
<thead>
<tr>
<th></th>
<th>Rested score</th>
<th>Post-call score</th>
<th>Change score across conditions, mean change (range)</th>
<th>Statistical difference across conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global cognitive score</td>
<td>102.2 99.65, 104.71</td>
<td>98.2 95.243, 100.997</td>
<td>-3.94 (-22.3 to 21.5)</td>
<td>-2.865**</td>
</tr>
<tr>
<td>Memory</td>
<td>98.1 96.54, 102.67</td>
<td>96.4 91.477, 101.283</td>
<td>-1.67 (-28.3 to 18.9)</td>
<td>-0.829</td>
</tr>
<tr>
<td>Executive function</td>
<td>103.0 99.28, 106.76</td>
<td>100.3 95.425, 105.262</td>
<td>-2.67 (-44.7 to 16.9)</td>
<td>-0.792</td>
</tr>
<tr>
<td>Visual spatial perception</td>
<td>102.3 96.09, 108.57</td>
<td>102.5 95.842, 109.072</td>
<td>0.13 (-53.7 to 43.8)</td>
<td>-0.168</td>
</tr>
<tr>
<td>Verbal function</td>
<td>98.5 93.57, 105.55</td>
<td>93.3 87.771, 98.883</td>
<td>-5.29 (-37.4 to 71.2)</td>
<td>-1.728</td>
</tr>
<tr>
<td>Attention</td>
<td>104.0 100.99, 107.05</td>
<td>98.9 94.017, 103.87</td>
<td>-5.03 (-54.1 to 9.3)</td>
<td>-2.921**</td>
</tr>
<tr>
<td>Information processing speed</td>
<td>106.1 102.19, 110.09</td>
<td>98.5 94.151, 102.876</td>
<td>-7.63 (-27.4 to 11.2)</td>
<td>4.3***</td>
</tr>
<tr>
<td>Motor skills</td>
<td>103.7 93.38, 107.91</td>
<td>98.0 94.576, 101.378</td>
<td>-5.67 (-23 to 6.6)</td>
<td>3.918***</td>
</tr>
</tbody>
</table>

**P < 0.01; ***P < 0.001.

Table 2 Descriptive and difference statistics for clinical decision-making scores and times (n = 30)

<table>
<thead>
<tr>
<th></th>
<th>Rested score</th>
<th>Post-call score</th>
<th>Change score across conditions, mean change (range)</th>
<th>Statistical difference across conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical decision-making score</td>
<td>49.6 45.38, 53.84</td>
<td>42.1 37.90, 46.29</td>
<td>-7.52 (-42.0 to 18.2)</td>
<td>2.805**</td>
</tr>
<tr>
<td>Clinical decision-making time</td>
<td>13.9 12.08, 15.76</td>
<td>15.3 13.33, 17.28</td>
<td>1.39 (-5.95 to 9.8)</td>
<td>-2.228*</td>
</tr>
</tbody>
</table>

*P < 0.05; **P < 0.01.
was −5.03, indicating an average decrease of 4.8%. Information processing speed showed the greatest average change from rested to post call (−7.63 points), representing a reduction in information processing speed of 7.2%. Scores in motor skills showed an average change of −5.67 from the rested to the post-call state, indicating a 5.5% decrease. Clinical decision-making scores were, on average, 15.2% (7.52 points) lower post call than when rested, while time taken to complete clinical decision-making problems was greater by 10% (1.39 points) post call than when rested (Fig. 2).

Scores in memory, executive function and verbal fluency were also found to be lower when tested post call; however, these differences were not statistically significant. Visual spatial skills were found to be marginally higher post call than when rested, but again this difference was not statistically significant.

Significant differences were therefore found in global cognitive scores, attention, information processing speed, motor skills and clinical decision-making scores across the two conditions. It is reasonable to surmise that these changes may be, at least, partially attributable to lack of sleep. It was further investigated whether changes in cognitive functioning scores would predict changes in clinical decision-making scores. When regressed on change in clinical decision-making scores, it was found that only one variable, i.e. change in information processing speed, consistently and significantly predicted the change in clinical decision-making scores (Table 3). This occurred while controlling for the effects of the individual’s baseline (rested) scores in both information processing speed and clinical decision-making. This positive effect means that as speed of information processing decreases, so does the quality of clinical decision-making. Interestingly, this analysis also demonstrated that the higher a person’s rested KFP score, the greater the negative change between their rested and post-call scores.

**Discussion**

Anyone would be at risk of having impaired cognitive functioning after working such long hours, with little sleep, in a stressful and mentally challenging environment. However, given the industry that such a work practice is occurring in, where doctors are responsible for the health and lives of others, the potential effect of working such hours should not be underestimated. In this study, attention, information processing and motor skills were the cognitive modalities found to be most affected by lack of sleep. While it is beyond the confines of this paper to examine these cognitive functions in depth, they will be very briefly examined in relation to their importance in doctors’ performance and patient safety.

To put it simply, attention is the cognitive process of selectively concentrating on one aspect of the environment while ignoring others [15]. Thus, a doctor who is working an on-call shift and whose attentional resources are decreasing may find it increasingly difficult to focus and hence may miss critical information.

A motor skill is a skill that requires an organism to utilize their skeletal muscles effectively in a goal-directed manner. If fatigued doctors’ motor skills are slower and less accurate, as was found in the present study, this potentially has important implications for not only surgical procedures, where fine motor skills are required, but also the more mundane, everyday tasks all junior doctors engage in that require gross motor skills, such as administering intravenous medications.

Information processing is a broad aspect of our cognitive functioning that has an impact on almost everything we do. It can be seen as the root of many other cognitive functions as it entails our ability to absorb and interpret information. Thus, if the information is absorbed or interpreted erroneously, there are consequences when we use this information. Impaired information processing may be significantly detrimental to doctors’ performance, for instance, misinterpreted information could lead to misdiagnoses.

Following on from this, an important strength of this study was the use of a test of both cognitive functioning and clinical decision-making. This allowed us to investigate not only how lack of sleep might impair doctors’ cognitive functioning, but also how this lowered cognitive functioning may impact doctors’ work. Thus, this provides valuable insights into how lack of sleep affects doctors’ performance on a practical level, rather than how working long hours and lack of sleep affects their scores on computerized tests. Not only were doctors’ scores on clinical decision-making problems found to decrease from rested to post call, but impaired cognitive functioning, specifically in attention, information processing speed and executive function, was also found to predict these lowered scores.

Impaired information processing means weary doctors do not absorb and remember information as quickly as when rested. It may, therefore, take them longer to carry out tasks.
Indeed, as was found in this study, tired doctors took significantly longer to complete clinical problems and were significantly less accurate in their answers, which may be related to their decreased ability to absorb and interpret new information. The results from this study indicate that information processing speed may be a particularly important cognitive modality that impacts doctors’ work and is affected by lack of sleep, as it was the variable with the strongest positive association with clinical decision-making scores.

This study therefore adds to the literature, first, by showing that doctors’ performance decreased not only in tests of cognitive functioning, but also in tests more specifically related to their actual work (i.e. tests of clinical decision-making) and, second, by showing how impaired cognitive functioning predicted decreases in clinical decision-making scores, thus providing evidence of a relationship between cognitive performance and medical errors in clinical decision-making. Furthermore, existence of such a relationship provides a first step in validating the use of cognitive assessments when trying to determine the impact of long working hours and lack of sleep on doctors’ performance and, subsequently, patient safety.

Other areas of cognitive functioning, specifically, memory, verbal function and executive function, although not statistically significant, also showed decreased performance, which is in line with much sleep deprivation research. Decreased performance in these cognitive areas could also have a negative impact on doctors’ work. For example, impaired memory functioning, specifically here working memory, means that tired doctors may not be able to consolidate new information, thereby the information will be lost and learning will not have taken place. According to Spurgeon and Harrington [16], the fact that doctors’ ability to retain new information is impaired when they are sleep deprived may counter one of the main justifications for doctors working hours, i.e. the wide experience thus gained.

Executive function serves as the ‘cognitive control’, a crucial component of a wide range of higher-order cognitive processes such as selective attention, error monitoring and decision-making. Sleep deprivation reduces cerebral metabolism within the pre-frontal cortex, the brain region most responsible for higher-order cognitive processes [17]. Lack of sleep, therefore, has a negative impact on doctors’ executive function, which has subsequent adverse effects on a range of higher-order cognitive processes that are important for their performance and patient safety.

The findings from this study would, therefore, indicate that the practice of working on-call shifts, as done in Ireland (and many other countries), whereby an average of 32.75 consecutive hours were worked with an average of 2.6 h sleep, has negative effects on cognitive functioning and clinical decision-making which may have subsequent negative consequences for patient care.

There are a number of methodological limitations to this study that must be considered. First, the sample size (n = 30) was small. This limits the generalizability of the findings. However, despite the small sample size, many significant results were found, and it is plausible that the overall trends found here would continue with a larger sample. Also each of the participants acted as their own control therefore eliminating the effects of variation caused by individual differences in cognitive abilities or clinical decision-making abilities. This was important as it ensured that differences found could reasonably be attributed to working long hours consecutively with little or no sleep.

For pragmatic reasons, it was not possible to strictly protect against practice effects. Twelve of the participants completed testing for the first time when rested, and 18 completed testing for the first time post call. Thus, a potential methodological limitation is that the order of conditions was not systematically counterbalanced across participants. However, the battery of cognitive tests contains practice or example sessions before each actual test, thus reducing the potential effect of test practice.

Another methodological consideration concerns the ‘rested condition’. It was originally planned that for this condition, participants would be tested immediately before they began an on-call shift. However, it was not possible to do this for all participants as testing took ≏1 h to complete and when junior doctors are on-call, they often have to begin working earlier than usual. Thus, many of them would have had to commence testing at about 5:00 a.m. Participants were reluctant to do this as they would be working through the following night. Furthermore, completing cognitive tests and clinical decision-making problems at an hour when one is usually asleep would arguably not yield an accurate reflection of the participants’ ability. Taking these issues into consideration, if a participant could not do the testing immediately before they started their on-call shift, it was arranged for another time when the participant would be rested. This was done on the basis that once a normal, rested standard for each participant was recorded, any decrease in performance due to an on-call shift could still be observed.

A final, possible methodological limitation was the test of clinical decision-making, the KFP. As described, these problems have demonstrated reliability and validity [14]. However, when typically used, more problems would be presented in the examination than the number used here (three at each time of testing). For instance, when used in the Royal Australian General Practitioner Medical Examination, 17 questions are given in total. It would not have been possible to give participants that many questions as testing already took ≏1 h. However, by only using three problems at each time of testing, their reliability may have been reduced.

**Conclusion**

This study has shown that working long hours consecutively and the accompanying lack of sleep has significant negative effects on junior doctors’ cognitive functioning and clinical decision-making. It is, therefore, a matter of critical importance that steps are taken to reduce the hours that junior doctors work consecutively when on-call, for the health and safety of both doctors and patients. Indeed, it is perhaps more important than ever as Ireland struggles to align itself with current regulations regarding working hours for junior doctors.
Acknowledgements

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Appendix 1—Selected test descriptions

Descriptions of only three MindStreams mild impairment tests are included due to space limitations.
For all test descriptions, see http://portal.mindstreamshealth.com/docs/TestDescriptions.pdf

Verbal memory

Cognitive domains: memory

The Verbal Memory test measures immediate and delayed recognition memory for verbal-paired associates. Participants are presented with 10 pairs of words to study followed by a recognition test in which they are presented with one member of a previously presented pair together with four possible alternatives for the other member of the pair. Responses are made using the keyboard number pad to indicate which pair was previously presented. Up to four consecutive study/test repetitions follow immediately, and an additional recognition test is administered following two other Mindstreams tests for a delay period of \( \approx 10 \) min. Outcome parameters include accuracy for each of the four immediate recognition tests, total accuracy across these repetitions and accuracy for the delayed recognition test. Slope of learning across repetitions may also be computed.

Go–NoGo response inhibition

Cognitive domains: executive function, attention

The Go–NoGo test is a test of response time and response inhibition. Participants are presented with a series of large colored squares at variable delays. Each square may be one of four colors. Participants are instructed to respond as quickly as possible by pressing a mouse button if the square is any color but red. Outcome parameters include accuracy, response time and its associated variance, a composite score computed as accuracy divided by response time.

Staged information processing speed

Cognitive domains: attention, information processing

The Staged Information Processing Speed test measures information processing at increasing levels of complexity. The test comprises three levels of information processing load: single-digits, two-digit arithmetic problems (e.g. \( 5-1 \)) and three-digit arithmetic problems (e.g. \( 3+2-1 \)). For each of these three levels, stimuli are presented at three different rates, incrementally increasing as testing continues. Participants are presented with a series of digits or arithmetic problems (as per the level) and are instructed to respond as quickly as possible by pressing the left mouse button if the digit or result is \( \leq 4 \) and the right mouse button if it is \( >4 \). Outcome parameters for each rate increment for each level include accuracy, response time and its associated variance, and a composite score computed as accuracy divided by response time.

Appendix 2—Key Features Problems examples

Case 2

Frances Hegarty, aged 42, complains of a right frontal headache for 4 weeks since having a severe episode of influenza. The headache comes on around 10 a.m. each morning and lasts for \( \approx 2 \) h. Frances’s headache is aggravated by leaning forward.

Question 1: What are the most likely differential diagnoses that you would now consider? List in note form only, up to three (3) diagnoses.

1. 
2. 
3. 

Question 2: What specific features would you look for on physical examination? List in note form only, up to four (4) features.

1. 
2. 
3. 
4. 

You manage Frances’s headache with your chosen therapy. Two weeks later, she returns and reports worsening headaches. Frances is now waking overnight with pain and is having difficulty achieving adequate analgesia.

Question 3: What further diagnoses would you now consider? List, in note form only, up to three (3) diagnoses.

1. 
2. 
3. 

Case 11

Colin Briggs, aged 55, has had diabetes for the last five years. He has managed to lose some weight and has increased his exercise. Colin’s home blood glucose readings are ranging
between 6 and 12 mmol/L (fasting). His current medications are as follows:

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metformin (Diabex/Diaformin)</td>
<td>850 mg two tablets twice daily</td>
</tr>
<tr>
<td>Glicazide (Diamicron MR)</td>
<td>30 mg two tablets twice daily</td>
</tr>
<tr>
<td>Rosiglitazone (Avandia)</td>
<td>8 mg twice daily</td>
</tr>
<tr>
<td>Perindopril (Coversyl)</td>
<td>5 mg twice daily</td>
</tr>
<tr>
<td>Aspirin</td>
<td>100 mg daily</td>
</tr>
<tr>
<td>Slimvastatin (Zocor/Lipex)</td>
<td>40 mg daily</td>
</tr>
</tbody>
</table>

His pathology results are produced below:

<table>
<thead>
<tr>
<th>Date</th>
<th>HbA1c (%)</th>
<th>Total cholesterol (mmol/L)</th>
<th>LDL cholesterol (mmol/L)</th>
<th>HDL cholesterol (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 06</td>
<td>9</td>
<td>6.5</td>
<td>5.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Nov 06</td>
<td>9.5</td>
<td>5.7</td>
<td>5.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Feb 07</td>
<td>9.2</td>
<td>5.4</td>
<td>4.5</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Question 1: What aspects of management would you now focus on to improve his glycemic control? List, in note form only, up to five (5) aspects.
1. 
2. 
3. 
4. 
5. 

Question 2: What aspects of physical examination will you focus on when reviewing Colin? List, in note form only, up to seven (7) aspects.
1. 
2. 
3. 
4. 
5. 
6. 
7. 

Question 3: You decide to write a care plan for Colin. List, in note form only, your specific management goals/targets. List, in note form only, up to eight goals.
1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 

Case 16

Katherine Holt, a 37-year-old woman, presents with a 3-week history of swollen, painful hands. Her symptoms are worse in the morning and she reports that her fingers feel ‘stiff’ for about an hour after waking. Katherine is having difficulty managing her housework.

Question 1: What diagnoses would you now consider? List, in note form only, up to four (4) diagnoses.
1. 
2. 
3. 
4. 

Question 2: What investigations would be most likely to assist you in making a diagnosis? List, in note form only, up to four (4) investigations.
1. 
2. 
3. 
4. 

Question 3: What initial management steps would you now advise? List, in note form only, up to four steps.
1. 
2. 
3. 
4. 

References

9. Ritsner MS, Blumenkrantz H, Dubinsky T et al. The detection of neurocognitive decline in schizophrenia using the


