To survive or to thrive: An investigation into fatigue and associated factors on surgical performance

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Volume Two

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Appendices

Appendix A – Systematic review search strategy

Key Concepts	Sleep Deprivation	Technical Skill	Surgeons	Simulation
Free Text Terms	Sleep Loss	Procedural skill	Doctor	Computer simulation
	Nonrapid eye movement	Proced*	Specialist	Computerised models
	NREM	Technical proficiency	Consultant	Educational measurement
	Rapid eye movement	Technique	Registrar	
	REM	Technical competence	Senior House Office (SHO)	
	Paradoxical sleep	Competenc*	Clinician	
	Desynchronised sleep	Technical expertise	Medical Practitioner	
	Nightshift	Dexterity	Attending Physician	
	On-call	Clinical Competence	Attending Resident	
	Post-call	Motor skills	Attending Surgeon	
	Fatigue*	Psychomotor performance		
		Performanc*		
		Visual Motor Performance		
		Perceptual Motor Performance		
		Sensory Motor Performance		
		Laparoscop*		
Controlled Vocabulary	>Sleep deprivation	>Clinical Competence	>Surgeons	>Simulation Training
	>Fatigue	>Motor Skills	>Physicians	>Computer Simulation
	>Sleep disorders, Circadian Rhythm	>Psychomotor Performance	>Consultants	>Patient Simulation
	>Sleep	>Professional Competence	>Medical Staff,Hospital	> Virtual Reality
	>Sleep Wake Disorders	> Task Performance and Analysis	>Internship and Residency	> High Fidelity Simulation Training
		> Laparoscopy	>General Surgery	>Simulation Training

Medline Search Strategy:

1.	Sleep loss.mp.
2	nonrapid eye movement.mp.
3	NREM.mp.
4	rapid eye movement.mp.
5	paradoxical sleep.mp.
6	nightshift.mp.
7	fatigue*.mp.
8	Sleep Deprivation/
9	FATIGUE/
10	sleep disorders, circadian rhythm.mp. or Sleep Disorders, Circadian Rhythm/
11	sleep deprivation.mp. or Sleep Deprivation/
12	FATIGUE/ or fatigue.mp.
13	SLEEP/ or sleep.mp.
14	sleep wake disorders.mp. or Sleep Wake Disorders/
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14
16	technical skill.mp.
17	procedural skill.mp.
18	technical proficiency.mp.
19	technique.mp.
20	competenc*.mp.
21	technical expertise.mp.
22	dexterity.mp.

23	clinical competence.mp. or Clinical Competence/
24	motor skill.mp. or Motor Skills/
25	psychomotor performance.mp. or Psychomotor Performance/
26	perform*.mp.
27	visual motor performance.mp.
28	perceptual motor performance.mp.
29	sensory motor performance.mp.
30	laparoscop*.mp.
31	professional competence.mp. or Professional Competence/
32	task performance.mp. or "Task Performance and Analysis"/
33	HAND-ASSISTED LAPAROSCOPY/ or LAPAROSCOPY/ or laparoscopy.mp.
34	16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	surgeon.mp. or SURGEONS/
36	doctor.mp.
37	specialist.mp. or Specialization/
38	consultant.mp. or Consultants/
39	registrar.mp.
40	senior house office.mp.
41	clinician.mp.
42	medical practitioner.mp.
43	attending practitioner.mp.
44	attending physician.mp.
45	attending resident.mp.
46	attending surgeon.mp.
47	physician.mp. or Physicians/
48	medical staff.mp. or Medical Staff/
49	intern*.mp.
50	residen*.mp.
51	"Internship and Residency"/
52	GENERAL SURGERY/
53	Specialization/
54	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53
55	simulation.mp.
56	computer simulation.mp. or Computer Simulation/
57	educational measurement.mp. or Educational Measurement/
58	computerised model.mp.
59	simulation training.mp. or Simulation Training/
60	patient simulation.mp. or Patient Simulation/
61	virtual reality.mp. or Virtual Reality/
62	high fidelity simulation.mp.
63	55 or 56 or 57 or 58 or 59 or 60 or 61 or 62
64	15 and 34 and 54 and 63

Embase Search Strategy:

#1	'sleep loss'
#2	'non rapid eye movement'
#3	'rem sleep'
#4	nrem
#5	rem
#6	paradoxic* AND sleep
#7	desynchronised AND sleep
#8	'night shift'
#9	'on call'
#10	'post call'
#11	fatigue*
#12	'fatigue'
#13	'circadian rhythm'
#14	'circadian rhythm sleep disorder'
#15	'sleep'
#16	'sleep disorder'
#17	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17
#18	'technical skill'
#19	'training'
#20	'technical training'
#21	proced*
#22	'procedures'
#23	'proficiency testing'

#24	'technical proficiency'
#25	'technique'
#26	'competence'
#27	'competency'
#28	'technical competenc*'
#29	'technical expertise'
#30	dexterity
#31	'clinical competence'
#32	'motor performance'
#33	'motor skill'
#34	'psychomotor performance'
#35	'psychomotor activity'
#36	'visual motor integration'
#37	'sensorimotor function'
#38	'sensorimotor integration'
#39	laparoscop*
#40	'laparoscopy'
#41	'laparoscopic surgery'
#42	'professional competence'
#43	'medical practitioner'
#44	'task performance'
#45	'laparoscope'
#46	#19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45
#47	'surgeon'
#48	'physician'
#49	'medical specialist'
#50	'registrar'
#51	'senior house office*'
#52	'clinician'
#53	'medical practitioner'
#54	'attending physician'
#55	'attending resident’
#56	'attending surgeon'
#57	'consultation'
#58	'medical staff'
#59	'medical education'
#60	'internship'
#61	'residency'
#62	'residency education'
#63	'general surgery'
#64	'general surgeon'
#65	#47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53 OR #54 OR #55 OR #56 OR #57 OR #58 OR #59 OR #60 OR #61 OR #62 OR #63 OR #64
#66	'simulation'
#67	'simulation training'
#68	'simulation based training'
#69	'simulation based medical education'
#70	'simulation based education'
#71	'laparoscopic simulator'
#72	'simulator'
#73	'computer simulation'
#74	'educational measurement'
#75	'education'
#76	'global rating scale'
#77	'checklist'
#78	'patient simulation'
#79	'patient simulator'
#80	'virtual reality'
#81	'virtual reality simulator'
#82	'high fidelity simulation training'
#83	'high fidelity simulation’
#84	#66 OR #67 OR #68 OR #69 OR #70 OR #71 OR #72 OR #73 OR #74 OR #75 OR #76 OR #77 OR #78 OR #79 OR #80 OR #81 OR #82 OR #83
#85	#18 AND #46 AND #65 AND #84

Ovid Search Strategy

1	sleep loss.mp.
2	nonrapid eye movement.mp.
3	NREM.mp.
4	rapid eye movement.mp.
5	paradoxical sleep.mp.
6	nightshift.mp.
7	fatigue*.mp.
8	Sleep Deprivation/
9	FATIGUE/
10	sleep disorders, circadian rhythm.mp. or Sleep Disorders, Circadian Rhythm/
11	sleep deprivation.mp. or Sleep Deprivation/
12	FATIGUE/ or fatigue.mp.
13	SLEEP/ or sleep.mp.
14	sleep wake disorders.mp. or Sleep Wake Disorders/
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14
16	technical skill.mp.
17	procedural skill.mp.
18	technical proficiency.mp.
19	technique.mp.
20	competenc*.mp.
21	technical expertise.mp.
22	dexterity.mp.
23	clinical competence.mp. or Clinical Competence/
24	motor skill.mp. or Motor Skills/
25	psychomotor performance.mp. or Psychomotor Performance/
26	perform*.mp.
27	visual motor performance.mp.
28	perceptual motor performance.mp.
29	sensory motor performance.mp.
30	laparoscop*.mp.
31	professional competence.mp. or Professional Competence/
32	task performance.mp. or "Task Performance and Analysis"/
33	HAND-ASSISTED LAPAROSCOPY/ or LAPAROSCOPY/ or laparoscopy.mp.
34	16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35	surgeon.mp. or SURGEONS/
36	doctor.mp.
37	specialist.mp. or Specialization/
38	consultant.mp. or Consultants/
39	registrar.mp.
40	senior house office.mp.
41	clinician.mp.
42	medical practitioner.mp.
43	attending practitioner.mp.
44	attending physician.mp.
45	attending resident.mp.
46	attending surgeon.mp.
47	physician.mp. or Physicians/
48	medical staff.mp. or Medical Staff/
49	intern*.mp.
50	residen*.mp.
51	"Internship and Residency"/
52	GENERAL SURGERY/
53	Specialization/
54	35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53
55	simulation.mp.
56	computer simulation.mp. or Computer Simulation/
57	educational measurement.mp. or Educational Measurement/
58	computerised model.mp.
59	simulation training.mp. or Simulation Training/
60	patient simulation.mp. or Patient Simulation/
61	virtual reality.mp. or Virtual Reality/
62	high fidelity simulation.mp.
63	55 or 56 or 57 or 58 or 59 or 60 or 61 or 62
64	15 And 34 and 54 and 63

EBSCO Search Strategy

1	'sleep deprivation'/exp OR 'sleep deprivation'
2	'sleep loss'
3	'non rapid eye movement'
4	'rem sleep'
5	nrem
6	rem
7	paradoxic* AND sleep
8	desynchronised AND sleep
9	'night shift'
10	'on call'
11	'post call'
12	fatigue*
13	'fatigue'
14	'circadian rhythm'
15	'circadian rhythm sleep disorder'
16	'sleep'
17	'sleep disorder'
18	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17
19	'technical skill'
20	'training'
21	'technical training'
22	proced*
23	'procedures'
24	'proficiency testing'
25	'technical proficiency'
26	'technique'
27	'competence'
28	'competency'
29	'technical competenc*'
30	'technical expertise'
31	dexterity
32	'clinical competence'
33	'motor performance'
34	'motor skill'
35	'psychomotor performance'
36	'psychomotor activity'
37	'visual motor integration'
38	'sensorimotor function'
39	'sensorimotor function'
40	'laparoscopy'
41	'laparoscopic surgery'
42	'professional competence'
43	'task performance'
44	S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S42 OR S43
45	'surgeon'
46	'physician'
47	'medical specialist'
48	'registrar'
49	'senior house office*'
50	'clinician'
51	'medical practitioner'
52	'attending physician'
53	'attending resident'
54	'attending surgeon'
55	'consultant'
56	'medical staff'
57	'internship'
58	'residency'
59	'general surgery'
60	S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55 OR S56 OR S57 OR S58 OR S59
61	'simulation'

62	'simulation training'
63	'simulation based medical education'
64	'laparoscopic simulator'
65	'simulator'
66	'computer simulation'
67	'educational measurement'
68	'global rating scale'
69	'checklist'
70	'direct observation procedural skill'
71	'DOPS'
72	'patient simulation'
73	'virtual reality'
74	'high fidelity simulation training'
75	S61 OR S62 OR S63 OR S64 OR S65 OR S66 OR S67 OR S68 OR S69 OR S70 OR S71 OR S72 OR S73 OR S74
76	S18 AND S44 AND S60 AND S75

Cochrane Search Strategy

1	'sleep deprivation'/exp OR 'sleep deprivation'
2	'sleep loss'
3	'non rapid eye movement'
4	'rem sleep'
5	nrem
6	rem
7	paradoxic* AND sleep
8	desynchronised AND sleep
9	'night shift'
10	'on call'
11	'post call'
12	fatigue*
13	'fatigue'
14	'circadian rhythm'
15	'circadian rhythm sleep disorder'
16	'sleep'
17	'sleep disorder'
18	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17
19	'technical skill'
20	'training'
21	'technical training'
22	proced*
23	'procedures'
24	'proficiency testing'
25	'technical proficiency'
26	'technique'
27	'competence'
28	'competency'
29	'technical competenc*'
30	'technical expertise'
31	dexterity
32	'clinical competence'
33	'motor performance'
34	'motor skill'
35	'psychomotor performance'
36	'psychomotor activity'
37	'visual motor integration'
38	'sensorimotor function'
39	'sensorimotor function'
40	'laparoscopy'
41	'laparoscopic surgery'
42	'professional competence'
43	'task performance'
44	S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S42 OR S43

45	'surgeon'
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52	'attending physician'
53	'attending resident'
54	'attending surgeon'
55	'consultant'
56	'medical staff'
57	'internship'
58	'residency'
59	'general surgery'
60	S45 OR S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55 OR S56 OR S57 OR S58 OR S59
61	'simulation'
62	'simulation training'
63	'simulation based medical education'
64	'laparoscopic simulator'
65	'simulator'
66	'computer simulation'
67	'educational measurement'
68	'global rating scale'
69	'checklist'
70	'direct observation procedural skill'
71	'DOPS'
72	'patient simulation'
73	'virtual reality'
74	'high fidelity simulation training'
75	S61 OR S62 OR S63 OR S64 OR S65 OR S66 OR S67 OR S68 OR S69 OR S70 OR S71 OR S72 OR S73 OR S74
76	S18 AND S44 AND S60 AND S75

Appendix B – BEME adapted guide coding sheet

Review Sheet for Each Study

1. Inclusion Criteria

Article in English	
Assesses a technical skill	
Includes sleep deprived surgeons	
Includes a validated simulated assessment tool	

2. Administrative

Study Number:

Reviewer:

Type of Study:

Book	
Comment	
Conference Paper/Proceeding	
Editorial	
Guidelines	
Interview	
Journal Article	
Lecture	
Letter	
News	
Non-peer review article	
Report	
Thesis	

Authors:

Title of Study:

Publication:

Volume, Issue, Pages:

Search Method:

Electronic Search	
Hand Search	
Recommendation	

3. Evaluation Methods

a. Research Design:

Non Comparative Studies:	
Audit	
Action Based	
Case Series	
Expert Opinion	
Narrative	
Observation	
Survey	

Comparative Studies	
Cross Sectional	
Case Control	
Single Group (before and after)	
Single Group (time series)	
Cohort Study (retrospective)	

Cohort Study (prospective	
Trial (randomised)	
Trial (non randomised)	

Meta-Analysis	

b. Data collection methods

Interview	
Patient Outcomes	
Observation	
Questionnaire	
Opinion	
Simulated Assessment	
Other:	

4. Expected outcomes of intervention/approaches

Clinical Skills	
Practical Procedures	
Patient Investigation	
Patient Management	
Health Promotion	
Communication	
Appropriate information skills	
Appropriate attitudes	
Appropriate decision making	
Patient safety/Reducing Errors	

Please indicate the specific skills assessed:

5. Context (Target Population)

Number of participants	
Number of control subjects (if any)	
Country/Location of study	

Duration of Study	
Number of times assessed	
When during the day did assessment take place (if given)?	
When during the study period did assessment take place (if given)?	
How long was the simulation (if given)	
Is the learned curve controlled for (if so, how?)	

Level of Participants	
UG	
Intern	
Residency	
Fellowship	

Profession	
Specialty	

6. Stated Aim of Study:

Aims:

Objectives:

Definition of sleep deprivation (if given):

Outcome measure to assess sleep deprivation (if given):

Is REM/NREM distinguishable in the sleep study (if so, how?):

Is acute and chronic sleep deprivation distinguished in the sleep study (if so, how?):

Is level of training distinguished between participants (if so, how and does it have an impact?):

7. Rate Evaluation Methods

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
Appropriateness of study design					
Implementation of study design					
Appropriateness of data analysis					

Comment on overall evaluation methods:

8. Overall Main Findings from Study

1.
2.
3.
4.

9. Strength of Findings

	Low (1)	(2)	(3)	(4)	(5) High
No clear conclusion drawn, not significant					
Results ambiguous but there appears to be a trend					
Conclusions can probably be based off results					
Results are clear and likely to be true					
Results are unequivocal					

10. Specific Features of Simulation

Name of simulator	
Manufacturer	
What does the simulator do?	
Is it validated (Inc. study to prove validity)	

How is performance assessed?	
Via simulator pre-setting's (please describe)	
Via DOPS (please describe)	

11. Documented improvement/deterioration in performance

Skills in psychomotor skill	
Skills in management decision skill	
Skills in other domains of professional practice (please describe)	

12. Overall Impression of article including strengths and weaknesses / Is Sleep Deprivation influencing technical skill?

Is sleep deprivation influencing technical skill?	
Yes	No

Appendix C – Effect sizes of each study in systematic review

Y (-)	Negative impact
N	No impact
Y (+)	Positive impact
Y/N	Both

Study Name	Time to Complete	Economy of Motion	Number of Errors	Overall Percentage
1.Aggarwal (2011)	Y (-) Manipulate Diathermy: 35 vs 41 seconds Stretch Diathermy: 41 vs 41 seconds % difference - 17% increase in time overall	Y (-) Manipulate Diathermy: 2.95 vs 3.25m Stretch Diathermy: 4.10 vs 4.20m % difference - 5.8% increase in path length overall	Y (-) Manipulate Diathermy: 59 vs 66 Stretch Diathermy: 4 vs 5 % difference - 11% increase in error overall	11.3% decrease in overall performance
2.Tsafrir (2015)	Y (-) BLS 5: 84.8 vs 89.2 % difference - 5.75% increase in time overall	N BLS 5(%): 51.8 vs 48.4 % difference - 3.4% decrease in economy of movement	Y (-) BLS 8: 95% vs 92% % different - 3% decrease in accuracy rate	4.1% decrease in overall performance
3.Uchal (2005)	N	N	N	0% change in overall performance
4.Robison (2018)	N	N	N	0% change in overall performance
5.Olasky (2014)	N	N	N	4.1% decrease in overall performance
6.Micko (2017)	N 10.1 vs 10.4 % difference - 3.0% increase in time overall	Y (+) Dominant Hand: 144 vs 145 sec Non-Dominant Hand: 108 vs 87sec % difference - 7.9% decrease in excessive force	N	5.4% increase in overall performance
7.Naughton (2011)	unknown	unknown	unknown	1 day increase required to reach plateau
8.Lehmann (2016)	N	N	N	0% change in overall performance
9.Eastridge (2003)	Y (-) 10 vs 11 % difference - 10% increase in time overall	Y (-) Right Hand: 17 vs 15 Left Hand: 16 vs 15 % difference - 10% decrease in economy of motion	Y (-) 5 vs 6 % difference - 20% more errors	13.3% decrease in overall performance
10.Sugden (2012)	N	N	N	0% change in overall performance
11.Taffinder (1998)	Y (-) 14% longer to complete task	Y (-) operative dexterity not provided	Y (-) 20% more	17.5% decrease in overall performance
12.Amirian (2014)	N	N	N	0% change in overall performance
13.Williams (2013)	N	N	N	0% change in overall performance
14.Schlosser (2012)	Y (+) Overall: 855.11 sec vs 708.66 sec % difference - 24.9% decrease in time overall	Y (+) Overall: 20.52m vs 15.49m % difference - 32.4% increase in economy of motion	N/A unknown	28.65% increase in overall performance
15.Ganju (2012)	N	N	N	0% change in overall performance
16.Hegar (2010)	Y/N	Y/N	Y/N	This study found all increases but none to significance
17.Erie (2011)	N	N	N	0% change in overall performance
18. Leff (2008)	Y (-) 290.5seconds vs 311.75 seconds	Y (+) 3.4 vs 3.5 % difference - 3 % increase in economy of motion	Y (-) 189.2 vs 387	52.6% decrease in overall performance

	% difference - 7.3% increase in time overall		% difference - 104% increase in error overall	
19. Kahol (2008)	Y (+) 17.8 vs 15.5 % difference - 18.4 decrease in overall time	Y (-) 0.2 v 0.15 % difference - 33% decrease in economy of motion	Y (-) 0.4 vs 0.55 % difference - 37.5% increase in errors	16.84% decrease in overall performance
20. DeMaria (2005)	N	Y (-)	N	Information not supplied
21.Jakubowicz (2005)	N	N	N	0% change in overall performance
22. Jensen (2004)	N	N	N	0% change in overall performance
23. Veddeng (2014)	N	N	N	0% change in overall performance
24. Gerdes (2008)	Y (-) 79sec vs 88sec % difference - 11.4% increase in overall time	Y (-) 12.75 vs 8.17 % difference - 36.0% decrease in economy of motion	Y (-) 1.7 vs 3.2 % difference - 47.3% increase in errors	31.6 % decrease in overall performance
25.Yamany(2015)	Y (-)			Information not supplied
26.Bharathan (2013)	Y (-)	Y (-)	Y (-)	Information not supplied
27.Daruwalla (2013)	Y (-)	Y (-)	Y (-)	Information not supplied
28.Philibert (2005)	Y (-)	Y (-)	Y (-)	N/A
29.Mark (2014)	Y (-) 572.5 sec vs 884 sec - % difference - 54.4% increase in overall time	Y (-) 1096.2cm vs 1266.3cm % difference - 15.6% decrease in economy of motion	Y (-) % difference - 200% increase in errors	90% decrease in overall performance => when controlling for skewed error result its 35%
30.Grantcharov (2001)	Y (-) 18 vs 25 % difference - 38.9% increase in time	Y (-) 6.1 vs 8.3 % difference - 36% decrease in economy of motion	Y (-) 1.3 vs 3.4 % difference - 161.5% increase in errors	78.8% decrease in overall performance => when controlling for skewed error result its 37.5%
31.Deaconson (1988)	N	N	N	Information not supplied
32.Brandenberger (2010)	Y (-)	Y (-)	Y (-)	Information not supplied
33.Tomasko (2012)	N	N	N	0% change in overall performance
Results	12 (Y-) ; 11 (N) ; 1 (Y+)	9 (Y-) ; 15 (N) ; 1 (Y+)	9 (Y-) ; 15 (N) ; 1 (Y+)	**32% decrement in performance across 10 studies** **23.8% decrement in performance across 12 studies (including the positives)** **11.9% decrement in performance across 24 studies (including the no impact)**

Appendix D – Invitation letter for Chapter 3 observational study

Subject: Invitation for Research to examine if sleep deprivation in surgeons, defined as being on-call and measured using EEG, impacts on surgical skill performance in a simulated environment

To whom it may concern,

I am writing to you to request your participation in a research project. The purpose of this project is to inform research in the area of sleep and professional practice in surgery.

Please see attached below a participant information letter explaining this study further. Should you wish to partake in the study, or have any questions relating to the study please email whelehd@tcd.ie for further details.

Your participation in this study is completely voluntary and all of your information will be kept confidential. The data will be used for publishing and for research purposes only. This data will not be used in any form of profiling in your personal work and location monitoring will not be identified throughout the process. If you are unsatisfied with the management of your personal data within this study, you have a right to lodge a complaint with the Data Protection Commissioner. You have the right to data portability through request of access to assessment reports The SJH/AMNCH Joint Research Ethics Committee has approved this study.

Thank you very much for your time and cooperation.

Sincerely,

Dale Whelehan

Research Doctorate Student,

Department of Surgery,

School of Medicine,

Trinity College Dublin

Paul Ridgway

Associate Professor

Department of Surgery,

School of Medicine,

Trinity College Dublin

Appendix E – Participant information letter for Chapter 3 observational study and example consent form

Participant Information Leaflet

Study title: To examine if sleep deprivation in surgeons, defined as being on-call and measured using EEG, impacts on surgical skill performance in a simulated environment

You are being invited to take part in a research study to be carried out at Tallaght University Hospital as part of a research doctorate degree affiliated with Trinity College Dublin, The University of Dublin looking at work-place based activities in surgeons. This study has Joint SJH/AMNCH Research Ethics Committee approval and is covered by insurance policies by Tallaght University Hospital.

Before you decide whether or not you wish to take part, you should read the information provided below carefully. Take time to ask questions – don't feel too rushed or under pressure to make a quick decision. Your participation in this study is completely voluntary.

You should clearly understand the risks and benefits of taking part in this study so that you can make a decision that is right for you. This process is known as 'Informed Consent'.

You can change your mind about taking part in the study any time you like. Even if the study has started, you can still opt out. You don't have to give us a reason. If you do opt out, rest assured it won't affect your future employment in Tallaght University Hospital or elsewhere.

Why is this study being done?

This research study is taking place to find out if sleep deprivation, defined as being on-call, and measured through use of EEG, has an impact on surgical skill performance.

As a result of initiatives made in the previous decades, such as the ACGME and EU-working directives, which limit doctors in the amount of hours they can work, the topic of sleep and surgery has been at the forefront of discussions. Sleep deprivation in medicine has been thoroughly researched both in the context of simulation and retrospective analysis of workload. A lot of this research has found that sleep deprivation leads to an increase cognitive load, which increases risk of error. The findings on whether sleep deprivation impacts on technical skill performance are, however, not as established.
This is an observational prospective cohort quantitative study design exploring the relationship between subjective and objective measurements of sleep deprivation, and their impact on simulated surgical performance.

Why am I being asked to take part?

You are being asked to take part in this study as participation is aimed at participants of differing levels of experience and training in the surgical profession i.e. senior house office, register, consultancy. The aim of the research is to answer a series of research questions:

- Does sleep deprivation impact on technical skill performance as measured by simulation?
- Does acute and sub-acute sleep deprivation differ in their impact on technical skill performance?
- Does level of experience mitigate the impact of sleep deprivation on technical skill performance?
- Do subjective and objective measurements of sleep deprivation have a correlation?

Do I have to take part? What happens if I say no? Can I withdraw?

You don't have to take part in this study. If you decide not to take part it won't affect your professional career. You can change your mind about taking part in the study and opt out at any time even if the study has started. If you decide to opt out, it won't affect your professional career. You don't have to give a reason for not take part or for opting out. If you wish to opt out, please contact Dale Whelehan, Principal Investigator (whelehd@tcd.ie) who will be able to organise it for you.

How will the study be carried out?

This study will commence in May 2019 in Tallaght University Hospital. Participants will be expected to complete two EEG assessments to measure baseline brainwave activity before going on-call and brainwave activity post on-call status. Participants will also be expected to complete a series of simulated surgical skill tasks and psychomotor testing to measure their performance using MIST-VR and Psychomotor Vigilance testing at baseline and post on-call status using a simulator such as MIST-VR. A series of subjective questionnaires will also be asked with regards to sleep and demographics. Participants will also complete a sleep-log journal for the duration of the research project. Participants will also use the app 'Pillow' , which is a sleep tracker app to measure quantity and quality of sleep, for the duration of the research project.

What will happen to me if I agree to take part?

By agreeing to take part in this study you will be providing informed consent to a series of tests associated with your level of sleep and its potential impact on your surgical technical skill performance. Once consenting to the process, you will be assigned to one of three study arms – a control group who will not have completed on-call for at least one week, a one-night on-call group, or a five-night on-call group.

Baseline performance through the Psychomotor Vigilance Test and MIST-VR Simulator, EEG measurements and Subjective surveys will be assessed at the beginning of your on-call shift, or, if in the case of the control group, the beginning of a normal working day. Participants will then be re-assessed immediately after on-call status, or if in the case of the control group, the end of the following normal working day. You will also be required to use a sleep-log journal and the sleep tracker app 'Pillow' for the duration of the research project. Finally, you will be required to not consume any caffeine during the period you are 'on-call' as part of the research project. This is to attempt to standardise the potential effect caffeine may have on your overall performance. In addition, if you are assigned to the '5 night on-call group' you will be assessed at a 3rd point – after the first night on-call.

EEG measurements will be assessed in the Department of Neurophysiology, Tallaght University Hospital under the supervision of a neurophysiological technician or consultant. All other data will be assessed in the Department of Surgery, Tallaght University Hospital under the management of a consultant.

All data will be coded by the Principal Investigator to protect confidentiality throughout data analysis. Participants will also be invited to complete a questionnaire regarding their sleep patterns and their subjective levels of sleepiness. The entire assessment period should take approximately 90 minutes.

Are there any benefits to me or others if I take part in the study?

Participants engaging with this study may benefit from technical skill performance enhancement through practice on simulation. Similarly, participants may become more aware of their levels of sleepiness which may offer mitigating opportunities to mediate any potential risks of practicing while feeling tired. It is envisaged that this observational study will also inform a future intervention study in the area of sleep management and hygiene in the surgical profession. Participants will have further opportunities to engage in future studies and benefit from potential interventions. Monetary compensation will be provided to all participants at the rate of time and a half in line with the HSE terms and conditions of employment.

Are there any risks to me or others if I take part in the study?

It is not envisaged that this study will provide any major risks to participants. During the EEG assessment process you will be supervised by a consultant in clinical neurophysiology or by a neurophysiological technologist and will have every opportunity to withdraw from the process at any stage. Should any adverse findings occur during the EEG assessment you will have the opportunity to discuss these with a consultant neurophysiologist. Participants may also experience tiredness upon the assessment required following on-call status. Participants may also be required to stay beyond their work shift in order to complete the assessment. You

will receive appropriate remuneration for this in accordance with the terms and conditions of employment (*https://www.hse.ie/eng/staff/resources/hr-publications/terms-and-conditions-of-employment.pdf*.)

Will I be told the outcome of the study? Will I be told the results of any tests or investigations performed as part of this study that relate to me?

In the unlikely event that any research impacts on your health you will be told immediately. Your individual performance scores on testing will be provided to you after assessments. Participants will be provided results of their own assessments, both on EEG finding and simulated technical skill performance. They will also have access to the sleep tracker device 'Pillow' findings. The collective research findings as agreed by the established research objectives aim to be presented as part of a PhD thesis, in a peer-reviewed academic journal and conferences.

What information about me (personal data) will be used as part of this study?

The following personal data will be collected for research purposes:

Sleep Related Data:

1. EEG assessment prior to a night on-call

2. EEG assessment after last night on-call (and in the case of the 5-night on call group after the first night-on call status as a 3rd data point)

3. Sleep quality and quantity as measured by the sleep tracker device 'pillow the week prior to on-call status and during on-call status

4. Hours awake as measured by sleep-log journals

Performance Related Data:

1.Surgical simulation performance at baseline which will measure performance on three grounds – number of errors made, time taken to complete procedure, and the economy of motion when completing a simple procedure such as suturing and more complex procedures such as dual-transfer tasks – both of which are required for the commonly performed laparoscopic cholecystectomy procedure.

2.Surgical simulation performance after last night on-call/after shift which will measure performance on three grounds – number of errors made, time taken to complete procedure, and the economy of motion when completing a simple procedure such as suturing and more complex procedures such as dual-transfer tasks – both of which are required for the commonly performed laparoscopic cholecystectomy procedure. (and in the case of the 5-night on call group after the first night-on call status as a 3rd data point)

3. Psychomotor testing at baseline which will measure reaction time.

4. Psychomotor testing after last night on-call/after shift which will measure reaction time. (and in the case of the 5-night on call group after the first night-on call status as a 3rd data point

Survey Collection:

1. A series of demographic questions at baseline including

-membership to the Irish Surgical training scheme or consultancy

-age

-gender

-length of time since graduation from medicine

-job specification

-job sector

-hand dominance

-experience in laparoscopic simulation

-experience in video games

-average cups of coffee per day

2. Subjective assessment of sleepiness using the validated Epworth Sleepiness Scale at baseline.

3. Subjective assessment of sleepiness using the validated Epworth Sleepiness Scale after last night on-call/after shift (and in the case of the 5-night on call group after the first night-on call status as a 3rd data point).

4. Subjective assessment of sleep quality using the validated Pittsburgh Sleep Quality Index at baseline.

5. Subjective assessment of sleep quality using the validated Pittsburgh Sleep Quality Index after last night on-call/after shift (and in the case of the 5-night on call group after the first night-on call status as a 3rd data point).

6. Subjective assessment of fatigue using the validated Chalder Fatigue Scale at baseline.

7. Subjective assessment of fatigue using the validated Chalder Fatigue Scale after last night on-call/after shift (and in the case of the 5-night on call group after the first night-on call status as a 3rd data point).

What will happen to my personal data?

All data relating to participants findings will be anonymised. This information will be kept for 5 years and may be used in further studies within this timeframe. These future studies may involve potential intervention studies that are informed by the research outputs of this research project.

Who will access and use my personal data as part of this study?

Access to completed assessments will be limited to the research team comprising of Principal Investigator Mr. Dale Whelehan, Supervisor Professor Paul Ridgway, and Researcher Mr. Michael Alexander. The data will not leave Tallaght University Hospital campus.

Will my personal data be kept confidential? How will my data be kept safe?

We will be using your information in our research to help us study the relationship between sleep deprivation and surgical skill performance in the surgical profession. This is intended for science research use. Participants information will be limited to the research team involved in this study and stored for 5 years. All data relating to participants findings will be encrypted and coded. Personal information that could identify the participant will be removed to protect the confidentiality of the participant

What is the lawful basis to use my personal data?

The basis for use of your personal data is in accordance with Article 6 and Article 9 of GDPR:

Article 6: thedata subject has given consent to the processing of his or her personal data for specific purposes

Article 9: Processing is necessary for achieving purposes in the public interest, scientific or historical research purposes of statistical purposes in accordance with Article 89(1) based on Union or Member State law which shall be proportionate to the aim pursued, respect the essence of the right to data protection and provide suitable and specific measures to safeguard the fundamental rights and interests of the data subject

What are my rights?

You have the right to withdraw consent to your data being used in this research project. You will be able to do this by contacting Dale Whelehan at whelehd@tcd.ie who will have access to the coded participant information. You have a right to request access to your data, as well as a copy of your data. You have a right to restrict or object to processing of your personal data. You have a right to have any inaccurate personal information corrected or deleted. You have a right to have your personal data deleted, unless the request is impossible or hinders conduct of the research. You have the right to data portability. You have a right to object to profiling.

Will it cost me anything if I agree to take part?

No. This study will not incur any personal cost.

Who is organising and funding this study?

This principal investigator of this research is Dale Whelehan, a research doctorate student in surgery affiliated with Trinity College Dublin, The University of Dublin under the supervision of Professor Paul Ridgway, Director of Perioperative Care, Tallaght University Hospital and Associate Professor in Surgery, in conjunction with Dr. Michael Alexander, Consultant in Clinical Neurophysiology, Tallaght University Hospital. This research has been funded through grants obtained through the Department of Surgery, Tallaght University Hospital.

Has this study been approved by a research ethics committee?

The SJH/AMNCH Joint Research Ethics Committee has approved this study in May 2019.

Will my personal data be used in future studies?

The research team intends to use your personal data for future research studies to inform an intervention study in the area of sleep deprivation and surgery. Participants information will be limited to the research team involved in this study and stored for 5 years.

Where can I get further information?

If you need any further information now or at any time in the future please see the 'Statement of Information Practice' affiliated with Tallaght University Hospital (*http://www.tuh.ie/About-us/Statement-of-Information-Practice.pdf)* , or contact:

Principal investigator's name:	**Dale Whelehan**
Principal investigator's title:	**Research Doctorate Student, TCD**
Telephone number of principal investigator:	**0852041559**
Consultant/co-investigator's name:	**Paul Ridgway**
Consultant/co-investigator's title:	**Associate Professor in Surgery, TCD**
Data Controller's/joint Controller's identity:	**Dale Whelehan and Paul Ridgway**
Data Controller's/joint Controller's details:	**whelehd@tcd.ie ridgwayp@tcd.ie**

What happens if I wish to make a complaint?

You have a right to lodge a complaint with the Data Protection Commissioner if you are unsatisfied with the management of your personal data within this study.

Will I be contacted again?

You may be contacted throughout the study process in order to arrange times for assessments. You may also be contacted for prospective future research in this area within a 5 year period.

Thank you for your consideration,

Dale Whelehan

Research Doctorate Student

Department of Surgery,

School of Medicine,

Trinity College Dublin, The University of Dublin

PARTICIPANT CONSENT FORM

Study title: To examine if sleep deprivation in surgeons, defined as being on-call and measured using EEG, impacts on surgical skill performance in a simulated environment

*I have read and understood the **Information Leaflet** about this research project. The information has been fully explained to me and I have been able to ask questions, all of which have been answered to my satisfaction.*	***Yes ☐***	***No ☐***
I understand that I don't have to take part in this study and that I can opt out at any time. I understand that I don't have to give a reason for opting out and I understand that opting out won't affect my future medical care.	***Yes ☐***	***No ☐***
I am aware of the potential risks, benefits and alternatives of this research study.	***Yes ☐***	***No ☐***
I have been given a copy of the Information Leaflet and this completed consent form for my records.	***Yes ☐***	***No ☐***
I consent to take part in this research study having been fully informed of the risks, benefits and alternatives.	***Yes ☐***	***No ☐***
I give informed explicit consent to have my data processed as part of this research study.	***Yes ☐***	***No ☐***
I consent to be contacted by researchers as part of this research study.	***Yes ☐***	***No ☐***

STORAGE AND FUTURE USE OF INFORMATION		
RETENTION OF RESEARCH MATERIAL IN THE FUTURE		
I give permission for material/data to be stored for possible future research **related** *to the current study* **without further consent being required** *but only if the research is approved by a Research Ethics Committee.*	***Yes ☐***	***No ☐***

_____ / _____ /

Participant Name (Block Capitals) | *Participant Signature* | *Date*

To be completed by the Principal Investigator or nominee.

I, the undersigned, have taken the time to fully explain to the above participant the nature and purpose of this study in a way that they could understand. I have explained the risks involved as well as the possible benefits. I have invited them to ask questions on any aspect of the study that concerned them.

_____

Appendix F – Psychometric properties of outcome measurements used in thesis

Measure: Electroencephalogram (EEG)
Reliability: high internal consistency (α = 0.850) (Benbadis et al., 1995).
Validity: high construct-validity in differentiating conditions and improvements in therapeutic intervention, and content-validity in face validity of patients (Roehrs and Roth, 1992).
Measure: Sleep Tracker Device
Reliability: not completed
Validity: general actigraphy measurements have been shown to have criterion-validity by having associations with measurements of sleep including 93% accuracy with polysomnography and 85% accuracy with reported sleep (Bisgaard et al., 2009).
Measure: Pittsburgh Sleep Quality Index (PSQI)
Reliability: moderate level of internal consistency (α = 0.69) (Spira et al., 2012), and high test-retest reliability in clinical populations (r=.87) (Backhaus et al., 2002).
Validity: acceptable criterion-related validity to other sleep measurements (Grandner et al., 2012; Spira et al., 2012), and moderate content-validity (Mollayeva et al., 2016).
Measure: Sleep log journals
Reliability: moderate level of internal consistency (α > 0.60) (Short et al., 2017), and higher test-retest reliability when used for more than five days in non-clinical populations (Short et al., 2017).
Validity: criterion-validity of 85% accuracy in reported sleep with objective measurements of sleep (Bisgaard et al., 2009).
Measure: Epworth Sleepiness Scale (ESS)
Reliability: high internal consistency (α = 0.82) (Hagell et al., 2007), and high test-retest reliability (r=.81 - .93) (for e.g. Gibson et al., 2006; van der Heide et al., 2015)
Validity: high criterion-validity in differentiating clinical and non-clinical populations (Johns, 2000). It also shows acceptable criterion-related validity to other sleep measurements (Spira et al., 2012), and construct-validity in detecting sensitivity (93.5%) and specificity (100%) (Johns, 1991).
Measure: Chalder Fatigue Scale (CFS)
Reliability: high internal consistency (α = 0.88-92) (Cella et al., 2010) with high reliability coefficients of equivalence and stability.(r=.83-.9) (De Vries et al., 2015). It has moderate test-retest reliability in clinical populations (Chilcot et al., 2016).
Validity: moderate construct-validity in differentiating conditions (Cella et al., 2010), and competing findings on level of content-validity (Morris et al., 1998; Fong et al., 2015). It has a level of criterion-validity in non-clinical population use (Fong et al., 2015).
Measure: Psychomotor Vigilance Task (PVT):
Reliability: high test-retest reliability (r=0.8 or above) (Dorrian et al., 2005)
Validity: high criterion-validity as a cognitive performance marker in sleep (Whitney, 2010), and high construct validity in detecting sensitivity of reaction time (Doran et al., 2001), and chronic sleep deprivation (Dinges et al., 1997).
Measure: Standardised Simulated Tasks
Reliability: no reliability measurements exist on simulator in *Chapter 3*. Test-retest reliability is low in small testing as participants must undergo significant training (8 sessions of 8 iterations of 7 virtual reality tasks) to improve realistic performance scores (Hogle et al., 2007)

Validity: high criterion-validity in predicting performance in direct observation of procedural skills (Verdaasdonk et al., 2008). It also shows high face validity (van Ginkel et al., 2020), and high construct validity in detecting experience as a predictor(van Ginkel et al., 2020), and the learning curve effect (Verdaasdonk et al., 2007).
Measure: Reflective Practice Questionnaire (RPQ)
Reliability: moderate-high level of internal consistency (α = 0.64-0.84) (Priddis and Rogers, 2017), but no test-retest reliability.
Validity: elements of construct-related validity in differentiating healthcare from non-healthcare samples (Rogers et al., 2019), and moderate content-validity (Priddis and Rogers, 2018).
Measure: Morningness-Eveningness Questionnaire (MEQ)
Reliability: high level of internal consistency (α = 0.83) (Paine et al., 2006), but no test-retest reliability.
Validity: elements of criterion-related validity in association with objective circadian phase markers (Taillard et al., 2004), and construct-related validity in differentiating morning, and evidence alertness in individuals (Horne and Östberg 1976)
Measure: NASA- Task Load Index (TLX)
Reliability: high level of internal consistency (α = 0.71-81) (Xiao et al., 2005), and test-retest reliability (r=0.77) (Battisse and Bortolussi, 1988).
Validity: elements of criterion-related validity in association with objective pupillary measurement, index of cognitive activity (Devos et al., 2020) construct-related validity in differentiating surgical environment stressors (Ruiz-Rabelo et al., 2015; Sewell et al., 2016), and content-related validity with moderate face validity (Longo, 2018).
Measure: Karolinska Sleepiness Scale (KSS):
Reliability: nil
Validity: moderate criterion-related validity in association with objective EEG and PVT markers (Kaida et al., 2006), and construct-related validity with >6 associated with impaired driving performance and sleep intrusions (Åkerstedt et al., 2014).
Measure: Test of Performance Strategies (TOPS-2- SF)
Reliability: high internal consistency (α > 0.7 for all measures except activation which was 0.69) (Kumar et al., 2020), and met all criteria for confirmatory factor analysis (Kumar et al., 2020)
Validity: criterion-validity through confirmatory factor analysis shows associations between TOPS and TOPS-2 (Hardy et al., 2010), while multi-trait method analysis shows meeting criteria for convergent and discriminant validity (Kumar, 2020). Finally, showed good content validity based on extensive review of literature (Thomas et al., 1999).
Measure: Thriving at Work (TAW)
Reliability: high internal consistency (α > 0.7) (Porath et al., 2012), but test-retest reliability has not occurred.
Validity: criterion-validity through correlations different survey instruments including leadership scales (Porath et al., 2012), with significant convergent and discriminant validity of the instrument through rigorous testing (Porath et al., 2012). Finally, excellent content validity based on extensive review of the literature (Porath et al., 2012).
Measure: Positive and Negative Affect Schedule (PANAS)
Reliability: high internal consistency (α > 0.7) (Crawford and Henry, 2004), but test-retest reliability has not occurred.
Validity: show criterion-validity through extensive used in other research, while CFA modelling largely supports construct validity (Crawford and Henry, 2004). It has good content validity as based off Zevon and Tellegen's mood checklist (Zevon and Tellegen, 1982).

Measure: Physician Wellbeing Index (PWBI)
Reliability: high internal consistency (α > 0.7 when the fatigue construct removed) (Dyrbye et al., 2010), but test-retest reliability has not occurred.
Validity: strong content validity as based off a literature review and experts in instrument design (Dyrbye et al., 2010). Further testing is needed for construct and criterion validity.
Measure: Psychological Capital Questionnaire (PCQ)
Reliability: high internal consistency (α > 0.7) (Luthans et al., 2007), but test-retest reliability has not occurred.
Validity: strong criterion-validity with positive relationship with composite facets of performance and satisfaction (Luthans et al., 2007), and discriminant validity of internal scales (Kline, 2005). A need for further examination of construct validity (Luthans et al., 2007). There is strong content validity as based off four other validated scale (Parker, 1998, Scheier and Carver, 1985, Snyder et al., 1996; Wagnild, 2009)
Measure: The Single-Item Measures of Personality (SIMP)
Reliability: high internal consistency (α > 0.78) (Woods and Hampson, 2005). Similar smaller scale measures of construct provide higher test-retest reliability (r = >0.65) (Gosling et al., 2003)
Validity: criterion-validity as designed in conjunction of consideration for the Big Five Inventory with corelations found between the variables (Woods and Hampson, 2005). They may have lower psychometric value but economically for valid (Woods and Hampson, 2005) which provides potential utility validity. Personality measures are difficult to assess given the debate with their utility. This provides a screen of potential self-perceived levels of the Big 5 when completing test as a covariable.
Measure: Workplace Climate Questionnaire (WCQ)
Reliability: lower supportive-receptive reliability (McManus et al., 2004). May be influenced by perceived personality aspects also.
Validity: previously validated on healthcare professions (McManus et al., 2004).
Measure: 3D fatigue inventory (3DFI)
Reliability: high internal consistency (α = 0.9) (Frone and Tidwell, 2015), but test-retest reliability has not occurred.
Validity: evidence of convergent and discriminant validity (Frone and Tidwell, 2015). There was content validity as they involved external experts in design of instrument (Frone and Tidwell, 2015).
Measure: Occupational Fatigue Exhaustion Recovery (OFER)
Reliability: high internal consistency (α = 0.82-0.93) (Winwood et al., 2005), while test-retest reliability was lower (0.62-0.64) (Winwood et al., 2005)
Validity: criterion validity through correlations with burnout exhaustion scale of BMI (Winwood et al., 2005). There was strong conformity with relevant factors and correlates negatively with hypothesised other factors (Winwood et al., 2005). Good content validity established through high face validity (Winwood et al., 2005)

Appendix G – Demographic assessment of surgeons and EEG assessment form

Are you a member of the Irish Surgical Training Scheme or a Consultant practicing in Ireland? :

Yes
No

Which work-pattern best describes your work life in this current time?

On-call status for 1 night
On-call status for more than 1 night
Not on-call status for more than 1 week

What age bracket are you in?

≤ 30 years
31-40 years
41-50 years
51-60 years
61-70 years
70+ years

What gender best describes you?

Male
Female
Non-Binary
Prefer not to disclose

How long it is since you graduated from medicine?:

≤ 5 years
6- 10 years
11-16 years
17 – 22 years
≥ 23 years

Which of these most appropriately corresponds to your current job title?

Senior House Officer
Registrar
Specialist Registrar
Consultant
Other: Please Specify

What surgical specialty best describes the area of work you are in?

Cardiothoracic Surgery
General Surgery
Neurosurgery
Oral and Maxillofacial Surgery
Otolaryngology (ENT) Surgery
Paediatric Surgery
Plastic Surgery
Trauma and Orthopaedic Surgery
Urology Surgery
Vascular Surgery
Other: Please Specify_____

What sector of work do you <u>primarily</u> work as a surgeon in?

Public
Private

What is your dominant hand?

Left Hand
Right Hand

What is your experience in laparoscopic simulation?

None (0 attempts)
Limited (1-10 attempts)
Advanced (> 10 attempts)

What is your experience in video games?

None (0 attempts)
Limited (1-10 attempts)
Advanced (> 10 attempts)

How many cups of coffee on average do you consume daily?

Insert Figure

Tallaght University Hospital

Department of Clinical Neurophysiology **[Tel: 414 3025; Fax: 4143024]**

Sleep latency Research Study EEG Request Form

Name …… **Male** or **Female (**please circle**)**
(First name) (Family name)
DOB ……
Address ……
Patient Tel/Mobile Numbers ……

Medical history that may affect the EEG (seizures, migraine, stroke, head injury)

……

……

……

Medication ……

……

Reporter	Sleep latency
Physiologist	**Post call** ____mins ____secs **Pre call** ____mins ____secs
Consultant	**Post call** ____mins ____secs **Pre call** ____mins ____secs

Signed……**Contact Tel/Bleep No**……**Date**……

Printed Name ……

***** ALL FIELDS MUST BE COMPLETED – INCOMPLETE FORMS WILL BE RETURNED *****

Protocol for performing the EEG as part of the study:

1. Standardisation of testing conditions is important.
   a. Quiet
   b. Dark
   c. Free of environmental noise
   d. Comfortable temperature
2. Tobacco use should be stopped at least 20 minutes before the test. Caffeine and exercise should be avoided on the test day.
3. Perform a full head measurement using 10/20 measurement protocol and apply all electrodes as usual.
4. At the start of the test, tell the patient, "Please lie quietly, assume a comfortable position, and try to fall asleep". **The start of the recording is taken as the first eye closure** (do not include cal. etc as start of recording)
5. Measure the time between the start of recording and sleep onset.
   a. Sleep onset – time from eyes closed to 1st epoch of sleep
      i. "microsleep" episodes of <15 seconds should not be scored
6. If there is no sleep the test is terminated at 20 minutes.

Appendix H – Caffeine product list provided for participants

Substance	Volume	Caffeine mean (mg)
Filtered coffee	125ml	85
Espresso	30ml	60
Soluble instant coffee	125ml	65
Decaffeinated coffee	125ml	3
Tea	150ml	32
Caffeinated soft drinks	330ml	39
Energy drinks	330ml	80
Chocolate	30g	20

Appendix I - Invitation letter for Chapter 4 survey study

Subject: Exploring clinical decision-making by general surgeons towards complex biliary tract surgery

To whom it may concern,

I am writing to you to request your participation in a brief survey. The purpose of this survey is to inform research into the processes of clinical decision making in general surgery across the Irish healthcare sector.

Introduction:

It is known that the work schedule of a surgeon is varied and time intensive. As autonomous practitioners, surgeons regularly use decision-making tools to assist them effectively in their day-to-day work. These cognitive tools are used to assist practitioners in making swift responses to diagnosis, treatment and management of their patients.

This research project is a research doctorate project for completion of a PhD programme in the area of 'work place based activities' in surgeons.
This study has two main aims:

- To explore clinical decision making in general surgeons
- To explore reflective practice in general surgeons

Procedures:

To complete this survey you must be registered to the General Surgery Scheme in the National Surgical Training Scheme and submit your RCSI student ID number for verification. The survey consists of three sections and should take less than 5 minutes to complete. Please click the link below to complete the survey. Survey link: ____. Should you decide to complete the survey, please return responses by **March 1st** .You should note that by completing and returning the survey you are providing your informed consent to participating in this study.

Confidentiality and Voluntary Participation

Your participation in the survey is completely voluntary and all of your responses will be kept confidential. You may withdraw at any time. If you decide not to participate, or if you withdraw, you will not be penalised and will not give up any benefits which you had before entering the study. This has been approved by the School of Medicine Research Ethics Committee, Trinity college Dublin.

Contact Details

Should you have any concerns, please don't hesitate to get in touch at whelehd@tcd.ie

Sincerely,

Dale Whelehan

Researcher Doctorate Student

Department of Surgery

School of Medicine,

Trinity College Dublin

Paul Ridgway

Associate Professor

Department of Surgery,

School of Medicine,

Trinity College Dublin

Appendix J - Participant information letter for Chapter 4 survey study

It is known that the work schedule of a surgeon is varied and time intensive. As autonomous practitioners surgeons regularly use decision-making cognitive tools to assist them effectively in their responses to diagnosis, treatment and management of patients. The importance of engaging in regular reflective practice has been shown to be important in the management of aspects of medical professional practice. However, the behaviours that are involved in clinical decision making and reflective practice remain unknown.

To complete this survey you must be practicing in Ireland and be either:
- a consultant in General Surgery or
- registered to the General Surgery Training Scheme in the National Surgical Training Scheme

The survey consists of three sections and takes less than 10 minutes to complete. You should note that by completing and returning the survey you are providing your informed consent to participate in this study.

Should you have any queries please do not hesitate to get in touch with the lead researcher, Dale Whelehan at *whelehd@tcd.ie*.

Thank you for participating in our research.

Appendix K – Clinical vignettes used for Chapter 4 survey study

Clinical Vignette 1

The additional *italicised* sentence is the additional information or 'hook' provided to half the participants. The clinical vignette is as follows:

"You are an experienced general surgeon and are reviewing a 53-year old female with strongly symptomatic cholelithiasis *and significant comorbidities including end stage renal failure*. Her symptoms have worsened in recent weeks. You have an open conversion rate of 5%. Based on her presentation and tests, there is a suspicion of Mirizzi syndrome as a differential diagnosis. How do you proceed?"

Options

a.)You decide to conservatively manage the patient
b.)You decide to perform a laparoscopic cholecystectomy +/- open
c.)You decide to refer to the Hepato-Pancreato-Biliary consultant

What is your clinical reasoning for your decision?

Clinical Vignette 2

The additional *italicised* sentence is the additional information or 'hook' provided to half the participants. The clinical vignette is as follows:

"You are an experienced general surgeon performing regular laparoscopic cholecystectomies. *You have assisted in many repairs of bile duct injuries in the past three months.* You are performing a laparoscopic cholecystectomy when a suspected common hepatic duct thermal injury with bile leak occurs intra-operatively. How do you proceed?"

Options

a.)You decide to perform an intraoperative cholangiography
b.)You decide to proceed to a primary repair of the injury
c.)You decide to consult the Hepato-Pancreato-Biliary consultant

What is your clinical reasoning for your decision?

Clinical Vignette 3

The additional *italicised* sentence is the additional information or 'hook' provided to half the participants. The clinical vignette is as follows:

"You are an experienced general surgeon and are operating on a 67-year old female who has been one and a half years on the waiting list for a cholecystectomy. *Pre-operatively, whilst obtaining consent from her, you note she has had some unexpected weight loss (one stone in 3/12).* You decide to look through the imaging which was over a year ago and stated uncomplicated cholecystitis on ultrasound. Intra-operatively you notice an abnormal growth on the gallbladder. How do you proceed?

Options

a.)You decide to continue with laparoscopic cholecystectomy and then conduct imaging post operatively
b.)You decide to convert to open surgery, recognising this may involve a wedge resection of the liver
c.)You decide to close the procedure without a cholecystectomy, and then conduct imaging

What is your clinical reasoning for your decision?

Appendix L - Invitation letter for Chapter 4 simulation study

Subject: Invitation to participate in research for examination improvement in UEMS fellowship examinations
To whom it may concern,

I am writing to you to request your participation in a research project. The purpose of this project is to inform research in validation of assessment of non-technical skill performance at the point of transition to fellowship. This will ultimately improve the examination process offered by UEMS.

Please see attached below a participant information letter explaining this study further. Should you wish to partake in the study, or have any questions relating to the study please email whelehd@tcd.ie for further details.

Your participation in this study is completely voluntary and all of your information will be kept confidential. The data will be used for publishing and for research purposes only. Access to coded personal data will only be available to the principal investigator and this data will not be used in any form of profiling in your personal work and location monitoring will not be identified throughout the process. If you are unsatisfied with the management of your personal data within this study, you have a right to lodge a complaint with the Data Protection Commissioner. You have the right to data portability i.e. the right to obtain and reuse your person data for your own purposes such as moving data, copying data, or transferring data across different services through request of access to assessment reports. This will not affect the usability of the data. The Royal College of Surgeons in Ireland Ethics Committee has approved this study.

Sincerely,

Dale Whelehan	Paul Ridgway	Marie Morris
Research Doctorate Student,	Associate Professor,	Senior Lecturer
Department of Surgery,	Department of Surgery,	Department of Surgical Affairs,
School of Medicine,	School of Medicine,	Surgical Affairs,
Trinity College Dublin.	Trinity College Dublin.	Royal College of Surgeons in Ireland.

Appendix M - Participant information letter for Chapter 4 simulation study

Participant Information Leaflet

Study title: Do fellowship examinations really examine clinical decision making? A validation study

Principal investigator's name:	**Dale Whelehan**
Principal investigator's title:	**Research Doctorate Student, TCD**
Telephone number of principal investigator:	**0852041559**
Consultant/co-investigator's name:	**Paul Ridgway**
Consultant/co-investigator's title:	**Associate Professor in Surgery, TCD**
Data Controller's/joint Controller's Identity:	**Dale Whelehan and Paul Ridgway**
Data Controller's/joint Controller's Details:	**whelehd@tcd.ie ridgwayp@tcd.ie**
Data Processor:	**Royal College of Surgeons in Ireland, Dublin 2**

You are being invited to take part in a research study to be carried out at the Royal College of Surgeons in Ireland as part of a research doctorate degree affiliated with Trinity College Dublin, The University of Dublin looking at work-place based activities in surgeons. This study has RCSI Research Ethics Committee approval and is covered by insurance policies by RCSI.

Before you decide whether or not you wish to take part, you should read the information provided below carefully. Take time to ask questions – don't feel rushed and don't feel under pressure to make a quick decision. Your participation in this study is completely voluntary.

You should clearly understand the risks and benefits of taking part in this study so that you can make a decision that is right for you. This process is known as 'Informed Consent'.

You can change your mind about taking part in the study any time you like. Even if the study has started, you can still opt out. You don't have to give us a reason. If you do opt out, rest assured it won't affect your prospective examination results or career opportunities.

Who is organising and funding this study?

This principal investigator of this research is Dale Whelehan, a research doctorate student in surgery affiliated with Trinity College Dublin, The University of Dublin under the supervision of Professor Paul Ridgway, Associate Professor in Surgery and Chair of Examinations (UEMS). This research has been funded as a quality improvement initiative for the UEMS examination.

Why am I being asked to take part?

You are being asked to take part in this study as participation is aimed at participants at the point of transition to fellowship. The aim of the research is to validate non-technical skill assessment of the examination while also achieving the following objectives:

- To validate the assessment of the simulation station for prospective examinations
- To assess clinical decision making towards a clinical scenario in surgeons pre-examination using a validated questionnaire
- To evaluate simulated clinical decision making towards a clinical scenario in surgeons in-simulation examination
- To compare self-reported clinical decision making processes and simulated clinical decision making processes amongst participants
- To explore behaviours and attitudes towards the clinical decision making assessment amongst surgeons using a focus group
- To explore real-life application of clinical decision making assessment using a follow-up survey
- To compare cultural and context-specific differences amongst participants

How will the study be carried out?

This study will commence in September 2019 in Royal College of Surgeons in Ireland. Participants will be expected to complete a pre-examination questionnaire on Day 2 after completing their formal examinations. Participants will also be expected to complete an in-simulation clinical scenario assessment on Day 2 after completing their pre-examination questionnaire as well as partake in a discussion on the research process and examination... Finally, participants will be asked on a 3-month follow up for their thoughts on the process once again.

What will happen to me if I agree to take part?

By agreeing to take part in this study you will be providing informed consent to three additional activities alongside the formal examination period – the pre-examination questionnaire, the post-examination discussion, and the 3-month follow up survey all of which will take place on Day 2 after the fellowship examination is completed. You will also be invited to complete a 3-month follow up survey.

All data will be coded by the Principal Investigator, who works independently of the formal UEMS examination, to protect confidentiality throughout the examination process (i.e. ensuring this will not affect summative examination results) and data analysis (i.e. ensuring protection of your data for research purposes).

Video and Audio Recording

Audio and video recording will occur during the simulated assessment aspect and audio recording for the post-examination discussion. This is for two reasons. The first is to assist in post-hoc external validation of the simulation station by an expert in Human Factors. The second is to assist in transcribing of discussions. Confidentiality will be assured by ensuring the camera is not directed towards facial identity. You do have a right, if you wish, to review and edit transcripts to which you have contributed.

What are the benefits?

This research process provides an opportunity to contribute to the development of the UEMS examination process and improve the quality of current assessment methods. This is an area of assessment that has not yet been explored and will benefit future professional practice.

What are the risks?

It is not envisaged that this study will provide any major risks to participants. The research project is run independently from the formal UEMS examination and managed by the independent investigator Dale Whelehan. The principal investigator will have sole access to ID coding and your individual performance in the study will remain confidential from members of the UEMS examination team. Your identity will be protected on audio and video recordings by ensuring facial identities are not recognisable. Assessment of performance in the examination process will be conducted by an external independent examiner.

Is the study confidential?

All data relating to participants findings will be encrypted and coded. Personal information that could identify the participant will be removed to protect the confidentiality of the participant. Access to completed assessments will be limited to the Principal Investigator and independent from the examination team to ensure confidentiality of the participants. This information will be kept for 5 years and may be used in further studies within this timeframe. These future studies may involve potential examination development studies that are informed by the research outputs of this research project. Participants will be provided results of their own assessments. The collective research findings as agreed by the established research objectives aim to be presented as part of a PhD thesis, in a peer-reviewed academic journal and conferences.

Data Protection

We will be using your information in our research to help us examine assessment of non-technical skills with the aim of validating an assessment station. This is intended for scientific research use only as supported by Article 6 and 9 of the General Data Protection Regulation (2016). Participant's coded information will be limited to the research team involved in this study and stored for 5 years. This data may be used for future studies in developing the UEMS examination assessment. You have the right to withdraw consent to your data being used in this research project. You will be able to do this by contacting Dale Whelehan at whelehd@tcd.ie who will have access to the coded participant information. You have a right to lodge a complaint with the Data Protection Commissioner if you are unsatisfied with the management of your personal data within this study. You have a right to request access to your data, as well as a copy of your data. You have a right to restrict or object to processing of your personal data. You have a right to have any inaccurate personal information corrected or deleted. You have a right to have your personal data deleted, unless the request is impossible or hinders conduct of the research. You have the right to data portability. This data will not be used in any form of profiling in your personal work.

Where can I get further information?

If you need any further information now or at any time in the future please see the 'UEMS Privacy and Data Security Policy' (*https://www.uems.eu/general/privacy-and-data-security-policy*), or contact:

Name : Dale Whelehan, Principal Investigator

Email: whelehd@tcd.ie

Address : Department of Surgery, Trinity Centre for Health Sciences, Tallaght University Hospital, Tallaght, Dublin 24.

Thank you for your consideration,

Dale Whelehan

Research Doctorate Student

Department of Surgery,

School of Medicine,

Trinity College Dublin, The University of Dublin

Appendix N – Pre-examination questionnaire for Chapter 4 simulation study

Questionnaire on professional views on gaining written consent for surgery.

You have been asked to see an 82-year-old man in the Emergency Room following review by your SHO.

- *He is acutely unwell with generalised peritonitis and signs of sepsis*
- *Your SHO is worried about the clinical condition of the patient & recognises that urgent surgical intervention is required*
- *The patient had an emergency CT abdomen and pelvis, which demonstrates a perforated sigmoid tumour.*

Based on his/her assessment your SHO`s believes an emergency laparotomy is indicated. The patient is refusing to have surgery and wants some painkillers and to go home.
Please select what you think is the most appropriate decision:

Options

1. Visit the patient; explain the seriousness of his condition and advise that you are going to proceed with surgery.
2. Assess the patient's cognition and if deemed deficient take power of attorney and proceed with the surgery.
3. Contact the Hospital Legal Team and get advice.
4. Discharge the patient home as per his wishes.
5. Delay surgery and manage the patient conservatively.
6. Other approach – please explain

Appendix O – Simulated scenario for Chapter 4 simulation study

FEBS OSCE September 2019

Candidate Instructions

Communication with patient – Emergency Laparotomy – perforated sigmoid

You are a Specialist Registrar in Surgery

Setting:

- *You have been called down to Emergency dept to a patient (Pat O Reilly) in the Resus room*
- *He is acutely unwell with generalised peritonitis and signs of sepsis*
- *You are worried about the clinical condition of the patient & recognise that urgent surgical intervention is required*
- *The patient had an emergency CT abdomen and pelvis which demonstrates a perforated sigmoid tumour*
- *The patient is unaware of the diagnosis*
- *Theatre is on stand by*
- *The plan is to perform an emergency laparotomy but your Senior House Officer has been unable to get consent.*

Task:

- *Your task is to* ***explain to the patient why emergency surgery and admission is a necessity and get consent for the surgery***

FEBS OSCE September 2019

Simulated Patient Instructions

Station Title: Communication with patient – Emergency Laparotomy – perforated sigmoid

Name: *Pat O Reilly* ***Age****: 77*

Setting
You have been unwell for the last couple of weeks with crampy abdominal pain, a change in bowel habit and some bleeding from the back passage. You have been meaning to go to your local GP to get a check-up but just have not had a chance. Today your symptoms have gotten acutely worse with the result that you have had to go to Emergency dept (ED) by ambulance. The Emergency dept doctor that examined you looked extremely worried and had you moved to the resus department very quickly. You are hooked up to wires and drips. You have also had a CT scan of your tummy. You don't understand what is going on. You just want to go home.

Clinical Details
You are feeling unwell – the pain in your tummy is unbearable, you feel feverish, a bit dizzy and disorientated. You have been told that a senior surgical doctor is coming to see you soon.

Situation
The reason why you have not had a chance to look after your own health recently is that your wife, who is also 77 has been unwell also. She has a history of Rheumatoid Arthritis and is confined to a wheelchair and has limited hand function. She is unable to care for herself and has had a bad chest infection for the past week. You have no children and you are your wife's sole carer. You don't like the idea of any external help (home help) coming into your home and have refused any social help that you have been offered. You pride yourself in looking after your wife. You main concern now that you are in ED is that she is at home by herself and it is getting late and you thought that you would have been discharged from ED by now. You are unaware and in denial of how serious your clinical condition is. You want to go home tonight.

Your Perspective
All you can think about is your wife who has been by herself all day. You are adamant that you need to go home. You are frustrated that the doctors don't seem to understand this. You think that your health problem can be sorted as an outpatient basis. You don't want to have an operation as who would care for both you and your wife. You and your wife have sworn to each other never to allow the other go to a nursing home.

Your Responses
You don't understand what the doctor is saying to you. You find it difficult to take on board that you need an operation, especially when the doctors start talking about stoma bags – this is unacceptable to you. The task of the doctor is to convince you to stay and consent to an operation and to reassure you sufficiently about how your wife is going to be cared for – you can respond as you feel appropriate.

If the doctor explains clearly and in an appropriate manner what they need to do and why they need to admit you, then you can be cooperative and pleasant. If you find their manner abrupt/unnerving, you can be defensive and uncooperative. If the doctor demonstrates empathy and you feel that they understand how difficult your situation is then you can be co-operative.

Appendix P – Assessment tool for Chapter 4 simulation study

Station: Consent Emergency Laparotomy

Candidate ID:

Communication Skills Process	Not done	Adequate	Good
Initiating the Session			
Introduces self and role, greets individual using their name			
Outlines purpose of the encounter and brief plan of what will be discussed			
Assesses individual's starting point			
Building the relationship			
Listens attentively, minimising interruption and leaving space for replies			
Demonstrates appropriate non-verbal behaviour e.g. eye contact, posture and position, facial expression, use of voice			
Uses empathy to communicate appreciation of the individual's feelings or predicament			
Aiding accurate recall and understanding			
Structures interview in logical sequence, attends to timing, keeps interview on task			
Chunks information and checks individual's understanding, using their response to guide next steps			
Uses clear language, avoids jargon and confusing language			
Achieving a shared understanding: incorporating the other individual's perspective			
Progresses from one section to another using signposting; includes rationale for next section			
Encourages individual to contribute reactions, feelings and own ideas			
Picks up and responds to verbal and non–verbal cues (body language, facial expression)			
Shared decision making, planning and closure			
Explores management options with individual			
Appropriately negotiates mutually acceptable action plan			
Summarises session briefly and clarifies plan of care			

Scenario specific content	**Not Done**	**Adequate**	**Good**
Displays appropriate level of clinical knowledge for year of training and specialty			
Community Support offered (e.g. GP, public health nurse, home help, respite care, community intervention team)			

What is the overall competence of this candidate? (independent of the scores above)		
Not competent ☐	**Borderline** ☐	**Competent/Pass** ☐

BLACK CARD BOX : **Extreme example of worrying or unprofessional behaviour**	(Place X in adjacent box if concerned and explain in the comments section. A' black card 'cannot be considered without comments)	

Comments:	
Examiner name (please print):	
Examiner IMC number (for CPD):	

Appendix Q – Semi-structured focus group interview questions for Chapter 4 simulation study

Focus Group Questions

Thank you all for agreeing to take part in this research project. Your opinions are highly valued and contribute to an important aspect of research. This is a judgement-free zone. I'd like to remind you again that this research process which involved the questionnaire you did, the simulation on gaining consent from the patient and this discussion are independent of the formal UEMS examinations process and will not affect your results. For the purposes of these discussions, video and audio recording will be taken to assist in transcribing. Your identities will not be disclosed.

So - You just completed a clinical scenario on an emergency laparotomy whereby it was difficult to obtain consent from the patient.

> First question is – have you ever come across something like this in your own professional practice? Or alternatively, is this something that you could come across within your own professional practice?

>If yes, what did you do in that scenario?
>Or alternatively, what would you do in that scenario?
> *Sub prompt:* Is this something that you think is reflective of real-life surgical practice?
> *Sub prompt:* What are some of possible decisions you could make in this situation?
> *Sub prompt:* What could be some of the potential influencers in making a decision in this situation?

>Thank you for your responses. Here is the follow up question. Is it your responsibility to perform surgery without consent? Where does overall responsibility lie if so/if not?
> *Sub prompt:* Who are the potential stakeholders involved in making this decision?
> *Sub prompt:* Ultimately, where and how are decisions made like this based on your experience?

>Here are the collected results of the top choices from the questionnaire completed by all of you. Can you talk us through your top choices?
> *Sub prompt:* As you can see, a majority of you chose the following and a minority chose the following. What were your thought processes behind that?

>What influenced your top choices? What influenced your bottom choices? (If there is a disparity amongst results – ask them why they think this disparity exists)
> *Sub prompt:* Was it your own personal experience working in similar situations that influenced your decision making?
> *Sub prompt:* Was it based off your reading and studying for this examination or local protocols that influenced your decision making?
> *Sub prompt:* Was there anything about the environment you were in that influenced your choices
> *Sub prompt:* Would a similar decision be made in a highly pressurised clinical context?
> *Sub prompt:* Or was there any missing pieces of information you'd like to have had to help you make a more informed decision?

>In a situation like this regarding obtaining consent, where would you normally get your information regarding consent?
> *Sub prompt:* Would you typically seek information through verbalising with someone? Or is there any specific websites or resources you would use to seek information on how best to approach consent?
> *Sub prompt:* What are some of the implications of not being informed about consent procedures?

>Finally, we'd like to hear your thoughts on the entire research process – including the questionnaire, the simulation, and this focus group. How did you find the process overall? Would you change anything?
> To reiterate, the information you have provided here is confidential and will be used to enhance and inform the examination experience for future years. With that in mind, what was one thing you liked about the research process here today, one thing you didn't like, and one potential change for next year?

>To summarise, I'd like to draw your attention to the European legislation surround consent. Since UEMS is a body affiliated with the European Union, it operates under European Law. Further information regarding consent can be found at this link: *link to be inserted*

Thank you once again for participating in this process. I wish you all the best in your examinations tomorrow. If you have any further queries or feedback regarding the process please do not hesitate to get in touch with me at whelehd@tcd.ie .

Appendix R - Post-examination questionnaire for clinical decision making simulation study

Follow-Up Survey

1. To what extent did the emergency laparotomy scenario on day 2 of the UEMS examination affect your professional practice?

0 – not at all
1 – to a small extent
2 – to some extent
3 – to a moderate extent
4 – to a great extent
5 – to a very great extent

2. To what extent did you find the emergency laparotomy scenario on day 2 of the UEMS examination useful?

0 – not at all
1 – to a small extent
2 – to some extent
3 – to a moderate extent
4 – to a great extent
5 – to a very great extent

3. Do you think the emergency laparotomy scenario on day 2 of the UEMS examinations was realistic?

1 – yes
2 – no

4. Would you use the emergency laparotomy scenario on day 2 of the UEMS examinations to assess your students?

1-yes
2-no

Please explain your reasoning:

_____

Appendix S – Simulated scenario for Chapter 4 cognitive load assessment of clinical decision making

Rationale: This is an explorative piece of research exploring the following questions:

- How do surgical trainees and surgeons make clinical decisions in a high-stake end of life care scenario
- What factors do surgical trainees and surgeons consider when making clinical decisions
- Does the presence of additional information bias decision-making processes
- Does sleep/deprivation or fatigue impact decision-making processes

The scenario is time pressured and shortened to evoke the presence of intuitive style decision making. Successful participants will decide 'don't know' in the first 3 phases before deciding NOT to operate by phase 4. By deciding to operate/not operate prior to these phases, participants may be utilising heuristic style decision-making ineffectively. Please fill out this questionnaire based on your current levels of sleepiness and fatigue.

Thank you. I would like you to talk through a common procedure with me. I want you give me an idea of how you rationalise your decision making in this scenario. Your performance will be anonymised independently and judged by two experts using assessments modelled off validated measurements of non-technical skill assessment. This scenario will be time pressured. If you go over the time you will receive a penalty. Have a read of the scenario ***give 2 minutes to read***

Scenario:

> **Phase 1:** You are on call as a registrar when a 79-year-old lady lands in the emergency with severe abdominal pain, signs of peritonitis and sepsis. Previously diagnosed with locally advanced carcinoma head of pancreas three months ago, she has been through an initial round of chemotherapy.

Question 1: What are your treatment options? *[20 seconds]*

[conservative, medical, surgical]

Question 2: Which option do you choose? *[20 seconds]*

1. Operate
2. Do not Operate
3. Don't know

[participants should choose don't know at this stage for correct answer]

Question 3: What factors would you need to take into consideration at this point to decide and come to a plan of action? *[40 seconds]*

[likely to be broken down into patient, disease and technical factors]

Question 4: What resources do you need? *[40 seconds]*

[CT, standardised tests etc.]

Phase 2: You have received some extra information.

- The history of the patient shows additional comorbidities of IHD and COPD.
- There is also an ejection fraction of 40%.

Question 5: Which option do you choose? *[20 seconds]*

1. Operate
2. Do not Operate
3. Don't know

[participants should choose don't know at this stage for correct answer]

Question 6: What factors do you need to take into consideration at this point? *[40 seconds]*

[likely to be broken down into patient, disease and technical factors]

Question 7: What resources do you need? *[40 seconds]*

Phase 3: You have received some extra information.

- The lady's husband arrives to the hospital with his daughter and son who has just arrived back from the United States for the first time in 10 years.
- On speaking to the family, you understand that this lady's name is Dolores
- Collateral obtained reports a good baseline function with no issues regarding capacity or ADL assistance.
- They beg you to do everything in your power and anything you can.

Question 8: Which option do you choose? *[20 seconds]*

1. Operate
2. Do not Operate
3. Don't know

[participants should choose don't know at this stage for correct answer]

Question 9: What factors do you need to take into consideration at this point? *[40 seconds]*

[likely to be broken down into patient, disease and technical factors]

Question 10: What resources do you need? *[40 seconds]*

Phase 4: You have received some extra information.

- CT shows an ischemic gut with patchy ischemia in the distribution of the superior mesenteric artery.
- The pain reported by the patient is disproportionate to CT findings.

Question 11: Which option do you choose? *[20 seconds]*

1. Operate
2. Do not Operate
3. Don't know

[participants should choose do not operate at this stage for correct answer]

Question 12: What factors do you need to take into consideration at this point? *[40 seconds]*

[likely to be broken down into patient, disease and technical factors]

Question 13: What resources do you need? *[40 seconds]*

Phase 5: You have decided not to operate **OR** *So you have decided to operate. A new PPOSSUM scores show a morbidity and mortality of 30% and 89%. Consultant anaesthesiologist is not agreeing to bring the patient into surgery.*

Now you are faced with the task of explaining Palliative care and end of life decision making to the patient and her family.

Question 14: What are the key messages you need to convey? *[60 seconds]*

Question 15: What factors do you need to take into consideration at this point? *[60 seconds]*

Phase 6: Now let's debrief on this scenario

Question 16: what motivated you to choose the way you did?

Question 17: If this situation happened to you, what thoughts and emotions would you experience?

Question 18: Impact of non-fatigued state on clinical decision making: This emergency has occurred at 10am in the morning – Using this survey, how difficult would you find this scenario? (Task-Load Index)

Question 19: Impact of fatigued state on clinical decision making: This emergency has occurred at 10am in the morning – Using this survey, how difficult would you find this scenario? (Task-Load Index)

Clinical Case Phase Timing:

1. Phase 1 (2 mins)
2. Phase 2 (2 mins)
3. Phase 3 (2 mins)
4. Phase 4 (2 mins)
5. Phase 5 (2 mins)
6. Phase 6 (1 min)

Appendix T – Proposed tool for Chapter 4 cognitive load assessment of clinical decision making

Standards for Assessment	Global Rating Score
Phase 1	
Decision:	**Operate Not Operate Don't Know**
Considered all relevant treatment options **Performance Checklist:** Providing and maintaining standards Identifying options Balancing risks and selecting options	**4-good** **3-acceptable** **2-marginal** **1-poor**
Considered all relevant biomedical and psychosocial elements in considering plan of action **Performance Checklist:** Planning and preparing Prioritising Providing and maintaining standards Coordinating activities with team members Assessing capabilities Anticipating Identifying options Balancing risks and selecting options	**4-good** **3-acceptable** **2-marginal** **1-poor**
Considered additional resources required to make an informed decision **Performance Checklist:** Providing and maintaining standards Identifying and using resources Coordinating activities with team members Exchanging information Recognising and understanding Anticipating	**4-good** **3-acceptable** **2-marginal** **1-poor**
Phase 2	
Decision:	**Operate Not Operate Don't Know**
Considered all relevant biomedical and psychosocial elements in considering plan of action **Performance Checklist:** Planning and preparing Prioritising Providing and maintaining standards Coordinating activities with team members Assessing capabilities Anticipating Identifying options Balancing risks and selecting options	**4-good** **3-acceptable** **2-marginal** **1-poor**
Considered additional resources required to make an informed decision **Performance Checklist:** Providing and maintaining standards Identifying and using resources Coordinating activities with team members Exchanging information Recognising and understanding Anticipating	
Phase 3	
Decision:	**Operate Not Operate Don't Know**
Considered all relevant biomedical and psychosocial elements in considering plan of action **Performance Checklist:** Planning and preparing Prioritising Providing and maintaining standards Coordinating activities with team members	**4-good** **3-acceptable** **2-marginal** **1-poor**

Assessing capabilities Anticipating Identifying options Balancing risks and selecting options	
Considered additional resources required to make an informed decision **<u>Performance Checklist:</u>** Providing and maintaining standards Identifying and using resources Coordinating activities with team members Exchanging information Recognising and understanding Anticipating	**4-good** **3-acceptable** **2-marginal** **1-poor**
Phase 4	
Decision:	**Operate** **Not Operate**
Considered all relevant biomedical and psychosocial elements in considering plan of action **<u>Performance Checklist:</u>** Planning and preparing Prioritising Providing and maintaining standards Coordinating activities with team members Assessing capabilities Anticipating Identifying options Balancing risks and selecting options	**4-good** **3-acceptable** **2-marginal** **1-poor**
Considered additional resources required to make an informed decision **<u>Performance Checklist:</u>** Providing and maintaining standards Identifying and using resources Coordinating activities with team members Exchanging information Recognising and understanding Anticipating	**4-good** **3-acceptable** **2-marginal** **1-poor**
Phase 5	
Identifies relevant information required to communicate to family **<u>Performance Checklist:</u>** Planning and preparing Prioritising Providing and maintaining standards Exchanging information Using authority and assertiveness Supporting Others Recognising and understanding Anticipating Identifying options Balancing risks and selecting options	**4-good** **3-acceptable** **2-marginal** **1-poor**
Considered all relevant biomedical and psychosocial elements in considering plan of action **<u>Performance Checklist:</u>** Providing and maintaining standards Coordinating activities with team members Exchanging information Using authority and assertiveness Supporting Others Recognising and understanding Anticipating Re-evaluating	**4-good** **3-acceptable** **2-marginal** **1-poor**
Overall Expert Thought	**Performed Exceptionally Well** **Performed Well** **Performed at a minimum level of requirement** **Performed unsafely** **Comments:**

Appendix U - Invitation letter for Chapter 4 and Chapter 5 qualitative interview and assessment of cognitive load clinical decision making

Title: Invitation to participate in a research interview exploring sleep, fatigue and surgical performance

To whom it may concern,

First of all – thank you for your consideration and engagement in previous research surrounding this topic. I am now writing to you to request your participation in a 45-50 minute interview in the Trinity Centre for Health Sciences or online. The purpose of this research is to inform a multi-faceted intervention to enhance surgical performance.

Please see attached below a participant information letter explaining this study further. Should you wish to partake in the study, or have any questions relating to the study please email whelehd@tcd.ie or contact me on 0852041559 for further details.

Your participation in this study is completely voluntary and all of your information will be kept confidential. The data will be used for publishing and research purposes only. If you are unsatisfied with the management of your personal data within this study, you have a right to lodge a complaint with the Data Protection Commissioner. The SJH/AMNCH Joint Research Ethics Committee has approved this study.

Thank you for your time and consideration.

Sincerely,

Dale Whelehan

Research Doctorate Student
Discipline of Surgery,
School of Medicine,
Trinity College Dublin

Appendix V - Participant information letter for Chapter 4 and Chapter 5 qualitative interview and assessment of cognitive load clinical decision making

Participant Information Leaflet

Study title: To examine if sleep deprivation impacts on surgical skill performance

You are being invited to take part in a research study to be carried out at Tallaght University Hospital as part of a research doctorate degree affiliated with Trinity College Dublin, The University of Dublin looking at work-place based activities in surgeons. This study has Joint SJH/AMNCH Research Ethics Committee approval.

Before you decide whether or not you wish to take part, you should read the information provided below carefully. Take time to ask questions – don't feel too rushed or under pressure to make a quick decision. Your participation in this study is completely voluntary.

You should clearly understand the risks and benefits of taking part in this study so that you can make a decision that is right for you. This process is known as 'Informed Consent'.

You can change your mind about taking part in the study any time you like. Even if the study has started, you can still opt out. You don't have to give us a reason. If you do opt out, rest assured it won't affect your future employment in Tallaght University Hospital or elsewhere.

Why is this study being done?

This research study is taking place to explore your thoughts and understanding of the relationship between professional performance, sleep deprivation and fatigue.

As a result of initiatives made in the previous decades, such as the ACGME and EU-working directives, which limit doctors in the amount of hours they can work, the topic of sleep and surgery has been at the forefront of discussions. Sleep deprivation in medicine has been thoroughly researched both in the context of simulation and retrospective analysis of workload. A lot of this research has found that sleep deprivation leads to an increase cognitive load, which increases risk of performance error.

This research aims to develop a process theory to establish standards of performance with the view to establishing impact measurements in a prospective intervention study. Qualitative approaches to explore this is warranted to appreciate the greater understanding between profession and non-professional causations of sleep deprivation and fatigue, and how that may impact on surgeons ability to perform professionally.

Why am I being asked to take part?

You are being asked to take part in this study as participation is aimed at participants of differing levels of experience and training in the surgical profession i.e. senior house office, register, consultancy.

Specifically, this research aims to:

- To explore self-awareness of sleep deprivation and fatigue in surgeons
- To explore professional and non-professional causations of sleep deprivation and fatigue in surgeons
- To explore sleep deprivation and fatigue impact on professional performance
- To explore mitigating strategies for fatigue management
- To explore willingness to disclose levels of sleep to patients
- To explore social resilience amongst surgical teams in fatigued states
- To establish validity of potential assessments and interventions to mitigate fatigue related decrement with the view to establishing a fatigue risk management programmes
- To track sleep and wakefulness behaviours of surgeons

Do I have to take part? What happens if I say no? Can I withdraw?

You don't have to take part in this study. If you decide not to take part it won't affect your professional career. You can change your mind about taking part in the study and opt out at any time even if the study has started. If you decide to opt out, it won't affect your professional career. You don't have to give a reason for not take part or for opting out. If you wish to opt out, please contact Dale Whelehan, Principal Investigator (whelehd@tcd.ie) who will be able to organise it for you.

What will happen to me if I agree to take part?

This study will commence in March 2020 in Tallaght University Hospital. Participants will be expected to a 45 minute interview with one of the research team investigators (Dale Whelehan or Maria Mahood) in Room 1.37 in the Trinity Centre for Health Sciences, Tallaght University Hospital. Participants will also be expected to complete a series of questionnaires relating to their sleep schedule and performance alertness. They will also complete a clinical decision making scenario which will be confidentially graded by two experts using a modified version of the Alternative Clinical Examination 'ACE' tool of non-technical skill assessment Participants will also be invited to use the sleep tracker 'Oura©', which is a sleep tracker app to measure quantity and quality of sleep.

Are there any benefits to me or others if I take part in the study?

The process may allow participants to become more aware of their levels of sleepiness which may offer mitigating opportunities to mediate any potential risks of practicing while feeling tired. It is envisaged that this observational study will also inform a future intervention study in the area of sleep management and hygiene in the surgical profession. Participants will have further opportunities to engage in future studies and benefit from potential interventions.

Are there any risks to me or others if I take part in the study?

It is not envisaged that this study will provide any major risks to participants. All information disclosed as part of the interview process will be recorded for transcription purposes. This data will be transcribed by Dale Whelehan and Maria Mahood. Data will be confidentially coded by Dale Whelehan prior to analysis of the findings. The coded transcripts will be shared with Dr. Taryn Taylor, Western University Ontario who will assist in data analysis theme formation. Dale Whelehan is an independent researcher with physiotherapy background. Non-confidential data will not be made available to research members from Dept. Surgery. Should participants feel overwhelmed by the process, the researchers involved will offer to assist the participant in seeking assistance from Occupational Health, private counselling or nationally available counselling therapies such as Samaritans.

Will I be told the outcome of the study? Will I be told the results of any tests or investigations performed as part of this study that relate to me?

If you decide to partake in using the 'Oura ©' tracker device this data will be made readily available to you on the '*Oura ©*' app. The collective research findings as agreed by the established research objectives aim to be presented as part of a PhD thesis, in a peer-reviewed academic journal and conferences.

What information about me (i.e. *personal data*) will be used as part of this study?

The following personal data will be collected for research purposes:

Sleep Oura© Related Data will use infrared optical pulse measurement, 3D accelerometer, gyroscope and body temperature sensor to infer:

-Wakefulness

-NREM and REM sleep

- Heart rate and Resting Heart Rate

- Heart Rate Variability

- Respiration Rate, Breathing Variance

- Recovery from Daily Mental and Physical Strain

- Inactivity and sedentary time

Interview Related Data:

-Workflow and Training

-Hours of sleep at night

-Awareness of recommended guidelines

-Professional and non-professional causes of sleep deprivation

-Wellbeing questions relating to hydration, diet, exercise, social interaction

-Perception of 'surgical performance'

-Case examples regarding sleep deprivation impacting on performance

-Disclosure of culture-specific issues relating to surgical profession with regards to sleep

-Self-awareness of fatigue

-Mitigating strategies and interventions associated with fatigue

-Perception of making patients aware of sleep levels

-Social resilience of surgical team

-Emotional state after on-call

-Anything else pertinent to the topic of sleep, fatigue and surgical performance in which the participant wished to disclose

Survey Collection:

1. A series of *sleep related measurements* including

-Alertness using the validated *Karolinska Sleepiness Scale*

-Circadian Rhythm using the validated *Morningness-Eveningness Questionnaire*

What will happen to my personal data?

All data relating to participants findings will be made confidential. Confidential data will be shared with collaborator Dr. Taryn Taylor in Western University, London Ontario for data analysis purposes. This information will be kept for 5 years and may be used in further studies within this timeframe. These future studies may involve potential intervention studies that are informed by the research outputs of this research project. A DPIA has been completed for this study in accordance with JREC requirements.

Who will access and use my personal data as part of this study?

Access to completed interviews will be limited to the research team comprising of Principal Investigator Mr. Dale Whelehan and co-investigator Dr. Maria Mahood. Confidentiality will be maintained through removing any identifiable characteristics before data analysis which will additionally comprise of input from Dr. Taryn Taylor and research supervisor Professor Paul Ridgway.

Will my personal data be kept confidential? How will my data be kept safe?

We will be using your information in our research to help us study the relationship between sleep deprivation and surgical performance. This is intended for science research use. Participant's information will be limited to the research team involved in this study and stored for 5 years in Dis. Surgery, Trinity Centre for Health Sciences. All data relating to participants findings will be computerised and encrypted and coded. Personal information that could identify the participant will be removed to protect the confidentiality of the participant.

What is the lawful basis to use my personal data?

The basis for use of your personal data is in accordance with Article 6 and Article 9 of GDPR:

What are my rights?

You have the right to withdraw consent to your data being used in this research project. You will be able to do this by contacting Dale Whelehan at whelehd@tcd.ie who will have access to the coded participant information. You have a right to request access to your data, as well as a copy of your data. You have a right to restrict or object to processing of your personal data. You have a right to have any inaccurate personal information corrected or deleted. You have a right to have your personal data deleted, unless the request is impossible or hinders conduct of the research. You have the right to data portability.

Will it cost me anything if I agree to take part?

No. This study will not incur any personal cost.

Who is organising this study?

This principal investigator of this research is Dale Whelehan, a research doctorate student in surgery affiliated with Trinity College Dublin, The University of Dublin under the supervision of Professor Paul Ridgway, Director of Perioperative Care, Tallaght University Hospital and Associate Professor in Surgery, in conjunction with Dr. Maria Mahood, Research Masters Student, Trinity College Dublin and Dr. Taryn Taylor, Associate Professor in Western University London Ontario.

Has this study been approved by a research ethics committee?

The SJH/AMNCH Joint Research Ethics Committee has approved this study in February 2020.

Will my personal data be used in future studies?

The research team intends to use your personal data for future research studies to inform and intervention study in the area of sleep deprivation and surgery. Participants information will be limited to the research team involved in this study and stored for 5 years.

Where can I get further information?

If you need any further information now or at any time in the future please see the 'Statement of Information Practice' affiliated with Tallaght University Hospital (*http://www.tuh.ie/About-us/Statement-of-Information-Practice.pdf)*, or contact:

Principal investigator's name:	**Dale Whelehan**
Principal investigator's title:	**Research Doctorate Student, TCD**
Telephone number of principal investigator:	**0852041559**
Supervisor/co-investigator's name:	**Paul Ridgway**
Supervisor/co-investigator's title:	**Associate Professor in Surgery, TCD**
Data Controller's/joint Controller's identity:	**Dale Whelehan and Paul Ridgway**
Data Controller's/joint Controller's details:	**whelehd@tcd.ie ridgwayp@tcd.ie**
Data Protection Officer details:	**dpo@tuh.ie**

What happens if I wish to make a complaint?

You have a right to lodge a complaint with the Data Protection Commissioner if you are unsatisfied with the management of your personal data within this study.

Will I be contacted again?

You may be contacted throughout the study process in order to arrange times for assessments. You may also be contacted for prospective future research in this area within a 5 year period.

Thank you for your consideration,

Dale Whelehan

Research Doctorate Student

Discipline of Surgery,

School of Medicine,

Trinity College Dublin, The University of Dublin

Appendix W – Interview guide for Chapter 5 qualitative study on fatigue

Introduction

Thank you: First of all, thank you for taking the time out of your day to take part in this piece of research. I just want to assure you that anything you say in this room will remain anonymous.

Purpose: The purpose of this research is to explore the topic of sleep, fatigue and surgical performance.

Disclosures: To do this, I will be asking you a series of questions relating to these topics. I want you to answer as openly and honestly as you feel comfortable to. There are no right or wrong answers in this interview. I will be recording this conversation for the purposes of transcribing the dialogue at a later stage so as to ensure I can devote my full attention to you now. You may refuse to answer or skip any questions and you can end the interview at any time. Prior to anonymizing the transcripts, you may request to withdraw your data.

Consent: You have been provided with further information relating to the study in the participation information leaflet. Have you any questions about the consent process or regarding this project? If not, can you please sign this consent form for me please?

Demographics

At the beginning, I'd like to ask some basic demographics.

Years of Training/Work:

1. How many years have you been in surgical training/working in surgery?

Life flow:

2. What is a typical Monday-Sunday flow like for you?

Genotypical Alertness:

3. Finally, there is one last survey I'd like for you to fill out. It is the Morningness-Eveningness Questionnaire. This will help us determine your genotypical level of 24-hour alertness. Thank you.

Surgical Performance Definition

The first question I'd like to open up with.

4. What does being a surgeon mean to you?
5. What do you understand of the term 'competent surgical performance'? i.e. what does this encompass?

Sleep Definition

Next we're going to talk a little bit about sleep.

6. What do you see are the main important functions of sleep?
7. How many hours of sleep do you think is a 'healthy' amount of sleep?

Personal Relationship with Sleep

A follow up to that question,

8. how many hours of sleep do you typically get?
9. Would you say this is consistent?

Sleep/Fatigue and Professional Practice

Self-awareness:

10. Do you have an awareness of your fatigue when at work?
11. Is there any particular time during the week/day you feel your workplace performance is most vulnerable?

Example:

12. Describe a time you experienced fatigue while working?

Professional tasks impacted:

Tasks impacted:

13. Are there any tasks you would avoid or struggle with in a sleep deprived state for (a) yourself, (b) for patient care?

Examples:

14. What measurable aspects of your performance are most impacted by sleep deprivation? Can you provide some examples?

Mitigating strategies:

15. When you do become aware, do you change your performance in anyway, or your workflow? Or have you any other strategies?

Sleep and On-call Work as a Surgeon

Personal Impact:

16. How does on-call or shift-associated work typically affect your sleep pattern?
17. How does recovering from the 'sleep debt' accumulated during the shift work affect your ability to sleep on recovery?
18. How do you typically feel after a night on-call?

Personal Monitoring:

19. How do you typically look after yourself while you're on call?

Clinical Scenarios

Next we're going to talk about a few scenarios and how you typically would respond. As a reminder, all this information is confidential.

Team Fatigue
A colleague has told you they only got 2 hours of sleep last night. You know that this is a frequent occurrence and they often look quite tired during the working day.

Reaction to Team Fatigue:

20. How would you typically respond/react?

Impact of Sleep Deprivation on Team Awareness of Performance:

21. In your experience how well do other surgeons assess the impact of their fatigue on their performance?

Impact of Sleep Deprivation on Team Social Resilience:

22. How does fatigue affect team performance? Is there flexibility in the team to support the colleague?

Peer Support:

23. What advice have you received from colleagues/supervisors about how to manage fatigue?

Fatigue and Patient Care

It's 8 am and you're about to perform an elective case for patient, Ms Smith. You've been up all night managing a complex case, with unanticipated surgical complications. Noting that you look a bit tired/worn out, Ms Smith asks you how many hours of sleep you got last night.

Reaction to Patient Concern:

24. How would you typically respond/react?

Impact of Sleep Deprivation on Patient Care:

25. How does fatigue affect patient care?

Sleep, Fatigue and Surgery Beliefs

***General beliefs*:** Fatigue and sleep deprivation is reported in the literature surrounding surgeon's work life.

26. What are your thoughts about this?

Relationship between fatigue and sleep:

27. What do you understand about the relationship between these two?

Relationship between fatigue, sleep and performance:

28. How do you reconcile your experience with the literature that suggests sleep deprivation and fatigue is dangerous?

Interventions Validation

We're going to talk about the changes necessary to improve your personal and professional performance. Please be as imaginative as possible. Imagine you could wave a magic wand. First I will ask you for your general thoughts and will then ask your thoughts on some specifics.

Experience:

29. Has your approach to managing fatigue changed over the years? If so, how?

European Working Time Directive:

30. Can you tell me a little bit about your understanding of working hour regulations?

Education:

31. Is education around fatigue management a valuable insight for you?

Cultural Awareness:

32. Are frank, open conversations amongst teams about the impact of sleep deprivation on their performance a potentially useful activity?

Personal Modifications:

33. What changes do you think would be effective in your personal life to improve your levels of fatigue?

Professional Modifications:

34. How is fatigue management managed by the hospital? What changes do you think could improve fatigue-levels here in the hospital?

Tracking and Monitoring:

35. How would a tracker or monitor inform your work behaviours if it could indicate whether you were at risk of performance impairment?

Fatigue and Clinical Decision Making

Closing Thoughts

Thank you for answering so openly with me today. Your thoughts and reflections will inform a multi-faceted intervention to address some of the topics we discussed today. Before we finish up,

36. Is there anything else relating to this discussion or research that you would like to discuss? If not, thank you once again.

Appendix X – Interview guide for Chapter 5 qualitative study on impact of COVID-19

UNINTENDED CONSEQUENCES OF PANDEMIC ADAPTIONS ON SURGICAL PERFORMANCE

Please answer these questions in the context of COVID changes, compared to your typical surgical practice and performance.

1. **Has changes in work practice affected fatigue, sleep levels and your overall surgical performance?**
    a. Do you feel any different with fatigue levels? Is it a different type of fatigue?
    b. Has your sleep pattern changed in any way? If so, how?
    c. How has your overall surgical performance (divided into your technical, cognitive and emotional performance) changed?
2. **Has COVID and the changes in systems affected your work as a consultant?**
    a. What changes in management have occurred?
    b. Has this changed your level of professional identity?
    c. What are your overall thoughts on the ramifications of surgery for you as a consultant?
3. **Has COVID impacted on the provision of services in surgery?**
    a. What has changed since the pandemic arose in Ireland?
    b. You are working new types of rotas with different resources – how has this impacted your level of professional engagement or satisfaction in work?
4. **Has the increased PPE requirements impacted on your performance as a surgeon?**
    a. are you required to take more regular breaks now?
    b. Has the pace of work slowed down?
    c. Do you feel as 'in control' of your performance when wearing PPE?
    d. Has PPE had an impact on any particular aspects of your workflow or your surgical performance?
5. **Has the COVID pandemic overall impacted on your personal wellbeing?**
    a. Is there anything particular you've noticed differently in your own life that may be causing you greater/lesser levels of stress and/or fatigue?
    b. Is there any changes in work practice that have influenced your levels of stress and/or fatigue?
6. **Is there anything else you would like to comment on with particular reference to the impact of the COVID pandemic on levels of fatigue (more broadly or specifically in work) and surgical performance?**

Appendix Y - Invitation letter and graphic for Chapter 6 survey study on modifiable factors that impact surgical performance

Invitation for Survey on Surgical Profession – Your Health and Work

To whom it may concern,

I am writing to you to request your participation in a brief survey. The purpose of this survey is better understand your professional and lifestyle behaviours as well as perceptions of the workplace. The summative results of this survey, in conjunction with other ongoing research in the area of sleep and surgical performance will inform future research initiatives to enhance your well-being and professional performance.

The survey should take approximately **5-10 minutes** to complete. Please answer openly and honestly. **All answers are anonymous**. Completion of this survey is indicative of informed consent and data will be collected if you exit the survey before completion. Please see attached a Participant Information Letter with further information regarding the research and data management for your due consideration.

If interested, please click the following link to complete the survey:
https://www.surveymonkey.com/r/SurgeonsHealthAndWorkCheck

Should you have any comments or questions please feel free to contact me at whelehd@tcd.ie or on 0852041559.

Thank you for your time and consideration.

Sincerely,

Dale Whelehan

Appendix Z – Participant information letter for Chapter 6 survey study on modifiable factors that impact surgical performance

Participant Information Leaflet

Introduction

It is known that the work a surgeon can highly pressurised and stressful. As a result of initiatives made in the previous decades, such as the ACGME and EU-working directives, which limit doctors in the amount of hours they can work, the topic of wellbeing and the surgical profession has been at the forefront of discussions. Lifestyle medicine and professional adaptions has shown promising results in addressing ongoing issues surrounding topics of fatigue and burnout in the surgical profession. This survey explores these topics in the context of surgical staff. This research project will inform a multifaceted intervention to enhance surgical performance as part of a research doctorate project in the area of modifiable factors that affect surgical performance.

Procedures

To complete this survey you must be affiliated with Association of Surgeons in Training (ASIT). The survey consists of a series of questions relating to personal lifestyle and perceptions of professional workstyle factors. It should take approximately **5 minutes** to complete. Should you decide to complete the survey, please return responses by **June 15th.** . You should note that by completing and returning the survey you are providing your informed consent to participate in this study and data will be collected if you exit the survey before completion.

Please click the link to complete the survey:

XXXX

Confidentiality and Voluntary Participation

Your participation in the survey is completely voluntary and all of your responses will be kept confidential. This is an anonymous survey and means you cannot withdraw your response if you complete and submit the survey. If you decide not to participate, or if you withdraw, you will not be penalised. No personal identifiable information will be associated with your responses to any reports of these data. Your IP address will not be recorded and therefore cannot be traced. The SJH/AMNCH Research Ethics Committee has approved this survey.

Contact Details

Should you have any comments or questions please feel free to contact me at whelehd@tcd.ie or 0852041559.

Thank you for your consideration and engagement with this research project.

Appendix AA – Chapter 6 survey instrument on modifiable factors that impact surgical performance

Which of the following best describes your professional title?
Intern
Senior House Officer
Registrar
Consultant
Q1. In general, how would you rate your overall health?
Excellent
Very good
Good
Fair
Poor
Q2. Do you currently smoke cigarettes, or not?
Yes, I do
No, I do not
Q3. About how many caffeinated drinks do you have each day?
0
1-4
5-8
9-12
Q4. How many litres of water would you drink daily?
insert figure
Q5. How many hours do you sleep on average each night on a week without on-call?
insert figure
Q6. In general, how would you rate your overall daily work performance when you're not on-call?
Excellent
Very good
Good
Fair
Poor
Q7. How many hours on average do you sleep when on-call?
Scale
Q8. In general, how would you rate your overall daily work performance when on-call?
Excellent
Very good
Good
Fair
Poor
Q9. How many hours on average do you sleep after on-call?
Scale
Q10. Would you consider your sleep pattern consistent?
Yes
No

Q11. In a typical week, how often do you feel fatigued at work?
Always
Most of the time
About half of the time
Once in a while
Never
Q12. In a typical week, how often do you feel fatigue negatively impacts your ability to perform surgical tasks optimally?
Always
Most of the time
About half of the time
Once in a while
Never
Q13. In a typical week, how often do you feel fatigue negatively impacts your ability to perform non-surgical professional tasks optimally?
Always
Most of the time
About half of the time
Once in a while
Never
Q14. I manage work-related fatigue effectively.
Strongly Disagree
Disagree
Neither Agree nor Disagree
Agree
Strongly Agree
Q15. In a typical week, how often do you feel stressed at work?
Always
Most of the time
About half of the time
Once in a while
Never
Q16. I find it easy to switch off after work.
Strongly Disagree
Disagree
Neither
Agree
Strongly Agree
Q17. How long do you typically spend commuting to work daily?
5-10 minutes
11-30 minutes
31-45 minutes
46-60 minutes
61-75 minutes
76-80 minutes
Greater than the above
Q18. How long do you typically spend commuting from work daily?

5-10 minutes
11-30 minutes
31-45 minutes
46-60 minutes
61-75 minutes
76-80 minutes
Greater than the above
Q19. About how many times in the average week do you engage in 30 minutes of light activity (i.e., leisurely walking, gardening, cleaning around the house)?
0
1
2
3
4
5 or more
Q20. About how many times in the average week do you engage in 30 minutes of moderate activity (i.e., brisk walking, light bicycling)?
0
1
2
3
4
5 or more
Q21. About how many times in the average week do you engage in 30 minutes of strenuous activity (i.e., running or jogging)?
0
1
2
3
4
5 or more
Q22. Do you feel you get too much exercise, too little exercise, or about the right amount of exercise?
Much too much
Somewhat too much
Slightly too much
About the right amount
Slightly too little
Somewhat too little
Much too little
Q23. How important is exercise to you?
Extremely important
Very important
Somewhat important
Not so important
Not at all important
Q24. About how many alcoholic drinks do you have each week?
0
1-4

5-8
9-12
13-16
More than 16
Q25. About how often do you eat breakfast?
Every day
Three or more times a week
Fewer than three times a week
Only on weekends
I rarely eat breakfast
Q26. About how often do you eat lunch?
Every day
Three or more times a week
Fewer than three times a week
Only on weekends
I rarely eat lunch
Q27. About how often do you eat dinner?
Every day
Three or more times a week
Fewer than three times a week
Only on weekends
I rarely eat dinner
Q28. About how often do you eat fast food?
Every day
A few times a week
A few times a month
Less than a few times a month
Never
Q29. In a typical day, how many microwavable or ready-made meals do you eat?
insert figure
Q30. About how often do drink sugar-carbonated beverages?
Every day (Several Times)
Every day (Once)
A few times a week
A few times a month
Less than a few times a month
Never
Q31. About how often do eat sweet things e.g., sweets, chocolate, crisps?
Every day (Several Times)
Every Day (Once)
A few times a week
A few times a month
Less than a few times a month
Never
Q32. About how many portions of fruit do you eat each day? If you don't know for certain, please provide an estimate.

None
One
Two-Three
Four-Five
Six or more
Q33. About how many portions of vegetables do you eat each day? If you don't know for certain, please provide an estimate.
None
One
Two-Three
Four-Five
Six or more
Q34. When is the last time that you saw a doctor?
Less than 6 months ago
6 months ago, to less than 1 year ago
1 year ago, to less than 2 years ago
2 years ago, to less than 3 years ago
3 or more years ago,
Q35. When is the last time that you saw a dentist?
Less than 6 months ago
6 months ago, to less than 1 year ago
1 year ago, to less than 2 years ago
2 years ago, to less than 3 years ago
3 or more years ago
Q36. In general, how would you rate your overall mental or emotional health?
Excellent
Very good
Good
Fair
Poor
Q37. During the past 4 weeks, how bothered did you feel by emotional problems such as feeling anxious, depressed, irritable, or sad?
Extremely bothered
Very bothered
Somewhat bothered
Not so bothered
Not at all bothered
Q38. During the past 4 weeks, how disruptive were your physical health or emotional problems to your normal social activities with family, friends, neighbours, or groups?
Extremely disruptive
Very disruptive
Somewhat disruptive
Not so disruptive
Not at all disruptive
Q39. During the past 4 weeks, how disruptive were your physical health or emotional problems to your normal professional activities?
Extremely disruptive
Very disruptive
Somewhat disruptive

Not so disruptive
Not at all disruptive
Q40. During the past 4 weeks, how supported did you feel when you wanted or needed help from others? For example, if you felt lonely and wanted to talk to someone or got sick.
Extremely supported
Very supported
Somewhat supported
Not so supported
Not at all supported
Q41. Staff are treated fairly when they make mistakes.
Strongly Disagree
Disagree
Neither Agree nor Disagree
Agree
Strongly Agree
Q42. We have enough staff to handle the workload.
Strongly Disagree
Disagree
Neither Agree nor Disagree
Agree
Strongly Agree
Q43. If asked, I would honestly tell patients how much sleep I had before their surgery.
Strongly Disagree
Disagree
Neither
Agree
Strongly Agree
Q44. Error disclosure is promoted and implemented effectively in our profession.
Strongly Disagree
Disagree
Neither Agree nor Disagree
Agree
Strongly Agree
Q45. I have made minor work-errors as a result of fatigue.
Strongly Disagree
Disagree
Neither Agree nor Disagree
Agree
Strongly Agree
Q46. I have made major work-errors as a result of fatigue.
Strongly Disagree
Disagree
Neither Agree nor Disagree
Agree
Strongly Agree

Appendix AB – Clinical sensibility testing measurement for Chapter 6 survey study design

Clinical sensibility testing tool

1. To what extent are the questions directed at important issues pertaining to lifestyle and work related factors in surgeons? (Please circle your response).

Small extent	Limited extent	Fair extent	Moderate extent	Large extent

2. To what extent are the response options provided simple and easily understood? (Please circle your response).

Small extent	Limited extent	Fair extent	Moderate extent	Large extent

3. How many items are inappropriate or redundant? (Please circle your response).

Very many	Many	Some	A few	Hardly any

4. How long did it take you to complete the questionnaire? _____ minutes

Thank you for your assistance

Appendix AC – Kendall's-tau correlations for Chapter 6 survey study design

Determining variables									
	Q1 Self-rated overall health	*Q37 Self-rated mental wellbeing*	*Q38 Regularly bothered by anxious and/or depression*	*Q12 Often self-report fatigued*					
Q1 Self-rated overall health	--	.415**	-.204*	-.282**					
Q37 Self-rated mental wellbeing	.415**	--	-.477**	-.329**					
Q38 Regularly bothered by anxious and/or depression	-.204*	-.477**	--	-.386**					
Q12 Often self-report fatigued				--					
Work: Culture									
	Q42 Staff treated fairly	*Q44 Honesty patients sleep*	*Q45 Error disclosure promoted*						
Q42 Staff treated fairly	--	.209*	.313*						
Q44 Honesty patients sleep	.209*	--	.214*						
Q45 Error disclosure promoted	.313*	.214*	--						
Work: Resources									
	Q43 Enough staff								
Q43 Enough staff	--								
Work: Commute									
	Q18 Commute to work	*Q19 Commute from work*							
Q18 Commute to work	--	.854**							
Q19 Commute from work	.854**	--							
Work: On-call work									
	Q15 Often on-call	*Q8 On-call sleep hours*	*Q10 After call sleep hours*						
Q15 Often on-call	--	.190*	.161						
Q8 On-call sleep hours	.190*	--	.119						
Q10 After call sleep hours	.161	.119	--						
Work: Performance management									
	Q7 Performance off-call	*Q9 Performance on-call*	*Q13 Fatigue with surgical tasks*	*Q14 Fatigue with non-surgical tasks*	*Q39 Disruptive social activities*	*Q40 Disruptive professional activities*	*Q46 Minor errors from fatigue*	*Q47 Major errors from fatigue*	
Q7 Performance off-call	--	.474**	-.099	-.090	-.105	-.196*	.024	-.024	
Q9 Performance on-call	474**	--	-.183	-.249**	-.100	-.265*	.181	.100	
Q13 Fatigue with surgical tasks	-.099	-.183	--	.628**	.034	.126	-.280**	-.395**	
Q14 Fatigue with non-surgical tasks	-.090	-.249**	.628**	--	.165	.212*	-.293**	-.283**	
Q39 Disruptive social activities	-.105	-.100	.034	.165	--	.510**	-.041	-.009	
Q40 Disruptive professional activities	-.196*	-.265**	.126	-.212*	.510**	--	-.024	-0.047	
Q46 Minor errors from fatigue	.024	.181	-.280**	-.293**	-.041	-.024	--	.400**	
Q47 Major errors from fatigue	-.024	.100	-.395**	-.283**	-.009	-.047	.400**-.	--	
Life: Smoking and Alcohol									
	Q2 Smoking	*Q25 Weekly alcohol intake*							
Q2 Smoking	--	-.012							
Q25 Weekly alcohol intake	-.012	--							
Life: Caffeine									
	Q3 Daily caffeine								
Q3 Daily caffeine	----								

Life: Hydration									
	Q4 Daily water								
Q4 Daily water	--								
Life: Sleep and Fatigue									
	Q6 Average sleep hours	*Q11 Consistent sleep pattern*	*Q15 Manage fatigue effectively*						
Q6 Average sleep hours	--	-.235*	.141						
Q11 Consistent sleep pattern	-.235*	--	-.159						
Q15 Manage fatigue effectively	.141	-.159	--						
Life: Stress									
	Q16 Often stress at work	*Q17 Easy to switch off*	*Q41 Supported feel at home*						
Q16 Often stress at work	--	.347**	-.177*						
Q17 Easy to switch off	.347**	--	-.102						
Q41 Supported feel at home	-.177*	-.102	--						
Life: Physical Activity and Exercise									
	Q20 Light activity	*Q21 Moderate activity*	*Q22 Strenuous activity*	*Q23 Amount of exercise*	*Q24 Importance of exercise*				
Q20 Light activity	--	628**	424**	-.350**	-.174*				
Q21 Moderate activity	.628**	--	433*	-.421*	.154				
Q22 Strenuous activity	.424**	.433*	--	-.524**	-.274**				
Q23 Amount of exercise	-.350**	-.421*	-.524**	--	.257**				
Q24 Importance of exercise	-.174*	-.154	-.274**	.257**	--				
Life: Diet									
	Q26 Often breakfast	*Q27 Often lunch*	*Q28 Often dinner*	*Q29 Often fast-food*	*Q30 Often ready-made meal*	*Q31 Often sugary drinks*	*Q32 Often sweet things*	*Q33 Portions of fruit*	*Q34 Portions of vegetable*
Q26 Often breakfast	--	249**	.040	-.204*	.105	-.124	-.153	-.223*	-.158
Q27 Often lunch	.249**	--	.131	.081	052	015	066	.156	-.249**
Q28 Often dinner	.040	.131	--	-.252**	.421**	-.162	.113	-.087	-.223*
Q29 Often fast-food	-.204*	.081	-.252**	--	-.391*	.221*	.248*	.182*	.246**
Q30 Often ready-made meal	.105	.052	.421**	-.391*	--	-.178*	-.118	.012	-.372**
Q31 Often sugary drinks	-.124	.015	-.162	.221*	-.178*	--	.222*	.065	.147
Q32 Often sweet things	-.153	.066	-.113	.248*	-.118	.222*	--	.163	.270**
Q33 Portions of fruit	-.223*	-.156	-.087	.182*	.012	.065	163	--	.378**
Q34 Portions of vegetable	-.158	-.249**	-.223*	.246**	-.372**	.147	270**	.378**	--
Life: Health checks									
	Q35 Last time doctor	*Q36 Last time dentist*							
Q35 Last time doctor	--	.168*							
Q36 Last time dentist	.168*	--							

Appendix AD – Chapter 7 Interview guide for thriving in surgery

Please answer these questions in the context of your own understanding of the question. Please feel free to ask any questions or make any observations relating to the question.

1. **First, can you tell me what do you understanding of the term 'thriving'?**
    a. What does 'thriving in surgery' mean to you?
    b. What could 'thriving in surgery' mean for surgeons overall?
    c. If you were to describe thriving to a non-surgeon, what would be some of the key words you would use to describe?
    d. Does this term resonate with you personally? If not, why?
2. **Next, I'd like to ask you about some of the enablers, or promotors of 'thriving'**
    a. What are some things in your own life that have helped you feel a sense of 'thriving' ?
    b. More specifically, is there anything in your work that helps promote thriving?
    c. If you could wave a magic wand, what would you change in your own life and/or workplace to facilitate thriving?
3. **Finally, we've discussing meaning enablers but what are some things that inhibit thriving in surgery?**
    a. What barriers exist in your personal experience to a sense of thriving?
    b. Is there anything personally which you could change that would allow you to thrive more?
    c. If you could wave a magic wand, what changes would you make to remove the barriers to thriving?
4. **Is there anything else you would like to comment on with particular reference to thriving in surgery?**

Appendix AE – Contextual factors influencing behaviour of surgeons

Defining the context:

One of the key considerations in intervention design is understanding from commencement that theoretical analysis of the target behaviour must be considered within its context. The question that had to be answered was 'what is the contextual factors which are influencing surgeons behaviours?' . Using the qualitative findings of this project, it is evident that surgeons were working long-hours, most of which were non-compliant with the EWTD limit of 48 hours/week, in a resource constraint environment. This places huge work demands to meet both training needs and service delivery needs to protect patient care. Further issues of negative cultural norms within the profession, such as bravado culture, leads to inertia in placing parity of importance on self-regulation of performance as an indicator of optimising surgical performance. This leads to poor individual, professional, and system based efforts to tackle known modifiable variables that decrement performance such as fatigue.

Individual	
Knowledge and information about thriving and relevant scientific domains	Physical health
Perception of risk in making change	Emotional and mental health
Skills and abilities to practice behavioural change e.g. mindfulness	Distrust of behavioural science
Motivation	Fear of stigma for making change
Emotions	Self-efficacy to adhere
Denial of behaviour	Attitudes towards mental health/emotional health/psychology/performance management
Intentions/readiness to change	Perceived social norms
Coping mechanisms – 'resiliency'	Perceived control
Personal income and socioeconomic status	Personal beliefs about sleep/fatigue/performance management/human factors/thriving and positive psychology
Outcome expectations	Empowerment
	Preparatory behaviour
Interpersonal/network	
Relationship powers and equity	Relationships satisfactions
Social support and trust (within work and outside work)	Communication levels with others
	Social networks
Community of Surgery	
Stigma	Cultural norms (masculinity, old boys club)
Peer pressure	Diverse population culturally (Middle Eastern, USA, Canadian, UK, Ireland)
Social norms of non-focus on psychological wellbeing and performance management	-isms (sexism, racism, masochism)
Institutional Health System	
Provision of appropriate services for performance management	Sufficient resourcing of environment
Competent, supportive and accessible support providers	Confidentiality and privacy
Modeling and peer advisors	Service integration
Friendly environment	System efficiencies
Structural	
Access to services (time, communication, cultural)	Training curriculum within RCSI and in-house (service delivery dominates)
Costs of services and fall out to patient care	Public policy and laws (consultant pay, EWTD, IMO call for industrial action)
Political context and priorities not on healthcare provision efficiency (COVID-19)	Enforcement of regulations and legislations
Funding for behavioural science interventions	Gender equity

Appendix AF – Identified behavioural constructs and associated considerations for Chapter 7

Modifiable factor	Applicable construct	The outcome measure	Potential intervention	Stakeholder intervention	Hierarchy of benefit
Sleep	Sleep: consistent sleep	• Overall wellbeing • Mental/Emotional wellbeing • Level of fatigue	Personal: Tracking sleep	• Institutional - I • Surgeons Individually – S	• Institutional • Consultant • Surgeons Individually • Patients
	Sleep: often fatigued	• Overall wellbeing • Mental/Emotional wellbeing	Personal: education about fatigue management	• National - N • Training Body - T • Institutional - I • Consultants - C • Surgeons Individually – S	• National • Training Body • Institutional • Surgeons Individually • Patients
	Sleep: manage fatigue effectively	• Level of fatigue			
Stress	Stress: supported feel	• Overall wellbeing • Mental/Emotional wellbeing • Level of fatigue			•
	Stress: often stress at work	• Level of fatigue	Personal: stress management programme	• National - N • Training Body - T • Institutional - I • Consultants - C • Surgeons Individually – S	• National • Training Body • Institutional • Consultant • Surgeons Individually • Patients
	Stress: easy to switch off	• Level of fatigue			
Exercise	Exercise: Light activity	• Overall wellbeing	Personal: increasing exercise levels	• National - N • Training Body - T • Institutional - I • Surgeons Individually – S	• National • Surgeons Individually
	Exercise: Moderate activity	• Overall wellbeing			
	Exercise: Amount of exercise	• Overall wellbeing • Mental/Emotional wellbeing • Level of fatigue			
Diet	Diet: Fast food intake	• Overall wellbeing • Mental/Emotional wellbeing • Level of fatigue	Personal: improving dietary intake	• National - N • Training Body - T • Institutional - I • Surgeons Individually – S	• National • Surgeons Individually
	Diet: ready-made meal intake	• Overall wellbeing			
	Diet: vegetable intake	• Overall wellbeing			
	Diet: dinner	• Mental/Emotional wellbeing • Level of fatigue			
Work culture	Culture: staff treated fairly Culture: error disclosure promoted	• Overall wellbeing • Mental/Emotional wellbeing • Overall wellbeing • Mental/Emotional wellbeing • Level of fatigue	Profession: changing resource allocation Profession: provision of rest times and facilities Profession: management led policy changes to tackle fatigue (inc. of fatigue risk management systems) Profession: changing rota system Profession: talking about fatigue	• National - N • Training Body - T • Institutional - I • Consultants - C • National - N • Training Body - T • Institutional - I • Consultants - C • Surgeons Individually – S	• National • Training Body • Institutional • Consultant • Surgeons Individually • Patients • National • Training Body • Institutional • Consultant • Surgeons Individually • Patients

Appendix AG – Prioritisation of behaviour interventions using the APEASE criteria

Identifying the behaviour:

In defining the context, the basic question of 'what behaviours is the researcher trying to change' had to be answered. These were assessed according to the research findings of this project. Surgeons were not prioritising/accessing/utilising some of the basic preventive healthcare measures required to reduce fatigue levels and improve wellbeing. This was inhibiting them from accessing states of thriving and optimising their surgical performance. Their patterns of behaviour are incongruent to performance optimisation.

List of barriers, associated causality and relevance

Level of intervention	Exhaustive List of Behaviours which contribute to surgeons not prioritising or accessing/utilising some of the basic preventative healthcare measures	Proposed Behaviour Change	Likely impact if behaviour were to change	Level of ease to change behaviour (cost, preference, acceptability)	Centrality of the behaviour in the system of behaviours and potential overspill	Ease of measurement for evaluation	Spill over to other people/behaviours	Overarching principle	Score
Personal	**Not believing in sleep science principles**	Increasing confidence in sleep science principles	High **3**	**Cost –** moderate **2** **Acceptability -**high 3	High 3	Easy 4	**Low 0**	1Increasing confidence in scientific principles	**15**
Personal	**Not believing in performance management principles**	Increasing confidence in performance management principles	High **3**	**Cost –** moderate **2** **Acceptability** -high 3	**High 3**	Easy 4	**Low 0**	1Increasing confidence in scientific principles	**15**
Personal	**Learning from COVID mentality**	Reflecting on the positive behavioural changes associated with forced changes during COVID	High **3**	**Cost –** low **3** **Acceptability –** moderate 2	**High 3**	Easy 4	**Low 0**	2Reflecting on COVID-19 as a positive opportunity	**15**
Personal	**Not viewing fatigue as an error risk**	Increasing awareness and emphasis of fatigue as an error risk	High **3**	**Cost –** moderate **2** **Acceptability -**moderate 2	**High 3**	Easy 4	**Low 0**	3Recognising the risks associated to performance and patient care	**14**
Professional	**Having a fear of judgement**	Reducing negative cultural	High **3**	**Cost –** moderate **2**	**Moderate 2**	Easy 4	**Low 0**	1Reducing negative cultural norms which contribute to a	**14**

		norms which contribute to a closed culture		**Acceptability** – high 3				closed culture (i.e., not needing sleep, aptitude)	
Personal	**Not valuing the impact of sleep deprivation on health and. wellbeing**	Valuing impact of sleep deprivation on health and wellbeing	High **3**	**Cost –** moderate **2** **Acceptability –** moderate 2	High 3	ModEasy 3	Low 0	3Recognising the risks associated to performance and patient care	13
Personal	**Not valuing the impact of sleep deprivation on performance**	Valuing impact of sleep deprivation on performance	High **3**	**Cost –** moderate **2** **Acceptability –** moderate 2	**High 3**	ModEasy 3	**Low 0**	3Recognising the risks associated to performance and patient care	**13**
Personal	**Not believing in positive psychology principles**	Increasing confidence in positive psychology principles	High **3**	**Cost –** moderate **2** **Acceptability –** low 1	**High 3**	Easy 4	**Low 0**	1Increasing confidence in scientific principles	**13**
Personal	**Believing that patient care is not impacted by sleep deprivation**	Recognising that optimal patient care requires an optimised practitioner	High **3**	**Cost –** high **1** **Acceptability –** moderate 2	**High 3**	Easy 4	**Low 0**	3Recognising the risks associated to performance and patient care	**13**
Professional	**Not being able to make changes due to workload**	Changing workload models and optimising within current restrictions	High **3**	**Cost –** high **1** **Acceptability –** high 3	**High 3**	ModEasy 3	**Low 0**	2Changing workload models and optimising within current restrictions	**13**
Personal	**Wanting to be viewed as an elite industry**	Show how success elite industries prioritise health and wellbeing	Moderate **2**	**Cost –** moderate **2** **Acceptability –** high **3**	**Moderate 2**	Easy 4	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**13**
Personal	**Being cautious of medicolegal issues**	Reducing anxiety associated with medicolegal issues	High **3**	**Cost –** low **3** **Acceptability –** moderate 2	**Low 1**	Easy 4	**Moderate Minus 1**	6Decreasing work-related anxieties and education on resilience	**12**

Personal	**Believing their current mitigation strategies work sufficiently**	Recognising that other strategies exist which can optimise their work	High **3**	**Cost –** high **1** **Acceptability -**moderate 2	**Moderate 2**	Easy 4	**Low 0**	7Education on effective strategies for thriving states	**12**
Personal	**Believing you can performance optimally when sleep deprived/sleep restricted**	Recognising that optimal performance requires optimal sleep	High **3**	**Cost –** high **1** **Acceptability –** moderate 2	**High 3**	ModEasy 3	**Low 0**	3Recognising the risks associated to performance and patient care	**12**
Personal	**Feeling they have to be resilient**	Increasing awareness of what 'resilience' is and what it isn't	High **3**	**Cost –** moderate **2** **Acceptability –** low 1	**Moderate 2**	Easy 4	**Low 0**	6Decreasing work-related anxieties and education on resilience	**12**
Personal	**Not managing anxiety and stress well**	Improving coping skills for dealing with anxiety and stress	High **3**	**Cost –** moderate **2** **Acceptability –** high 3	**Moderate 2**	ModDiff 2	**Low 0**	6Decreasing work-related anxieties and education on resilience	**12**
Personal	**Apathy to making change**	Increasing enthusiasm to making change	High **3**	**Cost –** high **1** **Acceptability** – high 3	**High 3**	Difficult 1	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**11**
Personal	**Lack of emphasis on human factors**	Recognising importance of human factors in performance management	High **3**	**Cost –** high **1** **Acceptability –** low 1	**Moderate 2**	Easy 4	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**11**
Personal	**Having cultural upbring approaches to workload management**	Bridge the gap between training culture and culture of practice within current setting – everyone prioritises their health	Moderate **2**	**Cost –** low **3** **Acceptability -**high 3	**Low 1**	ModDiff 2	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**11**
Professional	**Believing that sleep**	Reducing negative	Moderate	**Cost –** high **1**	**Moderate**	Easy 4	**Low 0**	4Increasing parity of esteem and work-life	**11**

	makes you a weak surgeon	cultural norms which contribute to ideologies of surgeons not needing sleep	**2**	**Acceptability -** moderate 2	**2**			balance for performance optimisation	
Personal	**Feeling expected to be present all the time**	Reducing anxiety associated with work	High **3**	**Cost –** moderate **2** **Acceptability –** low 1	**Low 1**	Easy 4	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**11**
Professional	**Blaming the resources for fatigue**	Changing resources and optimising within current restrictions	Moderate **2**	**Cost –** high **1** **Acceptability –** high 3	**High 3**	ModEasy 3	**Moderate Minus 1**	3Changing resources and optimising within current restrictions	**11**
Personal	**Utilising caffeine as a prophylactic**	Allowing caffeine to be an adjunct but not a prophylactic	Moderate **2**	**Cost –** moderate **2** **Acceptability –** low 1	**Moderate 2**	Easy 4	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**11**
Personal	**Not being disciplined enough to sleep well**	Increase awareness, emphasis and discipline in rest provision	Moderate **2**	**Cost –** moderate **2** **Acceptability –** high **3**	**High 3**	ModEasy 3	**Low 0**	7Education on effective strategies for thriving states	**11**
Personal	**Not regulating performance when on-call**	Having surgeons check in on their performance hourly when on-call	Moderate **2**	**Cost –** moderate **2** **Acceptability –** moderate 2	**Moderate 2**	ModDiff 2	**Low 0**	7Education on effective strategies for thriving states	**10**
Professional	**Believing you need an 'aptitude' to survive in surgery**	Reducing negative cultural norms which contribute to ideology that a certain person is required for surgery	Moderate **2**	**Cost –** high **1** **Acceptability –** low 1	**Moderate 2**	Easy 4	**Low 0**	1Reducing negative cultural norms which contribute to a closed culture (i.e., not needing sleep, aptitude)	**10**

Personal	**Feeling they don't have enough time to eat properly**	Strategizing to find times to eat during the day including timetabling and preparation	Moderate **2**	**Cost –** low **3** **Acceptability –** high 3	**Low 1**	Difficult 1	**Low 0**	7Education on effective strategies for thriving states	**10**
Professional	**Blaming the systems for fatigue**	Changing systems and optimising within current restrictions	Moderate **2**	**Cost –** high **1** **Acceptability –** high 3	**High 3**	ModEasy 3	**Moderate Minus 1**	4Changing systems and optimising within current restrictions	**10**
Personal	**Surgery being their lives/social supports**	Increasing social engagements with/without colleagues outside of work	Moderate **2**	**Cost –** low **3** **Acceptability –** moderate **2**	**Moderate 2**	Difficult 1	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**10**
Personal	**Feeling they don't have enough time to exercise**	Strategizing to find times to exercise during the day including timetabling and preparation	Moderate **2**	**Cost –** low **3** **Acceptability -** high 3	**Low 1**	Easy 1	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**10**
Professional	**Wanting control over rotas**	Allowing control of rotas and optimising within current restriction	Moderate **2**	**Cost –** high **1** **Acceptability – high 3**	**Moderate 2**	ModEasy 3	**Moderate Minus 1**	2Changing workload models and optimising within current restrictions	**10**
Professional	**Conforming and enforcing cultural norms**	Recognising and engaging in positive cultural change	High **3**	**Cost –** high **1** **Acceptability –** moderate 2	**High 3**	Difficult 1	**Low 0**	5Recognising and engaging in positive cultural change	**10**
Personal	**Eating poorly on-call**	Improving eating strategies on-call including scheduling and preparation	Low **1**	**Cost –** moderate **2** **Acceptability – high 3**	**Low 1**	ModEasy 3	**Low 0**	4Increasing parity of esteem and work-life balance for performance optimisation	**10**
Personal	**Not feeling they can take a**	Reducing personal and cultural	High **3**	**Cost –** high **1**	**Low 1**	Easy 4	**Low 0**	6Decreasing work-related anxieties and	**9**

	break/go home at scheduled time	anxiety associated with work		**Acceptability –** low 1				education on resilience	
Professional	**Not believing management care about staff**	Increase management engagement with surgical staff and feedback on changes made	Moderate **2**	**Cost –** moderate **2** **Acceptability –** moderate **2**	**Moderate 2**	ModDiff 2	**Moderate Minus 1**	6Increasing collegial and collective effort within departments	**9**
Personal	**Feeling gender makes a difference in perception of performance**	Reducing gender disparities by promoting an open disclosure culture	Moderate E **2**	**Cost –** moderate **2** **Acceptability – low 1**	**Low 1**	ModEasy 3	**Low 0**	6Decreasing work. related anxieties and education on resilience	**9**
Personal	**Wanting objective data to prove sleep deprivation impact**	Providing with objective measurement tools and feedback on same	Low **1**	**Cost –** high **1** **Acceptability – high 3**	**Low 1**	ModEasy 3	**Low 0**	1Increasing confidence in scientific principles	**9**
Personal	**Spending long hours in the hospital**	Requiring surgeons to leave hospital after a certain time	Moderate **2**	**Cost –** high **1** **Acceptability – low** 1	**Moderate 2**	Easy 4	**Moderate Minus 1**	5Drawing parallels and showcasing elite performance industries	**9**
Professional	**Blaming the work-rotas for fatigue**	Changing work-rotas and optimising within current. restrictions	Moderate **2**	**Cost –** high **1** **Acceptability – low 1**	**High 3**	ModEasy 3	**Moderate Minus 1**	2Changing workload models and optimising within current restrictions	**9**
Professional	**Not feeling supported to make changes**	Increasing collegiality and collective effort within departments to make change	High **3**	**Cost –** moderate **2** **Acceptability –** moderate 2	**Low 1**	Easy	**Low 0**	6Increasing collegial and collective effort within departments	**8**
Personal	**Having a sense of ongoing duty of care to patients and duty of no harm**	Recognising that duty of care is best optimised when surgeon is thriving	Moderate **2**	**Cost –** moderate **2** **Acceptability – low** 1	**Moderate 2**	Difficult 1	**Low 0**	3Recognising the risks associated to performance and patient care	**8**

Personal	**Believing adrenaline offsets decrement performance**	Showing that adrenaline alone doesn't optimise performance	Moderate **2**	**Cost –** high **1** **Acceptability –** moderate **2**	**High 3**	Difficult 1	**Low 0**	3Recognising the risks associated to performance and patient care	**8**
Professional	**Being overly competitive in training**	Reducing sense of competition and anxiety associated with it	Low **1**	**Cost –** high **1** **Acceptability -** low **1**	**Low 1**	Easy 4	**Low 0**	6Increasing collegial and collective effort within departments	**8**
Personal	**Being frustrated with lack of theatre exposure**	Increasing access and exposure to theatre	Low **1**	**Cost –** high **1** **Acceptability –** high **3**	**Low 1**	ModEasy 3	**Moderate Minus 1**	4Increasing parity of esteem and work-life balance for performance optimisation	**8**
Personal	**Disliking non-theatre activities**	Optimising strategies on tasks least liked by surgeons	Low **1**	**Cost –** high **1** **Acceptability –** high **3**	**Low 1**	ModEasy 3	**Moderate Minus 1**	4Increasing parity of esteem and work-life balance for performance optimisation	**8**
Personal	**Not believing in EWTD**	Showing value of EWTD in respect to performance management and workers' rights	Moderate **2**	**Cost –** high **1** **Acceptability –** low **1**	**Moderate 2**	ModDiff 2	**Low 0**	5Drawing parallels and showcasing elite performance industries	**8**
Professional	**Having to move around for work regularly**	Changing expectations within systems to move frequently	Low **1**	**Cost –** high **1** **Acceptability –** high **3**	**Low 1**	ModEasy 3	**Moderate Minus 1**	4Changing systems and optimising within current restrictions	**8**
Professional	**Disparities between trainees and consultants**	Bridging the gap between expectations and respect in trainees and consultants	Moderate **2**	**Cost –** moderate **2** **Acceptability –** moderate **2**	**Low 1**	Difficult 1	**Moderate Minus 1**	6Increasing collegial and collective effort within departments	**7**
Personal	**Having family commitment**	Supporting surgery parents by allowing them more time to raise a family	Low **1**	**Cost –** high **1** **Acceptability –** low **1**	**Low 1**	ModEasy 3	**Moderate Minus 1**	4Increasing parity of esteem and work-life balance for performance optimisation	**6**

Appendix AH – Seven step process of macro-level intervention for Chapter 7

1. Applying the behaviour to the COM-B system

Applying the COM-B system to complete a behavioural diagnosis then occurred. This identifies what needs to change within the surgeon and/or their environment in order to elicit the desired change in behaviour. Using the quantitative and qualitative analysis above an applied COM-B system was created.

Target behaviour: Increasing confidence in scientific principles of positive behaviour change to reduce self-reported fatigue		
Capability	Did not know what were the best ways to optimise their performance in managing fatigue risks	
Motivation	Didn't feel the need to make any change as they felt they were doing what was required at this point to 'make it' in surgery	
Opportunity	Didn't have time in their day to make space for effective intervention changes	
Com- B Component	**What needs to happen for target behaviour to occur?**	**Is there a need for change?**
Physical capability	Having the physical ability to get a good night's rest (i.e. not having a pathological sleep condition)	No change needed as most surgeons have these skills – though could be argued if some surgeons have occupational insomnia is related to this
Psychological ability	Know the correct ways to performance manage/sleep effectively/think positively	Change needed as surgeons not aware of these principles to the extent required – or emphasis of them
	Know the impact of fatigue on performance, patient care and wellbeing	Change needed as surgeons not aware of these principles to the extent require – or emphasis of them
Physical opportunity	Ability to actually effectively rest/get enough sleep/performance manage/fatigue manage	Change needed as staff are currently working more than recommended guidelines. Current work rotas not facilitating a work-life balance Change needed in personal lives to facilitate getting a good night rest.
Social Opportunity	Seeing staff prioritising getting sufficient rest, prioritising positive psychology principles and performance management	Change needed as surgeons do not always see seniors prioritising rest and other human related factors
Reflective Motivation	Hold beliefs that the longer hours they work the more they will be productive	Change belief that performance management requires effective rest management
	Holding the belief that sleep and rest are not as impactful as they are with regards to performance	Change belief that fatigue does indeed impact performance
	Holding the belief that sleep and rest are not as impact as they are with regards to wellbeing	Change belief that fatigue does indeed impact wellbeing

	Holding the belief that sleep and rest are not as impactful as they are with regards to patient care	Change belief that fatigue does indeed impact patient care
	Holding the belief that positive psychology are not useful	Change belief that positive psychology does impact wellbeing and performance to access thriving states
Automatic Motivation	Having established routines and habits (such as getting up early, not going to bed early enough, not taking enough breaks during the working day, not leaving work on time, overcaffeinated, not talking about their wellbeing to others, being caught in the 'constant learning'	Change needed to establish routine and habit formation
Behavioural Diagnosis of the relevant COM-B components: Psychological ability, Physical opportunity, Social opportunity, Reflective motivation, Automatic motivation		

Behavioural diagnosis of the relevant COM-B components for behaviour change in surgeons

2. Mapping to Intervention Functions

Providing an exhaustive list of potential interventions to mirror the nine intervention functions then occurred. These intervention functions were aligned to the behaviour diagnosis identified previously to identify which intervention functions are most suitable to elicit the desired behaviour change for this intervention.

Intervention Function	Definition	Surgical Example
Education	Increasing knowledge or understanding	Running a series of classes on sleep science, performance management and positive psychology modelled off elite industries
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Using imagery such as a better work-life balance and patient care to increase fatigue management
Incentivisation	Creating expectation of reward	Telling them if they implement changes in sleep regulation, performance management and positive psychology, they will get more surgery exposure/money
Coercion	Creating expectation of punishment or cost	Raising the cost of non-compliance with EWTD by having individuals pay the price
Training	Imparting skills	Running a series of workshops in fatigued states to identify when they should stop and check human factors. Running workshops with consultants on modelling the three areas of science Running a series of interactive workshops on the three areas of research
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviour)	Reducing key-card access to certain rooms after working hours to encourage 'go home' culture. Not allowing surgeons into theatre after a certain amount of hours in work.
Environmental Restructuring	Changing the physical or social context	Providing nudges for taking more breaks, having an app which checks in on performance and psychology, or providing with mandatory rest breaks
Modelling *modelling is only effective if reinforced and when observers pay attention, have adequate self-efficacy and skills, identify with the model, and observe a coping model instead of a mastery model (Kelder et al., 2015)*	Providing an example for people to aspire to or imitate	Having experts from elite industries (sport, aviation) speak about importance of interventions. Have them work with key change-agents within department (e.g Director of Perioperative Care) and have the consultants/director SHOW their changed practice to trainees.
Enablement	Increasing means/reducing barriers to increase capability or opportunity	CBT-I to help with sleep insomnia or anxiety management, sleeping tablets, changing work rotas, offering more familial support etc.

Mapping intervention functions to surgical intervention examples

	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental Restructuring	Modelling	Enablement
Capability psychological:									
Motivation automatic:									
Motivation reflective:									
Opportunity physical:									
Opportunity social:									

Alignment of the intervention functions to identified behavioural COM-B behavioural diagnosis

3. Mapping to Policy Categories

Providing an exhaustive list of policy categories to mirror the seven policy categories then occurred. These policy were then aligned to the relevant intervention functions identified to identify which policy categories are most suitable to enable and support the desired behaviour change for this intervention.

Policy Categories	Definition	Surgical Example
Communication/Marketing	Using print, electronic, telephonic or broadcast media	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
Fiscal	Using the tax system to reduce or increase the financial cost	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
Regulation	Establishing rules or principles of behaviour or practice	Establishing a requirement for no more 24 hour rotas
Legislation	Making or changing laws	A minimum work number personnel working at any given stage
Environmental/Social Planning	Designing and/or controlling the physical or social environment	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site
Service Provision	Delivering a service	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation

Mapping policy categories to surgical policy examples

	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental Restructuring	Modelling	Enablement
Communication/Marketing									
Guidelines									
Fiscal									
Regulation									
Legislation									
Environmental/Social Planning									
Service Provision									

Alignment of policy categories to identified relevant intervention functions

4. Applying the theoretically informed criteria to intervention function and policy categories

Having completed an exhaustive list of potential interventions, a tubulised version of intervention functions and supporting policy categories was created to identify the theorised applicable intervention functions and policy categories.

COM-B Component Required	What happens for target behaviour to occur?	Is there a need for change?	Likely effective intervention	Potential activity	Likely effective Policy	Potential activity
Capability psychological:	Know the correct ways to performance manage/sleep effectively/think positively Know the impact of fatigue on performance, patient care and wellbeing	Change needed as surgeons not aware of these principles to the extent required – or emphasis of them Change needed as surgeons not aware of these principles to the extent require – or emphasis of them	Education	Running a series of classes on sleep science, performance management and positive psychology modelled off elite industries	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Training	Running a series of workshops in fatigued states to identify when they should stop and check human factors. Running workshops with consultants on modelling the three areas of science Running a series of interactive workshops on the three areas of research	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching'

						session/Increasing national resource allocation
			Enablement	CBT-I to help with sleep insomnia or anxiety management, sleeping tablets, changing work rotas, offering more familial support etc.	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Environmental/Social Planning	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
Motivation automatic:	Having established routines and habits (such as getting up early, not going to bed early enough, not taking enough breaks during the working day, not leaving work on time, overcaffeinated, not talking about their wellbeing to others, being caught in the 'constant learning'	Change needed to establish routine and habit formation	Persuasion	Using imagery such as a better work-life balance and patient care to increase fatigue management	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation

			Incentivisation	Telling them if they implement changes in sleep regulation, performance management and positive psychology, they will get more surgery exposure/money	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Coercion	Raising the cost of non-compliance with EWTD by having individuals pay the price	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the

						lead researcher as a 'coaching' session/Increasing national resource allocation
			Training	Running a series of workshops in fatigued states to identify when they should stop and check human factors. Running workshops with consultants on modelling the three areas of science Running a series of interactive workshops on the three areas of research	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Environmental Restructuring	Providing nudges for taking more breaks, having an app which checks in on performance and psychology, or providing with mandatory rest breaks	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Environmental/Social Planning	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site
			Modelling	Having experts from elite industries (sport, aviation) speak about importance of interventions. Have them work with key change-agents within department (e.g. Director of Perioperative Care) and have the consultants/director	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the

				SHOW their changed practice to trainees.		lead researcher as a 'coaching' session/Increasing national resource allocation
			Enablement	CBT-I to help with sleep insomnia or anxiety management, sleeping tablets, changing work rotas, offering more familial support etc.	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Environmental/Social Planning	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site
Motivation reflective:	Hold beliefs that the longer hours they work the more they will be productive Holding the belief that sleep and rest are not as impactful as they are with regards to performance Holding the belief that sleep and rest are not as impact as they are with regards to wellbeing Holding the belief that sleep and rest are not as impactful as they are with regards to patient care Holding the belief that positive psychology are not useful	Change belief that performance management requires effective rest management Change belief that fatigue does indeed impact performance Change belief that fatigue does indeed impact wellbeing Change belief that fatigue does indeed impact patient care Change belief that positive psychology does indeed impact wellbeing and performance	Education	Running a series of classes on sleep science, performance management and positive psychology modelled off elite industries	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Persuasion	Using imagery such as a better work-life balance and patient care to increase fatigue management	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month

		to access thriving states			Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Incentivisation	Telling them if they implement changes in sleep regulation, performance management and positive psychology, they will get more surgery exposure/money	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Coercion	Raising the cost of non-compliance with EWTD by having individuals pay the price	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email

						synopses sent weekly for a month
					Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
Opportunity physical:	Ability to actually effectively rest/get enough sleep/performance manage/fatigue manage	Change needed as staff are currently working more than recommended guidelines. Current work rotas not facilitating a work-life balance Change needed in personal lives to facilitate getting a good night rest.	Training	Running a series of workshops in fatigued states to identify when they should stop and check human factors. Running workshops with consultants on modelling the three areas of science Running a series of interactive workshops on the three areas of research	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Restriction	Reducing key-card access to certain rooms after working hours to encourage 'go home' culture. Not allowing surgeons into theatre after a certain amount of hours in work.	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Regulation	Establishing a requirement for no more 24 hour rotas

					Legislation	A minimum work number personnel working at any given stage
			Environmental Restructuring	Providing nudges for taking more breaks, having an app which checks in on performance and psychology, or providing with mandatory rest breaks	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Environmental/Social Planning	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site
			Enablement	CBT-I to help with sleep insomnia or anxiety management, sleeping tablets, changing work rotas, offering more familial support etc.	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Environmental/Social Planning	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site
Opportunity social:	Seeing staff prioritising getting sufficient rest, prioritising positive psychology principles and performance management	Change needed as surgeons do not always see seniors prioritising rest and other human related factors	Restriction	Reducing key-card access to certain rooms after working hours to encourage 'go home' culture. Not allowing surgeons into theatre after a certain amount of hours in work.	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
			Environmental Restructuring	Providing nudges for taking more breaks, having an app which checks in on performance and psychology, or	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders

				providing with mandatory rest breaks	Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Environmental/Social Planning	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site
			Modelling	Having experts from elite industries (sport, aviation) speak about importance of interventions. Have them work with key change-agents within department (e.g. Director of Perioperative Care) and have the consultants/director SHOW their changed practice to trainees.	Communication/Market	Stop the fatigue campaign institutionally/nationally Positive psychology, sleep science and performance management email synopses sent weekly for a month
					Service Provision	Establishing support groups for positive psychology intervention/ creating a fortnightly check-in service with the lead researcher as a 'coaching' session/Increasing national resource allocation
			Enablement	CBT-I to help with sleep insomnia or anxiety management, sleeping tablets, changing work rotas, offering more familial support etc.	Guidelines	Producing and disseminating the fatigue risk management/performance management programme to all stakeholders
					Fiscal	Increasing EWTD sanctions on HR departments/HSE for non-compliancy
					Regulation	Establishing a requirement for no more 24 hour rotas
					Legislation	A minimum work number personnel working at any given stage
					Environmental/Social Planning	Significant ergonomic changes similar to Google/Facebook i.e. facilities on site

A broad overview of component to intervention suggestion

In ascending order of prevalence, the most theoretically applicable intervention functions included:

1. Enablement
2. Environmental Restructuring
3. Education, Persuasion, Incentivisation, Coercion, Restriction, Modelling

In ascending order of prevalence, the most theoretically applicable policy categories to support these applicable intervention functions included:

1. Guidelines, Regulation and Legislation
2. Fiscal, Service Provision
3. Communication/Marketing

4. Applying the APEASE criteria to intervention function

Using the APEASE criteria, the intervention functions were deemed to either meet the criteria, meet the criteria with conditions, or not meet the criteria.

Intervention Function	Intervention	Does it meet the APEASE criteria?	
Education	Running a series of classes on sleep science, performance management and positive psychology modelled off elite industries	A - moderate P – high E - moderate A – high S - low E - low	Meet the criteria – can be run alongside the morning meetings
Persuasion	Using imagery such as a better work-life balance and patient care to increase fatigue management	A - low P - moderate E - low A - low S - low E - low	Meet the criteria with conditions – if used in the context of cognitive dissonance and cognitive forcing in situations such as simulation it could work
Incentivisation	Telling them if they implement changes in sleep regulation, performance management and positive psychology, they will get more surgery exposure/money	A - low P - low E - moderate A - high S - high E - high	Maybe – will definitely help address the 'modifiable' aspect of this regarding going home etc.
Coercion	Raising the cost of non-compliance with EWTD by having individuals pay the price	A - low P - moderate E - low A - low S - high E - high	Don't meet criteria – not acceptable to staff
Training	Running a series of workshops in fatigued states to identify when they should stop and check human factors. Running workshops with consultants on modelling the three areas of science Running a series of interactive workshops on the three areas of research	A - moderate P - moderate E - moderate A - moderate S - moderate E - low	Meet the criteria – could be done during as an interactive series or online
Restriction	Reducing key-card access to certain rooms after working hours to encourage 'go home' culture. Not allowing surgeons into theatre after a certain amount of hours in work.	A - high P - low E - low A - low S - high E - high	Don't meet criteria – not feasible in this context
Environmental Restructuring	Providing nudges for taking more breaks, having an app which checks in on performance and psychology, or providing with mandatory rest breaks	A - moderate P - moderate E - moderate A - moderate S - low E – low	Meet the criteria – putting up posters, extra facilities such as beds etc.
Modelling	Having experts from elite industries (sport, aviation) speak about importance of interventions. Have them work with key change-agents within department (e.g Director of Perioperative Care) and have the consultants/director SHOW their changed practice to trainees.	A - moderate P - moderate E - high A - high S - moderate E - moderate	Meet the criteria – applicable in this sense and may play an important role in culture shift towards performance management and regulation
Enablement	CBT-I to help with sleep insomnia or anxiety management, sleeping tablets, changing work rotas, offering more familial support etc.	A - low P - low E - high A - high S - high E - low	Yes – provision of some form of 'counselling' to the surgeons or coaching may assist in helping them form behaviours

APEASE criteria applied to intervention functions

Based off the above APEASE criteria, the most applicable intervention functions included:

1. Education
2. Training
3. Environmental Restructuring
4. Modelling
5. Enablement

In addition, other intervention functions which were applicable subject additional conditions included:

1. Persuasion (limited by affordability and practicality)
2. Incentivisation (limited by. affordability, equity and cost-effectiveness)

6. Applying the APEASE criteria to policy categories

Using the APEASE criteria and recommended intervention functions, a modified APEASE criteria for policy categories were deemed to either meet the criteria, meet the criteria with conditions, or not meet the criteria.

Intervention Function	COMB-B Component	Potentially categories useful policy	Does it meet the APEASE criteria
Meet the criteria			
Education	Capability Psychological	Communication/Marketing	Meet the criteria
	Motivation Reflective	Guidelines	Meet the criteria
		Regulation	Meet the criteria with. Conditions - Possible in long term
		Legislation	Don't meet criteria
		Service Provision	Meet the criteria
Environmental Restructuring	Motivation Automatic	Guidelines	Meet the criteria
	Opportunity Physical	Fiscal	Don't meet criteria
	Opportunity Social	Regulation	Meet the criteria with conditions - Possible in long term
		Legislation	Don't meet criteria
		Environmental/Social Planning	Don't meet criteria
Modelling	Motivation Automatic	Communication/Marketing	Meet the criteria
	Opportunity Social	Service Provision	Meet the criteria
Enablement	Capability Physical	Guidelines	Meet the criteria
		Fiscal	Don't meet criteria
	Capability Psychological	Regulation	Meet the criteria with conditions - Possible in long term
	Motivation Automatic	Legislation	Don't meet criteria
	Opportunity Physical	Environmental/Social Planning	Don't meet criteria
	Opportunity Social	Service Provision	Meet the criteria
Training	Capability Physical	Guidelines	Meet the criteria
		Fiscal	Don't meet criteria
	Capability Psychological	Regulation	Meet the criteria with conditions - Possible in long term
	Motivation Reflective	Legislation	Don't meet criteria
	Opportunity Physical	Service Provision	Meet the criteria
Meet the criteria with conditions			
Persuasion	Motivation Automatic	Communication/Marketing	Meet the criteria
	Motivation Reflective	Guidelines	Meet the criteria
		Regulation	Don't meet criteria
		Legislation	Don't meet criteria
		Service Provision	Meet the criteria
Incentivisation	Motivation Automatic	Communication/Marketing	Meet the criteria
	Motivation Reflective	Guidelines	Meet the criteria
		Fiscal	Don't meet criteria
		Regulation	Meet the criteria with conditions - Possible in long term
		Legislation	Meet the criteria with conditions - Not practicable in hospital
		Service Provision	Meet the criteria

APEASE criteria applied to policy categories

Based off the above APEASE criteria, the most applicable policy categories included:

1. Communication/Marketing
2. Guidelines
3. Service Provision

In addition, other policy categories which were applicable subject additional conditions included:

1. Regulation (possible in the longer term)

7. Merging the theoretical informed criteria to the APEASE criteria

In order to find a balance between the theory informed criteria recommendations and APEASE criteria recommendations comparison tables between both were drawn to find areas of consistency.

THEORETICAL ANALYSIS	APEASE CRITERIA
Education	**Education**
Environmental Restructuring	**Environmental Restructuring**
Modelling	**Modelling**
Enablement	**Enablement**
Training	**Training**
Restriction	
Coercion	
With additional requirements	**With additional requirements**
Persuasion	**Persuasion**
Incentivisation	**Incentivisation**

Comparison table of intervention functions of theory informed criteria and APEASE criteria

THEORETICAL ANALYSIS	APEASE CRITERIA
Communication/Marketing	**Communication/Marketing**
Guidelines	**Guidelines**
Service Provision	**Service Provision**
Legislation	
Fiscal	
	In longer-term
Regulation	**Regulation**

Comparison table of policy categories of theory informed criteria and APEASE criteria

Appendix AI – Four step process of micro-level intervention

1. Identifying relevant TDF domains

In order to commence the micro-level intervention, identifying the relevant TDF domains to the five identified components of the COM-B model, as well as provided a surgical context them was undertaken. Deciding to focus this point on three areas of the COM-B system which were determined most amenable to change by the researcher (i.e. psychological capability, motivation automatic and motivation reflective), a filtering of relevant TDF domains further occurred.

Relevant TDF domain	Description	Surgical Context
Knowledge	An awareness of the existence of something.	Not there
Skills	An ability or proficiency acquired through practice.	Not there
Social/professional role and identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting.	Over-worked Personality-driven beliefs
Beliefs about capabilities	Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use.	Beyond need for sleep
Optimism	The confidence that things will happen for the best, or that desired goals will be attained.	Apathetic towards change
Beliefs about consequences	Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation.	Feel required to conform
Reinforcement	Increasing the probability of a response by arranging a dependent relationship or contingency, between the response and a given stimulus.	Culture reinforces – senior modelling
Intentions	A conscious decision to perform a behaviour or a resolve to act in a certain way.	Overwork to get exposure to learning/needs of patients
Goals	Mental representation of outcomes or end states that an individual wants to achieve.	Be a great surgeon; Do in patients best interests
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives.	Highly complex individuals with a priority aligned to surgical work
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour.	Non-disclosure culture Low resources call rota not facilitating work-life balance
Social influences	Those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours.	Lack of social support from colleagues or other MDT members Lack of peer support outside work
Emotion	A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event.	Apathetic and frustration towards the 'system'
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions.	Interventions required

Theoretical domains framework mapping with surgical context

Domain of COMB B	TDF Domain	TDF Domain	TDF Domain	TDF Domain	TDF Domain	TDF Domain
Psychological Capability	Knowledge	Cognitive and interpersonal skill	Memory, attention and decision processes	Behavioural Regulation		
Motivation Automatic	Reinforcement	Emotion				
Motivation Reflective	Social/Professional Role and Identity	Belief about consequence	Optimism	Intentions	Goals	Beliefs and capabilities
Opportunity Physical	Environmental context and resource					
Opportunity Social	Social influence					

Linking focused components of the COM-B to relevant TDF domains for prioritisation

2. Identifying the relevant constructs, considerations and behaviour change techniques

Having prioritised the TDF domains, they were then elaborated further to explore the relevant constructs which would inform outcome measurement of the intervention, key considerations in intervention material design, and the evidence based approach through an associated behaviour technique and its relevance to surgery.

Domain	Constructs	Question/s	Relevance, associated Behaviour Change Techniques
1.Knowledge (An awareness of the existence of something)	Knowledge (including knowledge of condition /scientific rationale)	Do they know the guideline, what do they think it says or what the evidence is behind? it?	**BCTs:** Feedback and Monitoring, Shaping Knowledge, Natural Consequences **Relevance:** Surgeons don't know about sleep science, performance science and positive psychology science
	Procedural knowledge	Do they know they should be, and/or why? they should be doing x?	
	Knowledge of task environment	What is the environment for doing x? Are they aware of the ins and outs of the environment?	
2.Skills (An ability or proficiency acquired through practice)	Skills	Do they know how to do x?	**BCTs:** Repetition and Substitution **Relevance:** Surgeons don't present with the necessary skills to self-regulate
	Skills development	Have they had the right training to do x?	
	Competence	Do they feel competent in delivering x?	
	Ability	How easy or difficult is it to perform x in the given context?	
	Interpersonal skills	Do they have the necessary interpersonal skills to work with others to deliver x or? undertake x?	
	Practice	Are there adequate opportunities to? practice x?	
	Skill assessment	Are they assessed and given feedback on the quality of their participation or delivery?	
3.Social/ Professional Role and Identity (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	Professional identity	What do they think about the credibility of the source of the guideline?	**BCTs:** None Given
	Professional role	Is the delivery within the role of the professional?	
	Social identity	Do they think a guideline should determine their behaviour?	
	Identity	Do they identify with x?	
	Professional boundaries	Is doing x compatible with professional standards?	
	Professional confidence	How confident are they about x despite the difficulties?	
	Group identity	Do they think the guideline or x is in keeping with what others are doing?	
	Leadership	Management or leaders facilitate the delivery of x	
	Organisational commitment	Management or leaders are willing to listen to problems associated with x or guidelines	
4.Beliefs about Capabilities Self-confidence (Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use)	Perceived competence	What would help them?	**BCTs:** Self-Belief **Relevance:** Surgeons believe they can make the changes required to make effective change
	Self-efficacy	How difficult or easy is it for them to do x?	
	Perceived behavioural control	Do they have control over delivering x?	
	Beliefs	Do they believe they can effectively delivery x in context?	
	Self-esteem	Do they feel good about themselves when delivering x?	
	Empowerment	Do they feel empowered by the work in delivering x?	

	Professional confidence	Are they confident they can deliver x despite the difficulties with self?	
5.Optimism (The confidence that things will happen for the best or that desired goals will be attained)	Optimism	Are they optimistic about the outcome?	**BCTs:** Self-belief **Relevance:** What are the personal factors for each surgeon that influence participation behaviour? Does pessimism interfere with participation? Why is there an inertia?
	Pessimism	Are they pessimistic about the outcome?	
	Unrealistic optimism	Are they always expecting good things to happen, despite the fact that sometimes bad things happen?	
	Identity	Do they identify with feelings of optimism?	
	Outcome expectancies	Do they expect a worthwhile outcome?	
6.Beliefs about Consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	Beliefs	Do they believe the delivery of x is useful?	**BCTs:** Covert Learning, Comparison of Outcomes, Natural Consequences, Reward and Threat **Relevance:** Is the outcome going to be better than the status quo?
	Outcome expectancies	Do they expect a worthwhile outcome?	
	Characteristics of outcome expectancies	Is it worthwhile to care?	
	Anticipated regret	Do they feel they might regret delivering x?	
	Consequents	What are the costs and consequences of doing x?	
7.Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	Rewards (proximal / distal, valued / not valued, probable / improbable)	What are and how likely are the rewards associated with doing x?	**BCTs:** Scheduled Consequences, Reward and Threat **Relevance:** Do surgeons see that the benefits outweigh the costs? Do surgeons suffer any perceived or real consequences for not participating? Are surgeons aware or any rewards or incentives, including social or emotional rewards?
	Incentives	Does the evidence and other incentives suggest doing x is a good thing?	
	Punishment	Are there punishments associated with not doing x?	
	Consequents	What are the costs/ consequences of not doing x?	
	Reinforcement	How will they feel if they do or don't do x? Are there financial reimbursements or recognitions?	
	Contingencies	Do benefits outweigh the costs?	
	Sanctions	What sanctions might be imposed and why?	
8.Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	Stability of intentions	Do they intend to deliver or not deliver x consistently over a period of time?	**BCTs:** Goals and Planning **Relevance:** Do surgeons intend to engage in this initiative? Where are they in stages of change?
	Stages of change model	How strong is their intention to deliver x? (Not considering, considering, acting)	
9. Goals (Mental representations of outcomes or end states that an individual wants to achieve	Goals (distal / proximal)	Are there goals set in the immediate and distant future for x?	**BCTs:** Goals and Planning **Relevance:** Do other things get in the way of doing the required behavioural change? What stage of change are surgeons at regarding behavioral change? Is this 'thriving' concept important or valued?
	Goal priority	How important are achieving goals associated with x?	
	Goal / target setting	Are there other things that they want to achieve that could interfere with x?	
	Goals (autonomous / controlled)	How much do they feel they need to do x?	
	Action planning	Has a plan been put in action do to x?	
	Implementation intention	What is the intention of doing x in a given period?	

10. Memory, Attention and Decision Processes (The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	Memory	Delivering x is something they seldom or often forget?	**BCTs:** None Given
	Attention	Will they think to do x?	
	Attention control	How much attention will they have to pay to do x?	
	Decision making	Will they remember to do, and then make the decision to do x? Might they decide not to?	
	Cognitive overload / tiredness	How much cognitive power is needed for x? Is it affected by tiredness?	
11. Emotion (A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	Fear	When working with x, there are feelings of fear	**BCTs:** Natural Consequences, Regulation, Social Support **Relevance:** How does the surgeon feel about participation in the project? Is anxiety/worry about failure a barrier to participation? Is tiredness and burn-out a disincentive?
	Anxiety	When working with x, there are feelings of anxiety	
	Affect	Working with x is likely to create affect	
	Stress	Working with x is likely to be stressful	
	Depression	Working with x contributes to depressed feelings	
	Positive / negative affect	Working with x can be positive, negative, or both	
14. Behavioural Regulation (Anything aimed at managing or changing objectively observed or measured actions)	Self-monitoring	Are self-monitoring behaviours are needed to deliver x?	**BCTs:** Feedback and Monitoring **Relevance:** Does engaging in this behavioural change mean going out of the way, or significantly altering/breaking well-established patterns/habits? Does the surgeon feel a burden of making a plan or action or having to be more self-aware?
	Breaking habit		
	Action planning		

Relevant TDF domains, associated constructs and BCTs

3. Identifying the relevant BCTs with associated domain in COM-B and TDF

A link between the macro to micro-level intervention was then conducted.

DOMAIN COM-B	Domain TDF	BCT
Capability Psychological	Knowledge	Feedback and monitoring
		Shaping knowledge
		Natural consequences
	Cognitive and interpersonal skill	Repetition and substitution
	Memory, attention and decision process	Nil
	Behavioural regulation	Feedback and monitoring
Motivation Reflective	Social/professional role and identity	Nil
	Beliefs about capabilities	Self-belief
	Optimism	Self-belief
	Intentions	Goals and planning
	Goals	Goals and planning
	Beliefs about consequences	Covert learning
		Comparison of outcomes
		Natural consequences
		Reward and threat
Motivation Automatic	Reinforcement	Scheduled consequences
		Reward and threat
	Emotion	Natural consequences
		Regulation
		Social support

List of BCT's to be used for the intervention in affiliation with associated domain in COM-B and TDF

4. Applying the APEASE criteria to BCTs

Identifying relevant surgical contexts to each BCT was undertaken and then application of the APEASE criteria to the BCT to prioritise relevant BCTs for inclusion in this intervention. Each BCT was assigned a numerical value to prioritise. Those that scored 10.5 or above (i.e. the top 12% of BCTs) were prioritised. These are brainstormed below.

Score of 12	Score of 11	Score of 10.5
5.2 Natural consequences: salience of consequences	**1.1. Goal planning: goal setting (behaviour)**	**2.3 Feedback and monitoring: self-monitoring of behaviour**
Use methods specifically designed to **emphasise** the consequences of performing the behaviour with the aim of making them more memorable (goes beyond informing about consequences) *Note: if information about consequences, also code **5.1, Information about health consequences**, **5.6, Information about emotional consequences** or **5.3, Information about social and environmental consequences***	Set or agree on a goal defined in terms of the behavior to be achieved *Note: only code goal-setting if there is sufficient evidence that goal set as part of intervention; if goal unspecified or a behavioural outcome, code **1.3, Goal setting (outcome)**; if the goal defines a specific context, frequency, duration or intensity for the behaviour, also code **1.4, Action planning***	Establish a method for the person to monitor and record their behavior(s) as part of a behavior change strategy *Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if monitoring of outcome of behaviour, code **2.4, Self-monitoring of outcome(s) of behaviour**; if monitoring is by someone else (without feedback), code **2.1, Monitoring of behaviour by others without feedback***
Show cases within medicine/other sectors where sleep deprivation/fatigue and performance management/positive psychology or poor psychology and culture has caused significant error – this is particularly important as behaviour change in surgeons is only likely to come if 'forced' by compromise to patient safety. Can't be framed in either positive/negative or both lights.	Increase awareness in the domains of the three sciences of sleep science, performance management and positive psychology i.e. levels of knowledge (understanding, appreciation, application)	Ask the surgeon to record daily in a diary whether they have engaged in the desired behavior change agreed upon in their 'goal planning' i.e., a change based on the principles of 1. Sleep science 2. Performance management 3. Positive psychology With reference to the duration frequency, intensity, and form of the behaviour. Alternatively, tracker devices owned by the surgeon may be used to measure the three domains e.g. 1.Sleept tracker device 2. Performance management trackers such as crew alert lite, fatigue calculator, energy tracker 3. Use of mindfulness or other positive psychology-based apps 4. Human factors-based app linking HALT to level of wellbeing (e.g., silver cloud)

9.1 Comparison of outcomes: credible source	1.2. Goal planning: problem solving	2.4 Feedback and monitoring: self-monitoring of outcome(s) of behaviour
Present verbal or visual communication from a **credible source** in favour of or against the behavior *Note: code this BCT if source generally agreed on as credible e.g., health professionals, celebrities or words used to indicate expertise or leader in field and if the communication has the aim of persuading; if information about health consequences, also code **5.1, Information about health consequences**, if about emotional consequences, also code **5.6, Information about emotional consequences**; if about social, environmental or unspecified consequences also code **5.3, Information about social and environmental consequences***	Analyse, or prompt the person to analyse, factors influencing the behavior and generate or select strategies that include overcoming barriers and/or increasing facilitators (includes '**Relapse Prevention**' *and* '**Coping Planning**')	Establish a method for the person to monitor and record the **outcome(s)** of their behavior as part of a behavior change strategy *Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behavior, do not code ; if monitoring behavior, code **2.3, Self-monitoring of behavior**; if monitoring is by someone else (without feedback), code **2.5, Monitoring outcome(s) of behavior by others without feedback***
Present an expert opinion on the topics 1. Fatigue (Taryn Taylor) 2. Performance regulation (Aviation Niall Buckley) 3. Human factors (Eva Doherty) 4. Thriving (Elite sport Daniel Brown)	Conduct a reflection exercise which identifies individual barriers and facilitators to getting enough sleep, managing fatigue in work, and having a positive mindset and work individually through coaching to overcome barriers or increase opportunities for facilitators **1.3. Goal planning: goal setting (outcome)** Set or agree on a goal defined in terms of a positive **outcome** of wanted behavior *Note: only code guidelines if set as a goal in an intervention context; if goal is a behavior, code **1.1, Goal setting (behavior)**; if goal unspecified code **1.3, Goal setting (outcome)*** Improved outcome measurements in the domains of the outcomes: ➢ Improved knowledge on related constructs to three domains of intervention ➢ Reducing levels of fatigue ➢ Reducing levels of perceived stress ➢ Improved levels of personal resilience ➢ Improving overall. Wellbeing ➢ Improving emotional and mental wellbeing ➢ Improving states of thriving ➢ Improved thriving at work outcome measure Improvement in satisfaction with performance over past month on 11-point scale (Brown et al., 2017) **1.4. Goal planning: action planning** Prompt detailed planning of performance of the behavior (must include at least one of context, frequency, duration, and intensity). Context may be environmental (physical or social) or internal (physical, emotional or cognitive) (includes '**Implementation Intentions**') *Note: evidence of action planning does not necessarily imply goal setting, only code latter if sufficient evidence* Prompt planning of a specific identified behaviour change within personal context in either/and 1. Sleep science 2. Performance management 3. Positive psychology with identification of an action plan which specifies: 1. The context (environmental i.e., physical, or social ; internal i.e., physical, emotional, or cognitive) 2. The frequency of the action 3. The duration of the action 4. The intensity of the action Encourage scheduling of the activity **2.7 Feedback and monitoring: feedback on outcome(s)**	Ask the surgeon to review their desired goals and actual outcomes, examining how much improvement/non-improvement was noted at the end of each working week and identify what helped go well and not so well in the form of a diary ➢ Level of knowledge on related constructs to three domains of intervention ➢ Levels of fatigue ➢ Levels of perceived stress ➢ Level of personal resilience ➢ Level of overall Wellbeing ➢ Level of emotional and mental wellbeing ➢ Level of states of thriving ➢ Level of thriving at work outcome measure Level of satisfaction with performance over past month on 11-point scale (Brown et al., 2017)

	of behaviour	
	Monitor and provide feedback on the outcome of performance of the behavior *Note: if Biofeedback, code only **2.6, Biofeedback** and <u>not</u> **2.7, Feedback on outcome(s) of behavior**; if feedback is on **behavior** code **2.2, Feedback on behavior**; if there is no clear evidence that feedback was given code **2.5, Monitoring outcome(s) of behavior by others without feedback;** if feedback on behaviour is evaluative e.g., praise, also code **10.4, Social reward***	
	Inform the surgeon improvement/dis improvement was noted in the pre-intervention outcome measurements Outcome measurements in the domains of the outcomes compared to pre-intervention: ➢ Level of knowledge on related constructs to three domains of intervention ➢ Levels of fatigue ➢ Levels of perceived stress ➢ Level of personal resilience ➢ Level of overall Wellbeing ➢ Level of emotional and mental wellbeing ➢ Level of states of thriving ➢ Level of thriving at work outcome measure Level of satisfaction with performance over past month on 11-point scale (Brown et al., 2017)	
	9.2 Comparison of outcomes: pros and cons	
	Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behavior (includes '**<u>Decisional balance'</u>***)* *Note: if providing information about health consequences, <u>also</u> code **5.1, Information about health consequences**; if providing information about emotional consequences, <u>also</u> code **5.6, Information about emotional consequences**; if providing information about social, environmental, or unspecified consequences <u>also</u> code **5.3, Information about social and environmental consequences***	
	Have the surgeons identify the pros and cons for not changing their behavior towards one of the three domains of 1. Sleep science 2. Performance management Positive psychology	
	10.4 Reward and threat: social reward	
	Arrange verbal or non-verbal reward if and only if there ***has been*** effort and/or progress in performing the behavior (includes '**<u>Positive reinforcement</u>**') *Note: if reward is material, code **10.2, Material reward (behavior)**, if unspecified code **10.3, Non-specific reward**, and <u>not</u> **10.4, Social reward**; if reward is for **outcome** code **10.10, Reward (outcome).** If informed of reward in advance of rewarded behaviour, also code one of: **10.1, Material incentive (behaviour); 10.5, Social incentive; 10.6, Non-specific incentive; 10.7, Self-incentive; 10.8, Incentive (outcome)***	
	Have the consultant congratulate the surgeon for each day they fulfill the desired behavioural change Have lead researcher message them daily for updates and provide positive reinforcement	

Appendix AJ – Study protocol used for Chapter 7 intervention study

Pre-post testing on educational and coaching based intervention on cohort of surgeons in Tallaght University Hospital

Question: Can the use of a behaviour-change intervention impact on self-reported access to states of self-reported thriving ?

Objectives:

- To assess relationship between known variables which impact on surgical performance in the context of evidence-based tailored interventional design to elicit a casual association between modifiable factors to optimize surgical performance
- To explore impact of self-reported vitality and learning opportunities for surgeons to increase access to states of self-reported thriving through an educational and complimentary coaching design study

Study Outcomes:

- Desired improvement in self-identified health-related behaviour using appropriate outcome measurement
- Desired improvement in self-reported fatigue levels
- Desired improvement in accessing states of thriving using appropriate outcome measurement

Process of Project	Total Time	Actions	Location	Timeline
Introduction to Project	Nil	• Send email to participants with PIL	Virtual	30 November
Baseline Assessment	20 minutes	• Aim for recruitment of 10 participants • Coffee and catering to encourage attendance • Thriving (Thriving at Work Scale/Basic Psychological Needs) • Clinical Performance (Self-reported assessment of performance – paralleled with the 8 domains of practice) • Modifiable factors (Fatigue/Self-reported wellbeing/Resilience/Stress/ Process-variables/Environmental Influences) • Behaviour Change (Confidence in behaviour change)	Department of Surgery, Tallaght University Hospital	December 2020 – February 2021
Identification of individual behaviour (15 minutes) and referral to coaching programme (5 minutes)	20 minutes	• Explaining what coaching is/is not • Brainstorm of potential behaviours (The wheel of life/8 practices to positive performance in surgery)	Department of Surgery, Tallaght University Hospital	December 2020 – February 2021

Expert Education Session	55 minutes	• Introduction (Dale) – 5 minutes
		  • Focus on optimising surgical performance
		  • Focus on the barriers to that. Optimal performance
		• Each speaker (Niall/Taryn or Eva/Dan) get 15 minutes – 45 minutes
		• Performance Science - Niall
		• Sleep/Fatigue – Dale/Eva/Taryn
		• Positive Psychology – Dan
		  • What you can offer – draw industry parallel
		  • Science behind the research
		  • What happens when you apply/don't apply the principles (health/social/environmental/emotional consequences)
		  • Take away points for surgery
		• Wrap up and points on coaching (Dale) – 5minutes
		  • What it is/is not with examples
		  • Evidence of effectiveness of coaching
			Department of Surgery, Tallaght University Hospital	January 20th 2021

Coaching Programme (3.5-4.5 hours)	3.5 hours	• 1 session of 30 minutes • 3 sessions of 1 hour (variable and tailored to individuals) • GROW model of coaching	Centre for Learning and Development	December 2020 – **May** 2021
Endpoint assessment by research team	20 minutes	• Thriving (Thriving at Work Scale/Basic Psychological Needs) • Clinical Performance (Self-reported assessment of performance – paralleled with the 8 domains of practice) • Modifiable factors (Fatigue/Self-reported wellbeing/Resilience/Stress/ Process-variables/Environmental Influences) • Behaviour Change (Confidence in behaviour change) • Kirkpatrick model of assessment for coaching intervention • Qualitative feedback on the process	Room 1.37, Trinity Centre for Health Sciences	**May** 2021
Follow up and summative dissemination to department	40 minutes	• Departmental Inservice	Department. Of Surgery, Tallaght University Hospital	December 2021

Appendix AK – Link to material for education session (Phase 1)

Google drive link:
https://drive.google.com/drive/folders/1cjt736yO8v6783FqmVkn7iPvLk0nHqlS?usp=sharing

Appendix AL - Invitation letter for Chapter 7 intervention study

Invitation to participate in a research intervention in optimising surgical performance

Dear. XXX

I hope you're keeping well during the pandemic. I know these are unprecedented times with regards to time pressures and expectations being placed on staff.

I am emailing to request your participation in the final study of this PhD programme which is exploring optimising surgical performance. A series of studies conducted by our team within Tallaght University Hospital have explored the modifiable factors which impact on your ability to perform optimally. One of the most prevalent issues impacting performance in surgery is fatigue. The study aims to optimise surgical performance within individuals by providing bespoke targeted interventions to tackle fatigue in surgery.

This research is offering an evidence-based intervention comprising of two components - a practical education component informed by key experts; and an individualised coaching programme delivered by qualified coaches to better optimise your performance in surgery. Please see attached a PIL explaining this study further.

If interested we can try to organise a date and time to discuss the study further or to conduct a baseline assessment in person or virtually. Please don't hesitate to get in touch if you have any queries about the study at whelehd@tcd.ie.

Thank you for your time and consideration and wishing you all the best over the coming weeks and months.

All the best,

Dale Whelehan
PhD Candidate in Surgical Performance
Discipline of Surgery,
School of Medicine,
Trinity College Dublin

Appendix AM - Participant information letter for Chapter 8 intervention study

Participant Information Leaflet

Study title: To investigate the effectiveness of an individualised behaviour-change based intervention in improving modifiable factors known to enhance surgical performance

You are being invited to take part in a research study to be carried out at Tallaght University Hospital as part of a research doctorate degree affiliated with Trinity College Dublin; The University of Dublin looking at performance based activities in surgeons. This study has Joint SJH/AMNCH Research Ethics Committee approval.

Before you decide whether or not you wish to take part, you should read the information provided below carefully. Take time to ask questions – don't feel too rushed or under pressure to make a quick decision. Your participation in this study is completely voluntary.

You should clearly understand the risks and benefits of taking part in this study so that you can make a decision that is right for you. This process is known as 'Informed Consent'.

You can change your mind about taking part in the study any time you like. Even if the study has started, you can still opt out. You don't have to give us a reason. If you do opt out, rest assured it won't affect your future employment in Tallaght University Hospital or elsewhere.

Principal Investigator(s):
Dale Whelehan, PhD Candidate in Surgical Performance,
Room 1.37 Discipline of Surgery,
Trinity Centre for Health Sciences,
Tallaght University Hospital, Dublin 24
whelehd@tcd.ie

Co-investigator(s):
Dr. Eva Doherty, Royal College of Surgeons in Ireland, Ireland
Lt. Col. Niall Buckley, Irish Air Corp, Ireland
Dr. Taryn Taylor, Western University, Ontario, Canada
Dr. Daniel Brown, University of Portsmouth, England, United Kingdom
Prof. Paul Ridgway, Trinity College Dublin, Ireland

Why is this study being done?

This research study is informed by a culminated effort in understanding surgical performance in the context of staff based in Tallaght University Hospital. A series of studies conducted by this research team have explored the modifiable and non-modifiable factors which impact on your ability to perform optimally. One of the most prevalent issues impacting performance in surgery is fatigue. Fatigue can be defined as a decrement in physical and mental capacity, and has multiple causes.

This research is informed by previous studies conducted within the department, and modelled off an established behaviour change model. The study aims to optimise surgical performance within individuals by providing targeted interventions to tackle known modifiable factors such as fatigue. Similarly, accessing states of 'thriving' in performance i.e. a state of 'full functioning' is the desired outcome for this project. The study will involve two main activities – engagement in educational sessions on key areas of performance management science, and engagement in a tailored coaching programme for individualised desired behaviour change.

Why am I being asked to take part?

You are being asked to take part in this study as participation is aimed at participants of differing levels of experience and training in the surgical profession i.e. interns, senior house office, register, consultancy.

Specifically, these research objectives are:

- To assess relationship between known variables which impact on surgical performance in the context of evidence-based tailored interventional design to elicit a casual association between modifiable factors to optimise surgical performance
- To improve self-reported vitality and learning opportunities for surgeons to increase access to states of self-reported thriving and improved performance through an educational and complimentary coaching design study

Do I have to take part? What happens if I say no? Can I withdraw?

You don't have to take part in this study. If you decide not to take part it won't affect your professional career. You can change your mind about taking part in the study and opt out at any time even if the study has started. If you decide to opt out, it won't affect your professional career. You don't have to give a reason for not take part or for opting out. If you wish to opt out, please contact Dale Whelehan, Principal Investigator (whelehd@tcd.ie) who will be able to organise it for you.

What will happen to me if I agree to take part?

This study will commence in December 2020 in Tallaght University Hospital. Participants will also be expected to complete a series of baseline questionnaires relating to known modifiable factors to impact on surgical performance including fatigue, willingness to make behaviour change, their sleep schedule, performance alertness, relevant performance outcome measurements informed by your professional practice standards, and states of thriving which will be conducted by the PI (Dale). A study flow diagram is attached for further clarification of the study process.

Education Component: Participants will be expected to complete a basic education session with key experts from the field in performance science management. These areas include human factors, positive psychology and sleep science offered by experts from within surgery and from parallel elite industries. The purpose of this session is to provide you with the education and awareness of the necessary skills to develop in order to promote self-regulation of performance. This session will take approximately 45 minutes to complete via a virtual or in-face platform in Tallaght University Hospital. You may also be asked at this point to reflect on an individual behaviour which you would like to focus on for the subsequent aspect of the intervention – the coaching component.

Coaching Component: The coaching component will comprise of an initial 30 minute session working with a trained professional coach, and between 2-4 subsequent 1 hour coaching sessions to work on behaviour change and sustainability over a period of 4-6 months. The coaching component of the study will be carried out independently by the SOAR coaching programme offered by Tallaght University Hospital, with external coaches to allow you to be open and honest. The behaviour change you wish to make may be informed by the education component of the intervention, or by a separate desired individual change. The research principal investigator (Dale) will ask you prior to the sessions what area you wish to work on – which you can decide to disclose or keep confidential. The PI will complete regular assessment of your fatigue levels to evaluate if you have any differences in the aforementioned outcome measurements.

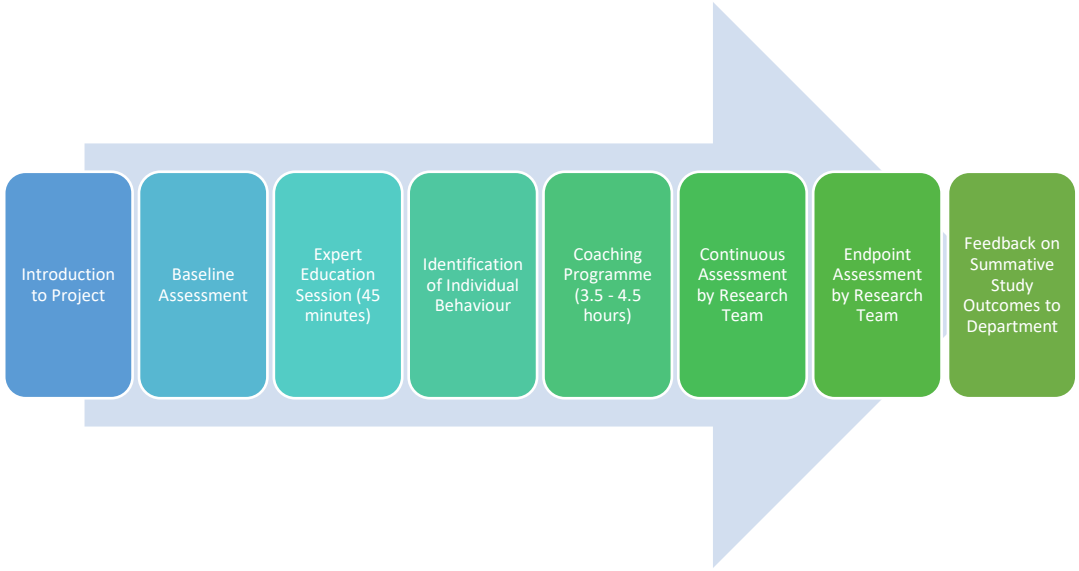

Figure: Study Process

Are there any benefits to me or others if I take part in the study?

The process may allow participants to become more aware of aspects of their performance management which you can better optimise to make your work life more enjoyable and easier. In particular, the opportunity to work with a coach may elicit opportunities for you to improve your work performance and also improve your personal well-being. This research is interested in optimising lifestyle factors (both physical and psychological) to reduce risks of burnout, increase access to states of thriving and improve your performance as a surgeon.

Are there any risks to me or others if I take part in the study?

It is not envisaged that this study will provide any major risks to participants. There may be potential adverse effects associated with two areas.

Change in behavioural activities: The potential inconveniences may include a reduced engagement with previous behaviours in which the participant was frequented with which may cause an initial increased stress through the behavior change. The level of oversight will only be as much as is supported by the participant, and the principal investigator who is training in motivational interviewing can assist participants at any point throughout the process outside of the formal points of intervention to reduce any inconveniences or challenges which participants face.

Risk of physical and/or mental health related issues arising: The educational component and subsequent coaching sessions may elicit feelings of worry and stress for participants who feel they may be at risk of health decrement. Similarly, the process of eliciting behaviour change, which involves self-recognition of core values and rationale of behaviour in its current format, may elicit negative emotions influenced by prior traumatic events. Non-confidential data will not be made available to research members from Dept. Surgery. Should participants feel overwhelmed by the process, particularly through the coaching programme provision, the SOAR coaching programme will offer to assist the participant in seeking assistance from Occupational Health or the employee assistance programme. Similar protocols are applied should individuals wish to disclose issues to any member of the research team. Dale Whelehan is an independent researcher with physiotherapy background which will reduce the risk of cultural-based disclosure of research issues. Dale Whelehan is available to them throughout the research process for support. Dale is a physiotherapist within the hospital, who has received professional development training in relevant skills such as motivational interviewing, basic counselling principles and cognitive behavioural therapy (CBT).

Will I be told the outcome of the study? Will I be told the results of any tests or investigations performed as part of this study that relate to me?

If you decide to partake in this study, you will be informed of your outcome measurements throughout the study. As coaching has 'feedback and monitoring' at its very core for behaviour change you will receive feedback from your coach, from the principal investigator and from self-feedback through reflection.

DATA PROTECTION

What information about me (i.e. *personal data*) will be used as part of this study?

The following personal data will be collected for research purposes through outcome measurement tools:

Intervention assessment related data:

Basic psychological needs (autonomy, competence, relatedness)
Resiliency
Wellbeing
Stress
Willingness and process variables for behaviour change
Fatigue
Sleep
Performance outcomes as informed by 8 Domains of Good Professional Practice (Irish Medical Council, 2016)

Demographic Related Data:

Workflow
Age
Gender
Experience in surgery
Professional title

What will happen to my personal data?

All data relating to participants findings will be made confidential. All primary data analysis will be conducted by the principal investigator Dale Whelehan, and will be conducted on-site at Tallaght University Hospital. At no point will identifiable data files be shared with other research team members as a precautionary data protection. This information will be kept for 5 years and may be used in further studies within this timeframe. These future studies may involve potential intervention studies that are informed by the research outputs of this research project.

Who will access and use my personal data as part of this study?

Identifiable data relating to the research mentioned above will be limited to the research team comprising of Principal Investigator Mr. Dale Whelehan. Confidentiality will be maintained through removing any identifiable characteristics before data interpretation which will additionally comprise of input from all research team members. Any information you disclose during your coaching session will be confidential between your coach and you. This process will be independent of the research team, and should you wish to not disclose what behaviour you are focusing on this will not affect your engagement or outcome with regards to the research project or professional career.

Will my personal data be kept confidential? How will my data be kept safe?

We will be using your information in our research to help us study the association between modifiable factors that impact on surgical performance, states of performance (thriving) , performance outcome measurements (as informed by the 8 domains of good professional practice), and the role of education and coaching in optimising these metrics. This is intended for science research use. Participant's information will be limited to the research team involved in this study and stored for 5 years in Dis. Surgery, Trinity Centre for Health Sciences. All data relating to participants findings will be computerised and encrypted and coded. Personal information that could identify the participant will be removed to protect the confidentiality of the participant.

What is the lawful basis to use my personal data?

The basis for use of your personal data is in accordance with Article 6 and Article 9 of GDPR.

What are my rights?

You have the right to withdraw consent to your data being used in this research project. You will be able to do this by contacting Dale Whelehan at whelehd@tcd.ie who will have access to the coded participant information. You have a right to request access to your data, as well as a copy of your data. You have a right to restrict or object to processing of your personal data. You have a right to have any inaccurate personal information corrected or deleted. You have a right to have your personal data deleted, unless the request is impossible or hinders conduct of the research. You have the right to data portability. Information regarding your rights and opportunities to evoke their use can be informed through the Joint Research Ethics Committee at research.ethics@tuh.ie

Will it cost me anything if I agree to take part?

No. This study will not incur any personal cost.

Who is organising this study?

This principal investigator of this research is Dale Whelehan, a research doctorate student in surgery affiliated with Trinity College Dublin, The University of Dublin under the supervision of Professor Paul Ridgway, Director of Perioperative Care, Tallaght University Hospital and Associate Professor in Surgery.

Has this study been approved by a research ethics committee?

The SJH/AMNCH Joint Research Ethics Committee has approved this study in November 2020.

Will my personal data be used in future studies?

The research team intends to use your personal data for future research studies to inform an intervention study in the area of surgical performance. Participants information will be limited to the research team involved in this study and stored for 5 years.

Where can I get further information?

If you need any further information now or at any time in the future please see the 'Statement of Information Practice' affiliated with Tallaght University Hospital (*http://www.tuh.ie/About-us/Statement-of-Information-Practice.pdf)*, or contact:

Principal investigator's name:	**Dale Whelehan**
Principal investigator's title:	**PhD Candidate, TCD**
Telephone number of principal investigator:	**0852041559**
Supervisor name:	**Paul Ridgway**
Supervisor title:	**Associate Professor in Surgery, TCD**
Data Controller's/joint Controller's identity:	**Dale Whelehan and Paul Ridgway**
Data Controller's/joint Controller's details:	**whelehd@tcd.ie ridgwayp@tcd.ie**
Data Protection Officer details:	**research.ethics@tuh.ie**

What happens if I wish to make a complaint?

You have a right to lodge a complaint with the Data Protection Commissioner if you are unsatisfied with the management of your personal data within this study.

Will I be contacted again?

You may be contacted throughout the study process in order to arrange times for assessments. You may also be contacted for prospective future research in this area within a 5 year period.

Thank you for your consideration,

Dale Whelehan

PhD Candidate

Discipline of Surgery,

School of Medicine,

Trinity College Dublin, The University of Dublin

Appendix AN – Chapter 7 survey instrument for assessment of intervention study

Demographic Information

Participant ID Number: _____

Today's date: _____

What age bracket are you in?

≤ 30 years	
31-40 years	
41-50 years	
51-60 years	
61-70 years	
70+ years	

What gender best describes you?

Male	
Female	
Non-Binary	
Prefer not to disclose	

How long it is since you graduated from medicine?

≤ 5 years	
6- 10 years	
11-16 years	
17 – 22 years	
≥ 23 years	

Which of these most appropriately corresponds to your current job title?

Senior House Officer	
Registrar	
Specialist Registrar	
Consultant	
Other: Please Specify	

What surgical specialty best describes the area of work you are in?

Cardiothoracic Surgery	
General Surgery	
Neurosurgery	
Oral and Maxillofacial Surgery	
Otolaryngology (ENT) Surgery	
Paediatric Surgery	
Plastic Surgery	
Trauma and Orthopaedic Surgery	
Urology Surgery	
Vascular Surgery	
Other: Please Specify_____	

SECTION 1: CLINICAL PERFORMANCE ENCOUNTERS

In this section questions relate to the ***clinical performance encounters*** *that* you have found yourself in over the past month. Please select tasks in which you perceived there to be a **load or strain** associated with the task and where you may have **experienced fatigue before, during, or after the performance**. For example, you may wish to choose a surgical procedure, a surgical clinic, completing rounds, other work-related tasks.

Task 1: _____

Task 2: _____

Task 3: _____

a. STRESS REACTION

The following statements describe how you might have felt about your clinical performance encounters over the past month. Using the examples of the tasks above, please tick the answer which applies to you most closely.

In relation to your *clinical performance encounters* over the past month..	**Not at all**					**Extremely**
1. How stressful did you expect the clinical performance encounter to be on average?	1	2	3	4	5	6
2. Did you expect that you would be able to cope with the encounter on average?	1	2	3	4	5	6

In relation to your *clinical performance encounters* over the past month..	**Not true of me**						**Very true of me**
1. I viewed the encounters as a positive challenge (*i.e. you perceived that you could overcome the encounter*)	1	2	3	4	5	6	7
2. I viewed the encounters as a threat (i.*e. you perceived that difficult was likely to have a negative impact and that you could not overcome the encounter*)	1	2	3	4	5	6	7

b. CLINICAL PERFORMANCE CONFIDENCE AND SATISFACTION

The following statements ask you about how you have felt satisfied and confident in being competent in your clinical performance encounters in the past month. Please tick the answer which applies to you most closely.

During my clinical performance encounters in *'relating to patients'*, my performance left me feeling	**Totally Dissatisfied**	0	1	2	3	4	5	6	7	8	9	10	**Totally satisfied**
	Self-assured	0	1	2	3	4	5	6	7	8	9	10	**Self-doubtful**
During my clinical performance encounters in *'possessing the necessary clinical skills'*, my performance left me feeling	**Totally Dissatisfied**	0	1	2	3	4	5	6	7	8	9	10	**Totally satisfied**
	Self-assured	0	1	2	3	4	5	6	7	8	9	10	**Self-doubtful**
During my clinical performance encounters in *'demonstrating professionalism'*, my performance left me feeling	**Totally Dissatisfied**	0	1	2	3	4	5	6	7	8	9	10	**Totally satisfied**
	Self-assured	0	1	2	3	4	5	6	7	8	9	10	**Self-doubtful**
During my clinical performance encounters in *'possessing the necessary communication and interpersonal skills'*, my performance left me feeling	**Totally Dissatisfied**	0	1	2	3	4	5	6	7	8	9	10	**Totally satisfied**
	Self-assured	0	1	2	3	4	5	6	7	8	9	10	**Self-doubtful**
During my clinical performance encounters in *'possessing management and self-management skills'*, my performance left me feeling	**Totally Dissatisfied**	0	1	2	3	4	5	6	7	8	9	10	**Totally satisfied**
	Self-assured	0	1	2	3	4	5	6	7	8	9	10	**Self-doubtful**
During my clinical performance encounters in *'demonstrating scholarship'*, my performance left me feeling	**Totally Dissatisfied**	0	1	2	3	4	5	6	7	8	9	10	**Totally satisfied**
	Self-assured	0	1	2	3	4	5	6	7	8	9	10	**Self-doubtful**
During my clinical performance encounters in *'providing patient safety and quality of care'*, my performance left me feeling	**Totally Dissatisfied**	0	1	2	3	4	5	6	7	8	9	10	**Totally satisfied**
	Self-assured	0	1	2	3	4	5	6	7	8	9	10	**Self-doubtful**

SECTION 2: WHAT FACTORS AFFECTED YOUR CLINICAL PERFORMANCE ENCOUNTERS

a. FATIGUE

The following questions and statements describe your levels of fatigue and some of the things that may influence fatigue levels. If you have been feeling tired for a long while, then compare yourself to how you felt when you were last well. Please tick the answer which applies to you most closely over the past month.

During or after work…	**Less than usual**	**No more than usual**	**More than usual**	**Much more than usual**
1. Do you have problems with tiredness				
2. Do you need to rest more				
3. Do you feel sleepy or drowsy				
4. Do you have problems starting things				
5. Do you lack energy				
6. Do you have less strength in your muscles				
7. Do you feel weak				
8. Do you have difficulties communicating				
9. Do you make slips of. the tongue when speaking				
10. Do you find It more difficult to find the right word				
	Better than usual	**No worse than usual**	**Worse than usual**	**Much worse than usual**
11. How is your memory				

In relation to your general *fatigue levels* over the past month how often did you..	**Everyday**	**At least once a week**	**At least once a month**	**Less than once a month**	**Never**
1. Feel physically exhausted at the end of the workday	1	2	3	4	5
2. Feel mentally exhausted at the end of the workday	1	2	3	4	5
3. Feel emotionally exhausted at the end of the workday	1	2	3	4	5

b. FATIGUE RECOVERY

The following questions relate to your usual recovery from fatigue over the past month. Please tick the answer which applies to you most closely.

In relation to my *recovery from work fatigue* generally over the past month…	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. I use a lot of my spare time recovering from work	1	2	3	4	5
2. I don't get enough time between work shifts to recover my energy fully	1	2	3	4	5
3. I usually feel fully relaxed by the time I go to bed	1	2	3	4	5
4. I usually recover my energy within a few hours of getting home from work	1	2	3	4	5
5. I feel fully rested at the start of each workday/shift	1	2	3	4	5

In relation to your *recovery from work fatigue* generally over the past month…	Not at all effective						Extremely effective
1. How effective do you feel when performing non-work activities?	1	2	3	4	5	6	7
	Not at all						A great deal
2. What extent do you feel close and connected to the people you are with outside of work?	1	2	3	4	5	6	7
3. How much freedom and choice do you have over the things you do outside of work?	1	2	3	4	5	6	7

c. SLEEP

The following questions relate to your usual sleep habits and levels of daytime sleepiness over the past month. Please tick the answer which applies to you most closely.

What time do you usually go to bed at night: _____

How many hours of actual sleep do you get at night (*This may be different than the number of hours spent in bed*)**:** _____

How would you rate your sleep quality overall?	Very Good	Fairly Good	Fairly Bad	Very Bad
1. My sleep quality overall is	1	2	3	4
How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?	Would never doze	Slight chance of dozing	Moderate chance of dozing	High chance of dozing
2. Sitting and reading	0	1	2	3
3. Watching TV	0	1	2	3
4. Sitting, inactive in a public place (e.g. a theatre or a meeting)	0	1	2	3
5. As a passenger in a car for an hour without a break	0	1	2	3

6. Lying down to rest in the afternoon when circumstance permit	0	1	2	3
7. Sitting and talking to someone	0	1	2	3
8. Sitting quietly after a lunch without alcohol	0	1	2	3
9. In a car, while stopped for a few minutes in the traffic	0	1	2	3

d. PSYCHOLOGICAL WELLBEING

The following questions relates generally to your psychological wellbeing over the past month. Please tick the statement which applies to you most closely.

Generally..	**Not at all true**	**Not true**	**Almost not true**	**Almost true**	**True**	**Very true**
1. I feel alive and vital	1	2	3	4	5	6
2. I feel so alive I just want to burst	1	2	3	4	5	6
3. I have energy and spirit	1	2	3	4	5	6
4. I am looking forward to each new day	1	2	3	4	5	6
5. I feel energised	1	2	3	4	5	6
6. I feel alert and awake	1	2	3	4	5	6
7. I do not feel very energetic	1	2	3	4	5	6
8. I feel depleted	1	2	3	4	5	6
9. I am lethargic	1	2	3	4	5	6
10. I lack energy	1	2	3	4	5	6
11. I am experiencing a considerable personal growth	1	2	3	4	5	6
12. I am growing in positive way	1	2	3	4	5	6
13. I have not grown much recently	1	2	3	4	5	6

14. I am stagnating	1	2	3	4	5	6
15. I enjoy seeing how my views have progressed	1	2	3	4	5	6
16. I continue to learn more as time goes by	1	2	3	4	5	6
17. I am finding new ways to develop	1	2	3	4	5	6
18. I am not learning	1	2	3	4	5	6
19. I am developing a lot as a person	1	2	3	4	5	6
20. I am not moving forward	1	2	3	4	5	6
21. I find myself learning often	1	2	3	4	5	6
22. I see myself continually improving	1	2	3	4	5	6
23. I think I am continuing to develop	1	2	3	4	5	6
24. I am failing to progress	1	2	3	4	5	6

Generally I feel ..	**Very slightly or not at all**	**A little**	**Moderately**	**Quite a bit**	**Extremely**
1. Interested					
2. Distressed					
3. Excited					
4. Upset					
5. Strong					
6. Guilty					
7. Scared					
8. Hostile					

9. Enthusiastic					
10. Proud					
11. Irritable					
12. Alert					
13. Ashamed					
14. Inspired					
15. Nervous					
16. Determined					
17. Attentive					
18. Interested					
19. Distressed					
20. Jittery					
21. Active					
22. Afraid					

Statement	**Response**	
Have you felt you were thriving in your work?	Yes	No
Have you felt you were in 'flow' in your work?	Yes	No
Have you worried that your work is hardening you emotionally?	Yes	No
Have you often been bothered by feeling down, depressed or hopeless?	Yes	No
Have you felt that all the things you had to do were piling up so high that you could not overcome them?	Yes	No
Have you been bothered by emotional problems (such as feeling anxious, depressed, or irritable)?	Yes	No
Has your physical health interfered with your ability to do you daily work at home and/or away from home?	Yes	No
Have you felt burned out from your work?	Yes	No

e. PERSONAL QUALITIES

The following statements describe your personal qualities and thoughts over the past month. Please tick the answer which applies to you most closely.

In my work performance…	Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree
1. I feel confident analysing a long-term problem to find a solution	1	2	3	4	5	6
2. I feel confident helping to set targets/goals in my work area	1	2	3	4	5	6
3. I feel confident presenting information to a group of colleagues	1	2	3	4	5	6
4. If I should find myself in a jam at work, I could think of many ways to get out of it	1	2	3	4	5	6
5. At the present time, I am energetically pursuing my work goals	1	2	3	4	5	6
6. There are lots of ways around any problem	1	2	3	4	5	6
7. Right now I see myself as being pretty successful at work	1	2	3	4	5	6
8. I can think of many ways to reach my current work goals	1	2	3	4	5	6
9. At this time, I am meeting the work goals that I have set for myself	1	2	3	4	5	6
10. When I have a setback at work, I have trouble recovering from it, moving on	1	2	3	4	5	6
11. I usually manage difficulties one way or another at work	1	2	3	4	5	6
12. I usually take stressful things at work in stride	1	2	3	4	5	6
13. I can get through difficult times at work because I've experienced difficulty before	1	2	3	4	5	6
14. I feel I can handle many things at a time at this job	1	2	3	4	5	6
15. When things are uncertain for me at work, I usually expect the best	1	2	3	4	5	6
16. If something can go wrong for me work-wise, it will	1	2	3	4	5	6
17. I always look on the bright side of things regarding my job	1	2	3	4	5	6
18. I'm optimistic about what will happen to me in the future as it pertains to work	1	2	3	4	5	6
19. I approach this job as if 'every cloud has a silver lining'	1	2	3	4	5	6
20. I feel confident analysing a long-term problem to find a solution	1	2	3	4	5	6

Generally I come across as..										
Someone who is talkative, outgoing, is comfortable around people, but could be noisy and attention seeking	**1**	2	3	4	**5**	6	7	8	**9**	Someone who is a reserved, private person, doesn't like to draw attention to themselves and can be shy around strangers
Someone who is forthright, tends to be critical and find fault with others and doesn't suffer fools gladly	**1**	2	3	4	**5**	6	7	8	**9**	Someone who is generally trusting and forgiving, is interested in people, but can be taken for granted and finds it difficult to say no
Someone who is sensitive and excitable, and can be tense	**1**	2	3	4	**5**	6	7	8	**9**	Someone who is relaxed, unemotional rarely gets irritated and seldom feels blue
Someone who likes to plan things, likes to tidy up, pays attention to details, but can be rigid and inflexible	**1**	2	3	4	**5**	6	7	8	**9**	Someone who doesn't necessarily work to a schedule, tends to be flexible, but disorganised and often forgets to put things back in their proper place
Someone who is a practical person who is not interested in abstract ideals, prefers work that is routine and has few artistic interests	**1**	2	3	4	**5**	6	7	8	**9**	Someone who spends time reflecting on things, has an active imagination and likes to think up new ways of doing things, but may lack pragmatism

f. PSYCHOLOGICAL PERFORMANCE SKILLS

The following statements relate to the psychological skills that you may have used during your clinical performance encounters over the past month. Please tick the answer which applies to you most closely.

During my clinical performance encounters…	**Never**	**Rarely**	**Sometimes**	**Often**	**Always**
1. I set realistic but challenging goals for practice	0	1	2	3	4
2. I say things to myself to help my practice performance	0	1	2	3	4
3. During practice I visualise successful past performances	0	1	2	3	4
4. My attention wanders while I am training	0	1	2	3	4
5. I practice using relaxation techniques at workouts	0	1	2	3	4
6. During competition I set specific result goals for myself	0	1	2	3	4
7. My self-talk during competition is negative	0	1	2	3	4
8. I rehearse my performance in my mind before practice	0	1	2	3	4
9. During competition I have thoughts of failure	0	1	2	3	4
10. I use practice time to work on my relaxation technique	0	1	2	3	4
11. I manage my self-talk effectively during practice	0	1	2	3	4
12. I am able to control distracting thoughts when I am training	0	1	2	3	4
13. I set very specific goals for competition	0	1	2	3	4

14. At practice, I can allow the whole skill or movement to happen naturally without concentrating on each part	0	1	2	3	4
15. I keep my thoughts positive during competitions	0	1	2	3	4
16. I say things to myself to help my competitive performance	0	1	2	3	4
17. At competitions, I rehearse the feel of my performance in my imagination	0	1	2	3	4
18. I manage my self-talk effectively during competition	0	1	2	3	4
19. I set goals to help me use practice time effectively	0	1	2	3	4
20. At practice, when I visualise my performance, I imagine what it will feel like	0	1	2	3	4
21. During practice I focus my attention effectively	0	1	2	3	4
22. I set personal performance goals for a competition	0	1	2	3	4
23. I talk positively to myself to get the most out of practice	0	1	2	3	4
24. I have very specific goals for practice	0	1	2	3	4
25. I imagine my competitive routine before I do it at a competition	0	1	2	3	4
26. I talk positively to myself to get the most out of competitions	0	1	2	3	4
27. I rehearse my performance in my mind at competitions	0	1	2	3	4
28. I can control my emotions when things are not going well at practice	0	1	2	3	4
29. My emotions keep me from performing my best at competitions	0	1	2	3	4

30. My emotions get out of control under the pressure of competition	0	1	2	3	4
31. I use relaxation techniques as a coping strategy at competitions	0	1	2	3	4
32. I can psych myself to perform well in practice	0	1	2	3	4
33. I am able to perform skills at practice without having to consciously think about them	0	1	2	3	4
34. I can get myself ready to perform when I am at competitions	0	1	2	3	4
35. I have difficulty with my emotions at competitions	0	1	2	3	4
36. During training sessions I use relaxation techniques to improve my performance	0	1	2	3	4
37. My emotions keep me from performing my best during practice	0	1	2	3	4
38. I am able to control distracting thoughts during competition	0	1	2	3	4
39. I can psych myself to perform well in competitions	0	1	2	3	4
40. I use relaxation techniques during competitions to improve my performance	0	1	2	3	4
41. I can get myself 'up' if I feel flat at practice	0	1	2	3	4
42. I am able to perform skills at competition without having to consciously think about them	0	1	2	3	4
43. If I'm starting to 'lose it' at a competition, I use a relaxation technique	0	1	2	3	4
44. I can get my intensity levels just right for competition	0	1	2	3	4

45. During practice, I can perform automatically without having to consciously control each movement	0	1	2	3	4
46. I am able to trust my body to perform skills in competition	0	1	2	3	4
47. In competition, I am sufficiently prepared to be able to perform an automatic pilot	0	1	2	3	4
48. I focus my attention effectively during competition	0	1	2	3	4
49. My practice performance suffers when something upsets me at training	0	1	2	3	4
50. I have trouble maintaining concentration during competition	0	1	2	3	4
51. I can get my intensity levels just right for practice	0	1	2	3	4

g. WORKPLACE

The following statements relate to your approach to work and the climate of your workplace. Please tick the answer which applies to you most closely.

In my workplace…	Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly agree
I pretty much decide how to do my work						
There is a real opportunity in my position for me to choose the particular thinks to work on						
I have a lot of choice in the work I do						
My co-workers are supportive and friend toward me						
My colleagues and co-workers really try hard to get to know one another						

The people I work with make a real effort to understand difficulties doctors may be having with their work						
My workload is too heavy						
My position requires me to do too many different things						

SECTION 3: BEHAVIOUR CHANGE AND KNOWLEDGE

a. BEHAVIOUR CHANGE

The following statements relate to your behaviour change as part of this project. Please tick the answer which applies to you most closely.

In relation to your *behaviour change* tick the appropriate statement	**Not at all**					**Extremely**
1. I am willing make behaviour change to improve my fatigue levels	1	2	3	4	5	6
2. I believe I am able to make behaviour change to improve my fatigue levels	1	2	3	4	5	6
3. I feel ready to make behaviour change to improve my fatigue levels	1	2	3	4	5	6

b. KNOWLEDGE

The following questions relate to your current understanding of some of the main themes of this project. Please tick the answer on the multichoice question you feel is correct.

Which of the following would not counteract the loss of situational awareness?	
A. Huddles	
B. What if conversations	
C. WHO safety checklist	
D. Focusing on the surgical task	
E. Psychological safety	
Which of the following statements is false?	
A. Fear triggers an avoidance reaction	
B. Stress only improves performance	
C. Relaxation training results in increases in brain activity	
D. The physiological feeling of excitement and stress is the same	
E. Thoughts and emotions re not the same thing	
Which part of the brain contains the suprachiasmatic nucleus (SCN) ?	
A. Amygdala	
B. Hippocampus	
C. Hypothalamus	
D. Thalamus	
E. Pons	
Sleep deprivation results in an increase of which compound?	
A. Amide	
B. Adenosine	
C. Propane	
D. Nonane	

E. Acetylene	
Which of the following statements is false?	
A. Sleep deprivation leads to increased risk of developing dementia	
B. Sleep deprivation leads to longer reaction times	
C. Sleep deprivation and fatigue are the same	
D. Adults should sleep for 7-8 hours a night	
E. You should sleep in a cool not warm room at night for better sleep	
Which type of brainwaves help us engage in relaxation and sleep?	
A. Alpha	
B. Beta	
C. Gamma	
D. Delta	
E. Theta	
Which of these are not an inhibitor to thriving in surgery?	
A. Personal cognitions	
B. Culture	
C. Surgical competency	
D. Sleep deprivation and fatigue	
E. Demands of surgery	
Thriving combines two subjective perceptions. Which are they?	
A. Satisfaction and Rest	
B. High-level performance and Well-being	
C. Work engagement and Social support	
D. Energy and Drive	
E. Motivations and Emotions	
Which of the following statements are true of fatigue?	

A. Fatigue is a component of a wider safety culture	
B. Fatigue is easy to identify as being linked to error	
C. Fatigue can only be managed by getting sufficient sleep	
D. Fatigue risk management is not a collective responsibility of all stakeholders	
E. Fatigue is made worse by taking regular breaks	
Which industry founded the concept of 'crew resource management' ?	
A. Nuclear	
B. Astronautics	
C. Healthcare	
D. Military	
E. Elite sport	

Additional conclusion component

SECTION 3: HOW HAVE YOU CHANGED AFTER YOUR ENGAGEMENT IN THE PROJECT

The following statements indicate changes that may have occurred following your engagement in the project. Please indicate the extent of change that has occurred as a result of your engagement in the project.

As a result of the intervention…	**No change**	**Very small change**	**Small change**	**Moderate change**	**Great change**	**Very great change**
1. I changed my priorities about what is important in life	0	1	2	3	4	5
2. I developed new interests	0	1	2	3	4	5
3. I more clearly see that I can count on people in times of trouble	0	1	2	3	4	5
4. I have a greater sense of closeness with others	0	1	2	3	4	5

5.	I am more willing to express my emotions	0	1	2	3	4	5
6.	I know better that I can handle difficulties	0	1	2	3	4	5
7.	I have more compassion for others	0	1	2	3	4	5
8.	I am more likely to try and change things which need changing	0	1	2	3	4	5
9.	I feel more vital or energetic	0	1	2	3	4	5

SECTION 4: EVALUATION OF THE OVERALL INTERVENTION

The following questions relate to your feedback on the intervention overall. Please be elaborative and honest in your responses. There are no right or wrong answers.

1.	How was your overall experience of intervention?
2.	Did the intervention have an impact on your levels of fatigue? If so, in what way?
3.	Did it have an impact on your ability to perform both in work and outside work? If so, in what way?
4.	If any, what was the most important insights or learning you obtained from the intervention
5.	If any, what action has created the largest positive changes for you?
6.	Is there anything you would do differently now than before you tried this intervention
7.	What would you change about this intervention to make it more meaningful and impactful for surgeons? Was there insufficient/sufficient/too many intervention components?
8.	Do you think the aims and outcomes of this intervention would have been different pre-pandemic? If yes, please explain.
9.	If you feel comfortable disclosing, please describe what the focus of your coaching sessions were.

THANK YOU FOR ANSWERING ALL OF THE QUESTIONS

Appendix AO – Fortnightly assessment of fatigue for Chapter 7 intervention study

Demographic Information

Participant ID Number: _____

Today's date: _____

WEEKLY REPORTING OF FATIGUE

In relation to your general *fatigue levels* over the past week how often did you..	Everyday	At least once a week	At least once a month	Less than once a month	Never
4. Feel physically exhausted at the end of the workday	1	2	3	4	5
5. Feel mentally exhausted at the end of the workday	1	2	3	4	5
6. Feel emotionally exhausted at the end of the workday	1	2	3	4	5

How would you describe the intensity or severity of the fatigue you experiences over the past week											
Mild	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Severe**

Overall, what do you believe is the most directly contributing to or causing your fatigue in the past week?
Answer:
Overall, what do you believe is the best thing you have found to relieve you fatigue in the past week?
Answer:

Appendix AP - Participant information letter for Chapter 8 physiotherapy sleep study

Introduction:

It is known that a lack of sleep may impact on your performance. Research has shown that sleep deprivation in nursing and medicine have impacted on their work activities including assessment, treatment and management of patient caseloads. As autonomous practitioners, physiotherapists are similarly responsible for patients care. It is, however, unknown if sleep deprivation is prevalent in the physiotherapy profession, and if physiotherapists work is impacted by sleep deprivation. This research project is a research doctorate project for completion of a PhD programme in the area of 'work place-based activities' in healthcare professionals. This study has three main aims:

- To identify levels of self-reported sleep deprivation, defined as a decrement in sleep quantity and quality, within the Irish physiotherapy population
- To identify levels of subjective sleepiness on daytime activities in Irish physiotherapists
- To explore the relationship between self-reported sleep deprivation and levels of subjective sleepiness on daytime activities in Irish physiotherapists

Procedures:

To complete this survey, you must be a member of the Irish Society of Chartered Physiotherapists. The survey consists of three sections and should take less than 5 minutes to complete. Please click the link below to complete the survey.

Should you decide to complete the survey, please return responses by **April 1st.** You should note that by completing and returning the survey you are providing your informed consent to participating in this study.

Confidentiality and Voluntary Participation:

Your participation in this anonymous survey is completely voluntary and all of your responses will be kept confidential. You have the right to withdraw consent to your personal data being used in this research project. You will be able to do this by contacting Dale Whelehan at whelehd@tcd.ie . Your IP address will not be recorded You may withdraw at any time. No personally identifiable information will be associated with your responses to any reports of these data. The data will be used for publishing and for research purposes only. This data will not be used in any form of profiling in your personal work and location monitoring will not be identified throughout the process. If you are unsatisfied with the management of your personal data within this study, you have a right to lodge a complaint with the Data Protection Commissioner. You have a right to request access to your data, as well as a copy of your data. You have a right to have your personal data deleted, unless the request is impossible or hinders conduct of the research. You have the right to data portability. The School of Medicine, Trinity College Dublin research ethics committee has approved this survey.

Contact Details

Should you have any comments or questions, please feel free to contact whelehd@tcd.ie or ridgwayp@tcd.ie .

Appendix AQ - Demographic assessment of physiotherapists

Are you a member of the Irish Society of Chartered Physiotherapists :

Yes
No

How long it is since you graduated from undergraduate physiotherapy:

< 5 years
6-10 years
11-16 years
17-22 years
> 23 years

Which of these most appropriately corresponds to your current job title?

Staff grade
Senior
Clinical specialist
Advanced practitioner
Private practice
Other: please specify

What sector of work do you primarily work as a physiotherapist in?

Public
Private

What physiotherapy work setting best describes the area of work you are in?

Hospital inpatient
Hospital outpatient
Primary care
Private practice
Other: please specify

What physiotherapy specialty best describes the area of work you are in?

Cardiology
Respiratory
Intellectual disability
Musculoskeletal and orthopaedics
Neurology
Gerontology
Oncology
Paediatrics
Rheumatology
Gender health
Sports and exercise medicine
Other: please specify

Appendix AR – Theoretical framework of psychological and performance constructs

Full zoom of theory available at :

https://www.easyzoom.com/imageaccess/e0275f685be64bcbb4fe6cd3c01561a6