Skills fade: a review of the evidence that clinical and professional skills fade during time out of practice, and of how skills fade may be measured or remediated.

1. Introduction

This is an exploratory study looking at skills fade in the health sector, particularly in doctors. It does not seek to make policy recommendations, rather to survey the evidence on the topic. The scope of this review is to identify what evidence exists to say when and how time out of practice impacts on skills, competence and performance. The review has sought evidence on:

- the impact of time and length of break from practice
- how this impact differs by type of practice
- mitigating factors for any diminution or loss of skills.

This review has gathered evidence from the published literature on doctors, other health professions and from other skilled professions.

2. Background

Time out from professional practice may happen for a variety of reasons: maternity, paternity or family leave; difficulty finding work, ill health; suspension; a career break or foray into another career; extended travel or study leave. It is reasonable to suppose that time out may impact on skills and competence. Measuring that likely impact would enable the professional, their employer and their regulatory body to identify means of addressing any training or support needs. Understandably, much of the wider literature on medical skills, competence and performance comes from medical education and is concerned with the assessment of doctors in training (Murphy et al, 2009, Batchelder and McCarthy, 2013). The recent focus on the types of evidence to support revalidation has meant that there is some interest in the assessment of competence of doctors who have completed their training (AoMRC, 2009, GMC, 2011, Overeem, 2012). Competence is seen as what the doctor is able to do. Performance is rather how they work and how competence is exhibited (Goulet, 2007; Hays et al, 2002). Public trust in professionals, according to Quick (2006) relies on those professionals having technical competence based on training in their specialised knowledge and skills.

The impact of skills fade on the performance of doctors is a matter of interest to the GMC because of its duty to protect the public by ensuring that doctors meet the expected standards of good medical practice. The multiple modes of regulating and monitoring performance through revalidation should provide assurance of the good medical practice of working doctors (Locke et al, 2013). However, revalidation is not designed to address the issue of skills fade in doctors returning from a break in practice. As the Academy of Medical Royal Colleges (AoMRC) (2012b, 2012c) points out, within the current licensing and revalidation framework there is potentially a time lag between a doctor's return to practice and being reviewed at appraisal and revalidation, wherein the returning doctor's most current suitability to remain on the register may not have been recently reviewed.

Fitness to practise (FTP) proceedings may result in a break from practice in the form of a suspension, either as a result of findings of impaired fitness to practise or as the result of an interim suspension whilst an investigation is being carried out. Case (2011a, 2011b) discusses the impact of interim suspensions on doctors, saying that the impact of such can be more punitive and more severe than the final sanction (p364). She talks of 'a costly de-

skilling effect which needs to be 'addressed before the doctor returns to practice.' The Department of Health (2000) in its consultation on modernising medical regulation also raised public protection concerns about the restoration of a doctor to the register 'if he or she fulfills certain criteria, for example, after a lengthy period of erasure or after a formal reassessment of skills.' In 2003 the National Audit Office reported on suspensions of hospital and ambulance staff in the NHS in England. The report details the number of suspensions, their rationales and impact. With regard to returning to practice after suspension, the report acknowledges that one of the costs of suspension is the risk of loss of clinical skills, which in turn may impact on patient safety.

3. Research questions

The initiating questions for this study were:

1) What is the evidence to support how an individual de-skills over time out from practice and if so, over what period of time?
2) What factors tend to influence and mitigate for skills fade – for example, age, specialty, supervision, level of autonomy etc.
3) Do other comparable regulators undertake any form of performance assessment following a prolonged break in practice? If so, what led to the introduction of this assessment and what is the evidence base behind it?

4. Research strategy

A systematic approach was used to identify and evaluate written evidence to answer the study research questions. It incorporates a literature search and web-based review of online publications. A systematic review of the medical literature has been undertaken using online databases. The literature has been evaluated for quality and for relevance to the research questions. The content of relevant papers has been summarised in order to answer the review research questions.

Because of the limited published evidence available within the medical literature on this topic, a targeted review of literature from sources outside of medicine has been undertaken. Specifically, evidence from other health professions has been gathered along with evidence from the 'high reliability' professions of aviation, rail and engineering and also the military. Views and hitherto unpublished evidence from key stakeholders and previous researchers were also sought. The requirements for returning to the health professional registers were reviewed in case they offered some insight into how time out impacts on skills. The review therefore includes evidence from UK and international regulators on their requirements for returning to the register after a break.

5. Research methods

The review was undertaken in three phases. In the first phase, published evidence on the impact of time out on doctors was systematically searched for, reviewed and summarised. In the second phase, published evidence on the impact of time out on other regulated health professionals was systematically searched for, reviewed and summarised, along with a review of requirements for return to the respective professional registers. In the third phase, published evidence on the impact of time out on work-related skills and competence was systematically searched for, reviewed and summarised. A call for evidence was also sent out via email to fellow medical regulators internationally. This gathered seven responses.

5.1 Doctors

Search parameters
The following databases were searched:

AMED (Allied and Complementary Medicine)
CINAHL (Cumulative Index to Nursing and Allied Health Literature)
HBE (Health Business Elite)
HMIC (Health Management Information Consortium)
Medline
Pubmed
Academic Search Complete
Web of Science
Google Scholar

Published materials from the following organisations were reviewed:

British Medical Association (BMA)
Academy of Medical Royal Colleges (AoMRC)
Royal College of General Practitioners (RCGP)
Royal College of Physicians (RCP)
Royal College of Psychiatrists (RCPsy)
Royal College of Obstetricians and Gynaecologists (RCOG)
Royal College of Paediatrics and Child Health (RCPCH)
Royal College of Surgeons of England (RCSE)
Royal College of Anaesthetists (RCA)
American Medical Association (AMA)
NHS Employers

Search terms
Search terms for this review were

medic, doctor*
AND
leave, competence, career break, maternity leave, sanction, skills fade, study leave, fit to practise, career break, skills decline, return to practice, returners, remediation

Searches were limited to papers in English, published between 1999 and 2014

Inclusion Criteria
Included papers reported on or discussed the impact of time out on doctors.

Search results

2466 papers were identified using the search terms.
From these 207 were selected via title and abstract for further review as potentially containing evidence to answer the research questions.
When duplicates were removed, 135 papers were reviewed in full.

5.2 Other regulated health professionals

Search parameters
The following databases were searched:

AMED (Allied and Complementary Medicine)
CINAHL (Cumulative Index to Nursing and Allied Health Literature)

HBE (Health Business Elite)
HMIC (Health Management Information Consortium)
Medline
Pubmed
Academic Search Complete
Web of Science

Published materials from the following organisations were also reviewed:
Nursing and Midwifery Council (NMC)
College of Occupational Therapists (COT)
Chartered Society of Physiotherapists (CSPh)
General Dental Council (GDC)
General Pharmaceutical Council (GPhC)
General Optical Council (GOC)
Health and Care Professionals Council (HCPC)
Royal Veterinary Society (RVS)

Search terms

Search terms for this review were stems for each of the health professions

dent, nurs*, occupational therap*, optic*, opthalm*, pharma*, physio*, veterinar**
AND
competence assessment, career break, maternity leave, sanction, skills fade, study leave, fit to practise, skills decline, return to practice, remediation, skills assessment, skills retention, suspension

Searches were limited to papers in English, published between 1999 and 2014

Inclusion Criteria

Included papers contained evidence on the impact of time out on health professional practice.

Search results

Dentists

552 papers were identified using the search terms. From a title and abstract review and removal of duplicates, 23 papers were identified as having potential relevance and were reviewed in full, along with a further 2 papers gathered via the GDC website, 1 from the College of Postgraduate Dental Deans and Directors and 1 from the NPSA/NCAS. Of the 27 papers reviewed in full, 8 contained information of relevance to the research question. Of these, 5 presented primary research, 2 were literature reviews and1 was a guidance paper from the GDC.

Nurses

1495 hits were gained using the search terms, with much duplication between databases. Of these, 72 papers were reviewed in full. 28 met the inclusion criteria, in that they contained evidence on the impact of time out on nurses' practice. Of these, 20 presented primary research, 4 were literature reviews, 4 were discussion or descriptive papers

Opticians

The search for papers about opticians on this topic yielded no papers that met the inclusion criteria. Of the 565 hits gathered using the search terms, title and abstract reviews yielded no potentially relevant papers.

Occupational Therapists

A search for relevant papers looking at skills fade and retention in occupational therapists yielded 145 potentially relevant hits, of which 1 met the inclusion criteria. There were also 2 relevant guidance papers from the COT.

Physiotherapists

A search for relevant papers looking at skills fade and retention in physiotherapists yielded 102 potentially relevant hits, of which 1 met the inclusion criteria. There were also 2 relevant guidance papers from the Chartered Society of Physiotherapists.

Veterinarians
The search for papers about veterinarians on this topic yielded no papers that met the inclusion criteria. Of the 932 hits gathered using the search terms, title and abstract reviews yielded 3 potentially relevant papers. On close review these did not address the research questions.

5.3 Work-related skills and competence

As this part of the review aimed to gather evidence from a broader field than health, but has been time limited, fewer databases were searched using fewer (but more general) search terms. Searches were undertaken with specific reference to aviation, engineering, the military and the rail industry, based on an assumption that these industries may have addressed the matter of workforce skill retention as part of the safety culture of high reliability organisations (The Health Foundation, 2011; Lekka, 2011)

Search parameters
The following databases were searched:

Pubmed
Academic Search Complete
Web of Science
Google Scholar

Search terms
Search terms used in *title, abstract* and *topic* searches for this part of the review were:

skills, skills fade, decline in competence, skills retention, time out, career break, skills declin, break in practice, change in practice, human factors, disciplin, suspension*.

Searches were limited to papers in English, published between 1999 and 2014

Inclusion Criteria
Included papers were ones that described empirical research on the impact of time out on skills in working age adults.

Search results

995 papers were identified using the search terms. 11 further papers were found through citations from included papers. From a title and abstract review and removal of duplicates, 185 papers were identified for full review. 11 papers were embargoed or not available using the access permissions of the reviewer. 174 papers were therefore reviewed in full. Of these, 94 contained information of relevance to the research question and have been included in the review.

6. Overview of the quality and relevance of the included papers

The quality of the primary research studies referred to in this review has been generally high, in that the studies follow data collection, analysis and reporting conventions suitable to their research questions. Many studies, however, use small sample sizes and report considerable attrition between tests of retention. They also tended to be single site studies. For these reasons, any generalisations from findings should be cautiously made.

The larger scale reviews of the evidence on skill retention have been the ones undertaken by military researchers, who all draw on a similar pool of evidence yet do incorporate primary and secondary research into reports on the literature.

In several studies it is not clear how often practice and revision were undertaken by subjects between tests. There are many studies looking at retention of learning in novices and only a limited body of research looking at how experts or those with years of practice retain their knowledge. Studies have also tended to look at single skills or single sets of skills rather than overall competence in a role.

The applicability of findings from studies outside medicine is limited, given the often specific nature of the skill being assessed. Within the medical and health literature, reports on skill retention have mainly looked at the impact of training interventions.

7. Thematic analysis of included papers

7.1 Research question 1: What is the evidence to support how an individual de-skills over time out from practice and if so, over what period of time?

There is substantial evidence that time out of practice does impact on skills retention. Skills have been shown to decline over periods ranging from 6 to 18 months, according to a curve, with a steeper decline at the outset and a more gradual decline as time passes. The amount of time between learning and losing a skill varies between skills and between individuals, with many mitigating factors. Studies have tended to look at skill retention at intervals up to 2 years. This has more to do with the time-limited nature of research studies than 2 years necessarily being a vital cut off period.

This review has found no clear consensus on the period of elapsed time after which an assessment of competence should be introduced. This depends on the skill being assessed and the circumstances of initial acquisition and interim practice.

Overall, the topic of skills fade subsequent to time out of health professional or medical practice has not been studied widely. There is a body of research looking at retention of skills after a period out of practice of those skills, or after a gap since learning of certain skills. There is also a body of research looking at the opinions and experiences of medical and other health care professionals who have taken time out from or are returning to work. Some research papers of note were found on the subjects of doctors, dentists, nurses,

occupational therapists, pharmacists and physiotherapists. No papers of relevance to this review were found on opticians or veterinarians. There have been studies on skills fade in railway workers, machinery operators, pilots and army personnel. The most comprehensive analyses of skills fade have been undertaken by research teams looking at armed forces service personnel.

The theoretical basis for the understanding of skills retention and skills fade comes from cognitive psychology and some studies have been undertaken to measure skill retention in experiments using voluntary subjects (usually university students).

Freed et al (2007) conducted a literature search on physician inactivity and time out. They found papers on the numbers of inactive physicians, particularly paediatricians, and the reasons for doctors to take time out of practice. They do not report on the impact of time out on a doctor's skills.

7.1.1 The AoMRC Return to Practice review

The AoMRC (2012) Return to Practice guidance addresses the question of how best to facilitate a doctor's return to practice (RTP) after absence from the perspective of patient safety and revalidation. It includes checklists to be used with doctors who have had breaks of three months or more, which should be used to identify learning and support needs prior to or on return. According to the evidence reviewed by the AoMRC (2012), two factors impact on readiness to return to practice: length of time out and age of the doctor, with longer breaks (which it classifies as over three months, based on a consensus of the working group members) and older doctors signifying greater risks on return. The AoMRC cites Grace et al's[1] (2011, cited as 2010) study on medical reentry programmes as the basis of its findings, along with a review of submissions from international regulators and from key stakeholders in the UK (the Deaneries and Royal Colleges). The AoMRC finds there to be no clear evidence regarding the difference in RTP issues between the medical specialties. It also finds lack of evidence regarding the impact of particular lengths of time out. One recommendation of the AoMRC report is that the GMC and the Royal Colleges set clear standards and assessment processes for doctors who have taken time out. The AoMRC recommendations are aimed at doctors who have taken more than three months out because 'absence of less than three months, in the view of the Return to Practice working group, appears less likely to cause significant problems, but may still affect confidence and skills levels.' The working group say they will review the 'three months' cut off should more research evidence on impact of length of time out on skills emerge.

The AoMRC (2012) Return to Practice evidence review and call for evidence asked similar questions to the present review. The AoMRC found limited published evidence on how quickly skills fade in medicine and what factors impact on skills fade. They refer to findings of the revalidation pilots, namely that the small number of returning doctors included would still be able to gather enough evidence to complete the revalidation cycle. Responsible Officers reviewed appraisals for ten doctors who had taken a break, and found no difficulties from a responsible officer point of view. Revalidation pilot samples contained groups of post maternity and other returners to be in too small numbers to draw conclusions. The AoMRC cite statutory guidance on parental leave and report about NCAS and the Practitioner Health Programmes. The primary research they report was also found in the database search for this study (Grace et al, 2011; Bower et al, 2010; and Ali et al, 1996, 2001, 2002, 2003). The findings of the present review are similar to those

[1] Grace et al's (2011) paper is discussed in detail at 7.2.5

found by the AoMRC. Unlike the AoMRC review, the present review has looked more broadly at the subject of skills fade, and has also taken into account studies looking at particular skills.

7.1.2 Findings from military studies

There has been substantial military research on skills retention including several comprehensive reviews (Perez et al, 2013; Arthur et al, 1998, Wisher et al, 1995;Goodwin, 2006; Leonard and Martin, 2007; Sanders, 2001). The rationale for such work has been both that military service personnel may be called on to use skills on occasion that are not used frequently and that certain personnel, for example military doctors, may have periods of hiatus between episodes of service. The reviews surmise that long periods of non-use lead to skills fade and that skills fade differs according to the individual, the context and the type of task. Perez,et al (2013, p76) survey the military literature from the perspective of surgical skills in the military. They cite Arthur et al's 1998 finding that: *'after 365 days of non use or non practice, the average participant's performance was reduced by almost a full standard deviation {d = -0.92).*'

The reviews also surmise that over learning is a key factor in skills retention, with over learning being the extent to which an individual has learned and practised a skill beyond initial proficiency. Over learning leads to a reduction in but not an eradication of the drop off of skills after a period of non use.[2] Aspects of military studies with particular resonance for this review are presented here.

Cahillane and Morin (2012) describe findings of a UK pilot study of skills retention in 78 military personnel. They tested retention of the skills required to operate complex digital information management systems. These skills include being able to recall and perform the correct manoeuvres in a multi-stage procedure. The purpose of this study was to identify the optimum training regimen for skills retention. A quasi experimental design was used, with groups having differing prior relevant experience and differing assessment intervals. The study had a high attrition rate and so its results have limited validity. The study did find a decline in participants' retention of skills over time. They found also that participants with relevant prior experience tended to maintain performance to a certain standard for longer.

In an earlier military study Henik et al (2001) conduct a study looking at retention of skills in 330 Israeli service men in three groups of army personnel (tank gunners, tow operators and dragon operators). Their subjects were all personnel at the end of their military service whose proficiency was tested initially prior to leaving and then tested at 6, 12 and 18 months. Proficiency was measured both in terms of knowledge and practical performance. They found a similar pattern in drop off of skills in all three groups of personnel with an initial drop between 0 and 6 months and then little further decline in proficiency between 6 months and the following testing intervals. They also found that skill refreshers impacted only on retention of knowledge but not on practical abilities. Henik et al found that procedural knowledge (knowledge of processes, for example performing a procedure) decayed slower than declarative knowledge (knowledge of principles or facts). This study

[2] Perez et al summarise a core set of factors that influence the decay of trained skills. They include 'length of the nonuse interval, (b) degree of overlearning (training beyond mastery), (c) task characteristics (e.g., psychomotor versus cognitive, number of steps involved), (d) method of assessing original acquisition and retention (i.e., type of test), (e) condition of retrieval (e.g., recall versus recognition), (f) instructional strategies and training methods, (g) individual differences (e.g., spatial ability), and (h) motivation."(2013, p82)

is of relevance to the research questions of the present review as its subjects are experts rather than novices and because of the differentiation between factual knowledge and practical skills. Whilst the findings of this study may have some relevance to medical and surgical skill retention, there should be some caution exercised in extrapolating findings.

Stothard and Nicholson (2001) review the evidence on skill retention and decay in an army context in order to develop a theoretical model useful for army training. They argue for over training based on evidence that proficiency declines subsequent to training, but it will stay at a maintenance level. They say that, according to a curve, decay in skills drops most in the first few months after training (month zero to two) but this decline slows down over time. They do not give a specific percentage of decay over a particular rate. This fits with Henik et al's findings.

Stothard and Nicholson summarise the factors affecting retention as being the task, the training, the retention interval and the individual. The characteristics of the task include what skills it requires (for example is it using cognitive or motor skills?) and how complex it is. Training factors affecting retention include whether the skill has been learned just to proficiency level or over learned. They find that retention interval, meaning the gap between learning a skill and testing of retention of that learning, is one of the main factors impacting on retention, citing evidence from a variety of studies that performance decreases soon after training and then declines at an increasingly slower rate. Opportunity to practise similar skills or to cognitively rehearse the skill in question do increase retention. Individual factors that Stothard and Nicholson say may affect retention of skills are aptitude and motivation, however, the evidence they found on aptitude is mixed. There is a skill loss curve in both people with and without initial aptitude, and, according to some earlier military studies, once training is given to enable proficiency to a specific level, the retention of skills does not vary.

There have been some single studies published looking at job-related skill retention. Ebbatson et al (2009, UK) measure retention of flying skills after a hiatus in 66 pilots. They found a mixed picture of skills retention, with different skills following different patterns of decline. Edin and Gustavsson (2008, Sweden) present findings from a longitudinal large scale study looking at the impact of time out of employment on literacy skills. In their analysis of data on 622 individuals, they found that a year of unemployment was linked to a 5 percentile move down the distribution of skills.

7.1.3 Impact of a break from clinical practice

There is a body of research looking at the impact of time out of clinical practice. The majority of studies in this area are either interviews or surveys of health professionals who have taken time out from practice (Kurien et al, 2011; Mark and Gupta, 2002; Smith, 2012), parental leave (Gordon and Szram 2013; Gropper et al, 2010) or else discussions and descriptions of policies on parental leave (Bristol et al, 2008; Lent et al, 2000; Liebhardt et al, 2012). What is perhaps the most interesting aspect of these surveys and studies - in terms of this review - is that the impact of part-time training or breaks from training on skills and competence is not considered. Freed et al (2009), reporting on interviews with representatives from all 64 of the US state licensing boards, note that there is no research specifically examining the relationship between patient outcomes and doctors returning to practice after a period of inactivity. They do, however, cite evidence that case volume can impact on a doctor's clinical acumen, in that the more opportunities doctors have to practise a skill, their competence and acumen will be better.

Some studies and discussion papers have looked at the impact of the feminization of the medical workforce on policy and practice, with particular reference to career breaks and part time working (Brown et al, 2013 - Canada; Brown, 2011, Budderberg-Fischer et al, 2010; Carroll et al, 2007; Mayer et al, 2001; Smith et al 2006; Finch, 2003; the reports of the working group on women in medicine led by Baroness Deech, 2009). Most recently Holdcroft and the Medical Women's Foundation (MWF) (2013) have analysed data on career breaks taken from surveys of female doctors in academic and clinical roles. This study really focuses on the perceived impact of breaks on careers and the support and guidance female doctors would like to have. Assurance of competence on return to practice is mentioned but not explored in detail. Parcsi and Curtin (2013) interview Australian occupational therapists about returning to work after a maternity break. Their study report does not include a discussion of the impact of time out on skills decline. Sheppard et al (2010) interviewed returners to physiotherapy in Australia. Their focus was on the experiences and expectations of returners, for whom there was no mandatory return to practice programme. Regarding the impact of time out of practice, the authors found no evidence to say that a certain amount of time out of the profession should preclude reentry.

Gold et al's (2005) survey of Canadian doctors who had taken a maternity break is the sole paper in this group that makes some reference to skills fade. With regard to residents keeping in touch when on a break from practice, the authors say: *'Residents were able to keep in touch with their peer groups, an important source of support. They were able to keep their clinical skills active; an important consideration given that withdrawal from a* ***all clinical activity for 6 months*** *during residency training can allow skills to decline.*' 6 months was given as a reference point as this was the average amount of time taken off by the mothers in the study.

Phipps et al (2013) conducted an interview study of 18 pharmacists with experience of changes in or breaks in practice. Their study was in response to the call by the CHRE for the General Pharmaceutical Council to have a return to work policy. Phipps et al acknowledge that there is limited information about the risks associated with returning to or changing practice, and suggest that those practitioners lacking personal knowledge and skills and lacking social support may present more patient safety risks. Those interviewed describe informal mechanisms for measuring and updating skills, through peer support, mentorship and networks within particular organisations, but noted the lack of a formal scheme or explicit requirements, as there are with other professions and in other countries (Australia and New Zealand).

7.1.4 Measuring the decline of specific clinical skills

This section summarises a number of studies focusing on the decline of specific clinical skills. The included studies demonstrate that different skills fade at different rates in different groups of subjects. The evidence here is conclusive that skills do fade over time but at different rates and according to various factors, hence it can be difficult to determine a definitive cut off point for reassessment or refreshing of skills.

Much of the research on skills retention in medical education is focused on assessing the impact of a particular training method or tool. The goal of such studies is not to measure how long skills are retained per se. As such the studies tend to be undertaken using medical students, other undergraduates, novices or volunteers. The detail of these studies has not been included here.

Retention of clinical and surgical skills after training

Several studies measured the retention of surgical and clinical skills in medical students and doctors in training post training for particular skills after different intervals of time. Assessments of retention tend to show some decline in skills after set time periods, but in certain studies no decline in skill has been found.

There is a trend for studies looking particularly at skills learned through simulation. The aim of these studies is usually to determine the suitability of simulation to train doctors in such a way as to have lasting effects. Some studies look at skill retention over a very short time frame and hence have limited relevance to this review (Vine et al, 2013, for example measure retention of skills at 1 month). The key findings here are that a doctor's skills tend to decline if a skill is not practised. Also having the opportunity to practise a skill in the interim and having expertise in similar skills positively influence retention of the new skill.

Ahya et al (2012) tested retention of catheter insertion skills in nephrology resident doctors (n 12) 6 and 12 months after training using simulation. They found that mean scores on tests declined at 6 and 12 months testing, and that the range of scores between subjects widened as time passes.

Preisner et al (2012) measured retention of knee and shoulder aspiration skills learned by simulation in medical residents (n 44) at between 6 and 30 months. They found that proficiency declined over time compared to post-test proficiency. They compared a group who had undertaken actual procedures in the interim versus those who had not and found their confidence levels and proficiency in certain aspects to be higher than the control. Crofts et al (2012) measured the impact of a training intervention on shoulder dystocia on doctors and midwives at 3 weeks, 6 months and 12 months. In this study the majority retained skills at 6 and 12 months.

Jackson et al (2012) compare retention of knee surgery skills learned through simulation in 3 groups of resident surgeons (n 19). One group of surgeons had no practise of the task for 6 months. The study found that residents did not lose skill over a six-month interruption in task performance.

Maagaard et al (2011) measured retention of surgical endoscopy skills learned through simulation in novices and experienced surgeons. Novices were tested at 6 and at 18 months post training and were found to retain skills at 6 months but to have gone back to pre-training levels after 18 months with no practise in between. Expert surgeons were tested at 6 months and had retained the skills. In the interim they had been practising similar skills to those being tested. The expert group performed consistently to a higher standard than the novices. These findings have significance for the present review because they demonstrate that over learning (learning beyond the minimum) is associated with better performance of learned skills when tested.

Castalevi et al (2009) measured retention of laproscopic surgery skills taught to surgery residents (n 42). They found variability in retention between the different skills taught. They found a decline in skills at 6 months but found that skill loss could be minimised at 12 months with additional structured practice. Edelman et al (2008, US) measure retention of laproscopic surgery skills in surgical residents (n 16) one week post training and at a 7-8 month interval. They found a significant degree of skills was retained at the later time of assessment.

Sinha et al (2008) measured retention of laproscopic surgery skills in postgraduate doctors six months after their being declared proficient. They found that different skills associated with this practice showed different rates of deterioration, with the finer motor skills declining fastest. Mashaud et al (2010) measured laproscopic skill retention in surgery residents (n 91) every six months up to two years. They found high retention levels and pass rates on examination. Hiemstra et al (2009) report on retention of laproscopic skills in eight medical students one year after training. They found the various skills learned declined over time to different extent, but that all students presented with better skills at retention than at the baseline.

Boet et al (2011) tested retention of cricothyroidotomy procedural skills in simulation (anesthetists n34) immediately, 6 months and 1 year post-intervention. They found no significant difference in performance of the simulation task at either point post-intervention, surmising that simulation training, along with practice and feedback, maintains procedural skills at least up to 1 year. As with several of the studies here, it is not reported how often the subjects may have availed themselves of the opportunity to practise or refresh those particular skills during the interim. As such the studies measure practical skills retention post learning but not necessarily with there being a complete hiatus in professional practice. Stromski et al (2005) measure retention of cricothyroidectomy skills in emergency residents at 2 months and again at up to 18 months since training (n 17). They found significant decline between the 2 periods.

Enk (2003) measured retention of dermatology assessment knowledge in 6th-year medical students (n 84) following a dermatology elective much earlier in their studies. Their test scores were significantly higher than those of students who had not completed the elective.

Rubak et al (2008) measure retention of teaching knowledge in medical teachers following a medical teachers course. They found that most respondents did retain the knowledge after 6 months. Dennick (2003) asked medical teachers about their self-assessed retention of teaching skills after a one or two year interval. They indicated a high retention and continued use of the skills. Oh et al (2001) measured resident doctors' retention of patient centered interviewing skills two years after their having been trained in the approach. They found that the skills were retained after the time period.

Regarding surgical and clinical skills, the disparate evidence on specific skills shows that:

- The majority of subjects assessed for retention of learned skills did not totally lose the new skill after a set time period (Jackson et al, 2012, Crofts et al, 2012, Edelman et al, 2008, Mashaud et al 2010) and newly learned skills were still in evidence when tested after various time periods ranging between 4 and 9 months (Enk, 2003), 6 months (Rubak et al, 2008), 2 years (Oh et al, 2001) and 6 months to 1 year (Ahya et al, 2012).
- The range of assessment scores between subjects widens over time (Ahya et al, 2012).
- Proficiency declined over time (Preisner et al, 2012, Boet et al, 2011, Stromski et al, 2005).
- Practice in the interrim increases confidence and proficiency when tested (Preisner et al, 2012, Maagaard et al, 2011).
- Experts may retain skills better than novices (Maagaard et al, 2011).
- There is variability in retention between the skills being assessed (Castaevi et al, 2009, Sinha et al, 2008 - who found fine motor skills to decline fast, Hiemstra et al, 2009).
- Additional structured practice between 6 and 12 months can repair skills loss detected at a 6 month assessment (Castalevi et al, 2011).

Advanced and basic life support, cardio pulmonary resuscitation and defibrillation

The research evidence on retention of specific skills associated with life support comes from studies undertaken to determine the appropriate time lag between refreshers or to evaluate one training approach over another. As such, the findings of these studies have some applicability to the present research question, in that they demonstrate skills and knowledge do decline, and that rate of decline is not fixed.

Life support skills

A large number of studies on adult Advanced Life Support (ALS) show that knowledge and skills decay at six months to a year from training and that skills decline faster than knowledge (Yang et al, 2012; Mohammad et al, 2014). Also, whilst cognitive retention of ATLS information declines over time, those with previous training retain the ability to perform clinical tasks, thus retaining psychomotor skills (Azcona et al, 2002). Similarly, Ali et al's (2001) work looking at the effectiveness of ATLS training methods found that whilst the cognitive aspect of ATLS decline over time, the same has not been significantly found in terms of clinical skills. Nicol et al (2011) measured retention of Immediate Life Support (ILS) skills in interns after variable gaps in training. They found that skills were retained for 6 to 9 months.

Smith, Gilcreast and Pierce (2008) evaluate nurses' advanced cardiac life support (ACLS) and basic life support (BLS) skills after 3, 6, 9 and 12 months in a repeat measures study. They find that whilst nurses retained the theoretical knowledge from their training, their skills in performing ACLS and BLS degraded quickly. They also found that 'ACLS skills degrade faster than BLS skills with 63% passing BLS at 3 months and 58% at 12 months. Only 30% of participants passed ACLS skills at 3 months and 14% at 12 months'. They cite earlier studies (outside of the date range of this review) that have also demonstrated that resuscitation skills fade fast. Smith, Gilcreast and Pierce's study evaluates performance according to an external test. The findings of these studies support the view that particular skills fade at different rates.

Skidmore and Urquhart (2001, Canada) measure retention of resuscitation skills in birthing room staff (n 62) 6 and 12 months after training. They find some decline in knowledge and skills at both intervals, but no return to pre training levels. Mosley and Shaw (2013) report on testing of retention of neonatal life support(NLS) skills in 67 attendees at a NLS course (nurses, midwives, resuscitation officers and doctors) 3-5 and 12-14 months after training. They found a decline in skills at both times of testing. They also found that those subjects who had had the most opportunity to use similar skills in the interim fared better in the test. Also self assessment of competence did not differ between those who passed or failed the tests.

Defibrillator skills

Beckers et al (2007, Germany) measured retention of defibrillator skills in medical students (n 59) 6 months after training. They found all individuals to perform safely at the 6-month mark. Kopacek et al's (2010, US) study looks at retention of defibrillation skills by 103 pharmacy students at one school. They tested retention of learned skills and found they were on average retained after 4 months, but diminished after that time period.

CPR

Hamilton (2012, UK) reviews the literature on retention of CPR skills in nurses, looking at 24 papers. She differentiates between retained CPR knowledge and retained CPR skills, citing studies that suggest that skills decline faster than knowledge, as per Yang's (2012) review. This is at odds with the findings of some other studies, notably the military studies (Goodwin et al, 2001), wherein knowledge is shown to be retained better than skills. Oermann (2012) measured nurses' retention of CPR skills at 12 months after either one-off or periodic practice. Those subjects undergoing periodic practice were better than those undertaking the one off practice.

Madden (2006) reports on retention of CPR skills in 18 Republic of Ireland nursing students. At 4 months since CPR training students had significant deterioration in knowledge and psychomotor skills, consistent with earlier studies. The level of skills and knowledge was higher than before the training though.

Meaney et al (2012, Botswana) measure the retention of CPR skills in health care workers in Botswana following a training course. They found skills were retained at 3 and 6 months. This study has limited generaliseability, however, in that it had a high drop-out rate (from n214 to n96 between time 0 and time 2). Pemberton et al (2013) measured retention of inter professional Trauma Team Training after a course in Guyana, using interviews, a multiple choice test and a simulation. They found a slight decline in skills after four months.

CPR in lay people

There have been numerous studies looking at retention of CPR and defibrillation skills in lay people. They have limited relevance though, given that they look at skill retention in novices whose experience may be very different from experts who are returning to a practice with which they were once familiar. Einspruch et al (2007) measured retention of CPR skills in lay volunteers (n 284) 2 months after training, comparing 2 methods of training. They found a general retention of skills but for some groups this was to the extent of being at the same level of skills as untrained controls. Isbye et al (2007) compare retention of resuscitation skills in 194 Danish adults and 76 children 3 months after being taught. They found that whilst adults and children fared differently on the retest, adults scored significantly higher in terms of retention of what had been taught. Papalexopolou et al (2014) look at the influence of age and educational attainment level on retention of CPR skills post training. They find that both of these factors do influence retention. Mahony et al (2008) measured retention of CPR skills in 35 cabin crew 12 months after training. They found that whilst theoretical knowledge was good, practical skills when dealing with a simulated scenario were suggestive that real-life cardiac arrests would not be managed adequately.

Regarding skills associated with life support, the disparate evidence on specific skills shows that:

- Knowledge and skills decay over time (tested at 6 and 12 months) (Yang et al, 2012; Mohammad et al, 2014, Smith, Gilcreast and Pierce, 2008, Skidmore and Urquahart, 2001, Mosley and Shaw, 2013).
- Some studies looking at retention of specific skills show full retention after 6 months (Becker et al, 2007) and 4 months (Kopacek et al, 2010). Others show decline at 4 months (Madden et al, 2006, Pemberton et al, 2013).
- Skills and knowledge decline at different rates, with relative decline being different in different studies (Smith, Gilcreast and Pierce, 2008, Ali et al, 2001, Hamilton 2012, Yang, 2012, Manoney et al, 2008).

- Opportunity to practise similar skills or having previous training in the interim increases retention (Mosley and Shaw, 2013, Oermann, 2012, Azcona et al, 2002).
- Self assessment of competence may not reflect competence shown in tests (Mosley and Shaw, 2013)
- Even if there is decline in skills over time, there is usually not a return to pre training level of skill (Madden et al, 2006).
- In lay people, age and educational attainment level impact on retention of skills (Isbye et al, 2007, Papalexopolou et al, 2014).

7.2 Research question 2: What factors tend to influence and mitigate for skills fade – for example, age, specialty, supervision, level of autonomy etc.

Evidence from several studies looking at retention of specific clinical, surgical and life-support skills suggests that level of prior expertise and opportunity to practise similar skills in the interim can positively influence retention of a learned skill. The concept of over learning is key here, given that evidence from military studies shows that the higher the level of learning and proficiency prior to hiatus the higher the level of retained skill will be.

There is a consensus that skills fade may be mitigated for through keeping in touch with peers during a hiatus and staying aware of relevant developments.

There is evidence that self assessment of competence does not necessarily match the findings of more objective assessments of competence. This has potential patient safety implications, and suggests that self assessment would not be sufficient to determine how skills fade may be addressed.

Grace et al's (2011) study suggests that older age and length of time out can lead to lower performance scores when returners' skills are assessed. The results of this study speak so clearly to the questions of this review, just as they did to the AoMRC return to practice review.

The conclusions of reviews in both the military and in industrial and professional literature are that competence retention and deterioration depends on organisational, job or task, training and assessment and individual factors. The degree of influence these factors have, and the nature of influence that specific aspects of, say the individual's personality or experience have, has not been widely posited or tested outside of the military research field. As such, all these should be taken into account when assessing or addressing the fade.

7.2.1 Retention of skills in medicine

Grace et al's (2011) paper on performance assessment of 62 returner physicians who had taken a break for reasons other than discipline or sanction hold information of relevance to the present review. As discussed at 7.1.1, this study was the primary research relied on in the AoMRC evidence review on return to practice. In this study the retraining requirements of 62 physicians reentering the profession after time out were assessed by a clinical-skills assessment that included 2–3 90-minute interviews conducted by specialty-matched board-certified physician consultants. They also conducted simulated patient encounters, a documentation exercise, a test of cognitive function and written testing. According to the assessments, physicians were rated on a scale between 1 and 4, with those immediately ready to return to independent practice being rated as 1and those rated as requiring remedial education rated as 4.

Grace et al found that two factors impacted on performance as assessed on return: age and years out of practice, with older doctors and those with more time out having statistically significant lower performance scores on return to practice assessments. They also found that of the 62 doctors assessed, one quarter had minimal educational needs on return, but 67% had moderate to considerable reeducation or updating, with 6.5% having educational needs to the extent that a residency programme was suggested. As Grace et al acknowledge, this study's generaliseability is limited given its small sample size, however a link between skills deficits and both age and years out of practice is established. Grace et al call for further similar studies to be done.

Ali et al (2002) compared retention of ATLS skills in doctors who had fewer than 50 trauma patients per year versus a group who saw more than 50 trauma patients. They measured retention of skills and knowledge via an objective structured clinical examination (OSCE) and a multiple choice questionnaire (MCQ) in doctors who had undertaken the ATLS course 2, 4, 6 and 8 years previously, with 12 doctors in each group. They found that cognitive skills attrition was progressive with a decline in knowledge as measured in an MCQ happening after 6 months. OSCE performance also declined, but doctors maintained a high level of global skill even up to 8 years. Doctors who have more contact with trauma patients consistently performed better for all time intervals. Drawing conclusions from this study should be done cautiously as this study had a small sample size and is not a longitudinal study. It does, however, demonstrate that opportunity to practise similar skills will increase likelihood of a comparatively better performance when tested. In a 2003 paper Ali et al asked whether other factors than exposure to trauma patients in the interim affected retention of ATLS skills in the same study as the 2002 paper. They found that age, gender and specialty did not significantly correlate with better or worse test scores. This finding is contradictory to the Grace (2011) findings, which have influenced the AoMRC report.

Papadimitriou et al (2010) measure the impact of two different life support and defibrillation training approaches for 303 lay people, including retention of learning after 1, 3 and 6 months. They found no difference in retention of skills and knowledge between the two groups using the approaches, although they did find a significant decline in skills between the course end and testing at one and three months. Woollard et al (2004,2006, UK) measured retention of AED and CPR skills in lay volunteers after an initial and a refresher course. The refresher course seemed to significantly boost skills and confidence at 6 and 12 months and found a decline in skills over time. They conclude that refresher classes at intervals are required to increase confidence in use of AEDs. Wik et al (2002, 2005) measure 6 and 12 month retention of CPR skills in 35 lay people, with one group receiving booster sessions and feedback during the time period and another group not. They found the 'overtrained' group to have better retention of skills than the control group. Riegal et al (2003, 2005) report on a large scale US study on CPR and AED skills learning in lay people. They find age, gender, marital status, education and prior experience all affected CR skills retention. They also found that CPR and AED skills retention declines at small increments over time.

7.2.2 Factors affecting retention of military skills

Goodwin et al's (2007) look at retention of battlefield skills learned in training after an 8 week hiatus since learning. They found knowledge retained better than digital (motor) skills. They link lack of retention to personal characteristics but also to the nature of the test and skills being learned. Individuals with more background experience and training

fared better, with these factors accounting for 25-35% of performance variability. Individuals' initial aptitude for certain tasks also affects retention. These findings have relevance to the present study, given that they suggest that background experience impacts on skill retention. Doctors, and all health professionals, will have spent years in training across a medical curriculum and will have been selected for the profession based on having an aptitude for the role.

Hoffmann and Feltovich (2010) report for the US Air Force Research Laboratory on a literature review and workshop on proficiency and retention. As with all of the military studies, the same primary research and findings are presented. Hoffmann and Feltovich look specifically at how best to train military personnel in order to promote retention of skills. They recommend spacing and random practice in order to promote long intervals of retention. They also recommend over learning, concluding that the best predictor of skill retention after a hiatus is level of performance prior to the hiatus. They also refer to research on expertise in performance (in particular Ericsson, 2006), surmising that high performance is linked to practice, self assessment and self-directed learning, the most important of these being practice.

When considering the impact of time out on performance Hoffmann and Feltovitch refer to the same sources as the other military reviews (for example, Henik et al, 2001, Wisher et al, 1991), much of which is out of the date range of this review. They compare spaced versus massed practice, finding spaced practice to have better retention effects. This has implications for the present review, in that it speaks to the organisation of medical training, which may well be in blocks or rotations (see Enk et al's 2003 study on the retention of dermatology assessment skills after a gap since the 2 week sole experience of the specialism). Research cited by Hoffman and Feltovich on flying skills depletion after a hiatus find significant depletion, particularly those skills where cognitive and 'control' (i.e. motor) skills are required. They cite findings from Healy's (2008) work, that '*Trainer experience in the F-16 Refresher Training is that no one comes back after a hiatus of any duration (more than a few months) at greater than 80% proficiency. For long hiatus, proficiency upon return is estimated at 40-30%*' (2010, p80). As with other studies this research shows that the greater degree of previous proficiency is linked to greater degree of retention. It also predicts speed at which skills return.

Hoffmann and Feltovitch discuss the generaliseability of findings from retention studies, citing other work from Healy et al (1992) which shows that certain skills might show improved performance after retention, and that open versus closed loop tasks and tasks requiring declarative versus procedural knowledge may be retained or decay differently. Open loop tasks are those without set beginnings and ends, for example tracking or problem solving. Closed loop task have discrete stages and defined beginnings and ends, such as the pre-flight checks a pilot does (Henik et al, 2001). Declarative knowledge is the retention of facts and principles, whereas procedural knowledge is concerned with remembering processes (Henik et al, 2001). Along with the generalisation they put forward about performance before hiatus predicting retention, Hoffmann and Feltovich offer another generalisation, that performance after a retention interval is best predicted by the similarity of conditions between the test and training. They conclude that caveats must be placed on any conclusions about retention after hiatus, given the multiple interacting variables at play and the range of findings from experimental studies.

7.2.3 **Retention of skills in industry and employment**

There has been some interest from the rail and other industries in addressing the problem of ensuring that people can retain the skills and knowledge to perform tasks that are vital but seldom used. The UK Rail Safety & Standards Board (RSSB) (2011a, 2011b) undertook Project T717, the goal of which was to develop a model for retention of competence in the rail industry workforce. This project incorporated research, solution development and testing and the development of good practice guidance. The research phase consisted of a literature review, consultations and feedback and a review of incidents. The review finds that competence deterioration may be minimised through either improving training, altering the task or recruiting people best suited to it. Competence retention at organisational level may be influenced by culture, stability, staff turnover and working practices. At job or task level, it can be influenced by the frequency, difficulty, type of task, workload and access to job aids. In terms of training, competence retention may be influenced by methods of training and assessment, competence of instructors and the lag between training and performance. At individual level, competence retention is influenced by aptitude, personality, learning style, psychological state and prior experience. For the purpose of this review, the individual factors are of most interest, because of the focus on assessing skills fade in individual doctors. Whilst the RSSB papers discuss individual factors (such as age and gender, or health and well being), the specific degree of influence of these on skill retention is not reported or suggested.

Weaver et al (2012) draw on the literature on skills decay to make suggestions about its relevance for decay in diagnostic skills in health professionals. They too summarise the factors affecting cognitive skill decay as being the individual, the task, the retention period and the conditions of retrieval. Again, the work undertaken by military researchers is central to Weaver et al's analysis.

Angel et al (2012) conducted a review of the literature on 'skill perishability' in relation to 'use of force' skills in the police. This Canadian study makes similar findings as the research available in other professions and industries, in that again, training, task, personal or individual characteristics (aptitude, expertise and motivation) and retention interval factors are what affects retention of skills. The same (predominantly military) literature is cited as in other studies. Angel et al also make the point about laboratory based studies on retention of particular skills, that these studies are so artificial and specific in nature as to have limited relevance to how experts in the field retain and use the skills they have learned and practiced over time.

7.2.4 Findings from psychological experiments

Theory on skills retention based on laboratory experiments (Proctor and Vu, 2006) offers three important concepts for this review. First, skill retention rates decline according to a curve. Secondly, different skills decline at different rates (there is however variable evidence as to which skills decline faster). Third, 'over learning' can influence how well skills are maintained. As previously stated, over learning means learning to a degree beyond that which is required. As skills will fade, if not practiced, along a curve until they reach a maintenance level, over learning can influence where that maintenance level is, meaning that it may still be within the realm of competent performance required.

There is also good evidence from psychological experiments that prior expertise in similar skills increases retention of learning of a new skill. This is distinct from over learning. Romano et al (2010) report on an experiment to investigate retention at one year of procedural skills in people with a high degree of motor skills proficiency (piano players and video gamers) versus controls. They also compared young and old subjects. They found

retention of learning of sequences at one year and some evidence of motor skills retention for the young expert, older expert and older non experts. All of these general findings have relevance to skills fade in doctors, in that they suggest that the years of professional training involved in achieving a certificate of completion of training should influence the rate at which skills are retained.

Kantak and Winstein (2012) review the literature on motor skills retention. They find that there is a distinction between performance post-learning versus performance following a long period since learning. Sauer et al (2000) describe findings from their experiment asking 25 volunteers to learn a computer task simulating a spacecraft's life support system. They found that an expected decline in performance at the 8 month test of skill retention did not occur. Their study is of relevance to the present review because they are particularly interested in how best to train for skills linked to tasks and procedures that are vital but rarely performed. Hikosaki et al (2002) looked at retention of motor skills in human subjects (students n4) and monkeys. They found retention of learned sequences at 18 months but speed and accuracy of task completion were affected.

Kluge and Frank (2013) report on the impact of refresher interventions on skill and knowledge retention in an experiment looking at process learning in student volunteers (n 68). They find that short refreshers can attenuate skill and knowledge retention. Donovan et al (1999) conduct a meta analysis of the evidence on distributed versus massed practice on retention of skills. They identify a lack of research studies looking at retention over time. They also find that much of the research in this area has focused on learning of simple motor tasks (pressing buttons in a certain order for example and so may not be generaliseable to more complex cognitive tasks). The application of the findings of such studies to the matter of skills fade in doctors should be cautious, given the difference between real world practice and experimental situations, and given the lack of a definitive time period within which skills may fade.

Peladeau et al (2003) measure retention of knowledge in students using methods of learning using flashcards. The findings of their experiment support the theory that over learning greatly improves retention of competence.

7.2.5 Self assessed competence and confidence in skills linking to frequency of use

Numminen et al (2013) measure Finnish nurses' self-assessed competence in a variety of nursing roles using the Nurse Competence Scale (NCS) designed by Meretoja et al (2004, 2012). They found that nurses' self assessment of competence is linked to how frequently they use the skills associated with that role. They find a statistically significant positive correlation between self-assessed quality and frequency of action. O'Leary (2012) also applies Meretoja et al's NCS to critical care nurses in one hospital in the US. He again finds self-assessed competence linked to frequency of use of a particular set of skills. The studies do not note specific cut off points from which the nurse would not want to use a particular skills.

Langan et al's (2007) survey of licensed but not practicing nurses in one US state included a question about the skill sets they would want to refresh prior to a return to practice. The skills that respondents most wanted refreshing were medications, intravenous skills (IV), equipment and a review of basic nursing skills. Hawley and Foley (2004) evaluate a nurse refresher course in the US, surveying 37 course attendees. They do not measure competence before and after the course, but they did survey nurses on the impact of the course on self-assessed competence. The course was deemed to impact positively on

nurses' self-assessed preparedness in terms of nursing theory, clinical knowledge and clinical skills.

7.3 Do other comparable regulators undertake any form of performance assessment following a prolonged break in practice? If so, what led to the introduction of this assessment and what is the evidence base behind it?

In this section evidence from the UK health professional regulators and from international medical regulators has been considered. Reports of remediation and return to practice programmes are also summarised here, in order to enable comparison.

Health professional regulators have various responses to practitioners wanting to return to practice after time out. Within medicine, UK doctors must at present abide by the requirements of revalidation in order to assert ongoing fitness to practise. They must also abide by the requirements of their Royal College with regard to maintenance of skills and knowledge. There are specific requirements for doctors in training regarding stepping off and back on their training programmes.

Outside the UK, there are variable responses from the medical regulators to doctors taking time out. In Finland, the Republic of Ireland and France there are no requirements placed on doctors to prove their fitness to continue to practise on returning after a break. Australia and New Zealand have statutory requirements regarding proving fitness to continue to practise, particularly if the break is longer than three years. In the US different State Medical Boards have different requirements regarding reentry. There are no reports of particular performance assessments that take place, although some US state boards and the Registrar of the Medical Council of New Zealand may require one to be undertaken.

The health professional regulators in the UK have requirements regarding CPD that must be met in order to return to the register. The NMC does validate return to practice courses but there is variation between such courses in terms of their length and content. The HCPC requires returners to undertake 30 days of updating if they are out for over 2 years, 60 days updating if they take over 5 years out.

7.3.1 Regulatory responses to time out: requirements for reregistration

One function of the UK health professional registers is to inspire public confidence that those registered meet standards of competence, conduct and performance. Individual professionals maintain their registration and by so doing assert that they meet those standards. Evidence of continuing professional development (CPD), and latterly - for doctors - revalidation, demonstrates individual efforts to abide by the expectations of their registered profession. Health professionals may leave the register or let their registration lapse for various reasons. The different professional regulators have different requirements for that person to reregister. What may be surmised from a review of these requirements is that there is a common assumption that time out will potentially impact on competence and that this potential decline in competence may be usually addressed through CPD and return to practice (RTP) activities.

UK Doctors

The route in the UK for returning to medicine after a break is different depending on where a doctor is in their career. Return to a training post (GP training or F2 or below) should be negotiated with the relevant Local Education Training Board (LETB). Return to practice for

doctors who have completed their training should be negotiated with the relevant Royal College and Postgraduate Dean/Director responsible for Medical Education at the relevant local LETB (NHS Careers website).

From December 2012 the GMC has required that doctors who have been away for more than 5 years are required to work in an APS (Approved Practice Setting) when they return to the register. Doctors who have been away for less than 2 years can generally return to the register without a practice setting restriction. Periods away of between 2 and 5 years, will depend on the individual doctors circumstance.

In the context of revalidation, the GMC (2011) advises that 'a short break' from practice should not preclude a doctor from gathering the evidence required for revalidation and participating in the five year revalidation cycle. Whilst still in training, the allowed time out within any rotation may be fixed by the relevant Royal College or professional body. Employees are recommended by the BMA (2011) to refer to Royal College guidance if time out is taking place. The Royal College of Surgeons of England, for example, limits permitted time out without stepping back a cohort to four weeks maximum in a FY1 or FY2 rotation. For those with a National Training number, every week of time out over three months will move forward a proposed Certificate of Completion of Training (CCT) date. All doctors in training (up to CCT level) are subject to progression reviews, and all doctors now (since revalidation) are subject to an annual appraisal. There is some assurance therefore, in an (at least) annual review of fitness to continue to practise.

The AoMRC (2012) evidence report supporting its (2012) Return to Practice Guidance quotes verbatim from its call for evidence responses from Deans and the Royal Colleges. A range of requirements regarding return to practice are found, with the East Midlands Deanery assessing on return to practice after a 6 month or more gap; the Royal College of Opthalmologists (RCOpth) opting for a more tailored, case based approach; the RCOG reporting few problems in this regard; the Northern Deanery having different requirements for under 2 years, between 2 and 3 years and 3 to 5 years, with breaks over 5 years requiring 'a full refresher package'. The AoMRC report summarises the return to work policies of other UK colleges and deaneries, including the GP Induction and Refresher scheme of the London Deanery, and the Royal College of General Practitioners, following the Committee of General Practice Education Directors (COGPED) (2011) guidance; the tailored programme of the Royal College of Anesthetists; the individualised approach to doctors who have taken 9 months or more off from the Faculty of Public Health. It found the College of Emergency Medicine to have no RTP policy, but it does require doctors to make up CPD requirements over the 5 year cycle. The Royal College of Anaesthetists' May 2012 guidance on return to work suggests that trainee returners may undertake the College's Initial Assessment of Competence (IAC) as part of the return. Speciality grade and consultant doctors are suggested to refer to the Anaesthetic List Management Assessment Tool (ALMAT) for their attached theatre sessions and the Acute Care Assessment Tool (ACAT) for intensive care, and to incorporate these in their Return to Work portfolio.

Doctors outside the UK

Information here comes from a review of online published information and from responses to the GMC call for evidence from other medical regulators. Responses to the call for evidence came from seven countries (Finland, Latvia, Republic of Ireland, the US, Australia, France, Canada). The Finnish regulators have no requirements for doctors who have taken a break from practice. In Latvia doctors who have taken a break of two years

or more must undertake a theoretical and practical exam to receive a new medical certificate. The Medical Board of the Republic of Ireland has no requirements on return to practice, save the duty of doctors to maintain ongoing professional competence. In France, a break from practice of three years or more triggers a requirement to provide evidence to the Conseil national de l'Ordre des médecins, although there is no recognised legal evidence base for the three-year cut off. For doctors trained elsewhere applying to practice in France, there is a requirement to present sufficient evidence and guarantees about theoretical and practical knowledge. For doctors already registered, there is a drafting of regulation taking place in 2014 to allow the French Medical Association to deal with doctors whose practice does not meet the required standard, including a requirement to complete further training. The Canadian response to the call for evidence came from the Collège des Médecins du Québec, who evaluate doctors after a break from practice over three years. This was recently reduced from four years. The College determined not to reduce the return to practice requirements to affecting doctors after two years, as this would impact on doctors undertaking fellowships, which are usually of two years in length.

The Medical Board of Australia's submission cited its (2010) Recency of Practice registration standard as setting expectation regarding return to practice. This states that for doctors with two years or more practice experience prior to a break, absences of less than one year have no specific requirements. For absences of one to three years practitioners must complete a minimum of one year's pro rata of CPD activities. For absences greater than three years the practitioner must submit a professional development plan to the Board. This is similar to the requirements of the Medical Council of New Zealand, which requires doctors returning to practice after a three year plus break to submit a detailed induction plan on application to return. The Registrar may place various conditions on practice. Conditions may include undertaking an Advanced Cardiac Life Support course within three months of commencing practice (MCNZ, 2004).

In the US, according to the Federation of State Medical Boards response to the GMC (citing 2013 statistics), 37 state medical boards have policies on a physician's reentry to practice after a break. The time period after which the policy applies ranges between 18 months and five years. Reentry requirements vary between boards and between doctors, ranging from assessments, interviews and mini-residency programmes. The AoMRC (2012) report on evidence around return to practice includes several responses from US state boards regarding return to practice. A range of approaches are documented, both in terms of the time required to trigger a return to practice assessment and the means of assessing returners' competence. What is broadly acknowledged, though, is the lack of empirical evidence to back up the timeframes.

Bower et al (2010, p89) report that in the US: '*Most states recommend, and 6 require, physicians who take a leave of absence for more than 24 months to participate in a physician reentry program.*' Freed et al (2009) survey 64 state licensing boards and find that only 34% require inactive doctors to demonstrate clinical activity prior to renewing their licence. Varjavand et al (2012a, 2012b), more recently find that requirements of inactive doctors are different between state boards, with 36% making no inquiry regarding the physician's clinical activity status, 22 boards (34%) querying physicians regarding their clinical activity status at both initial licensure and renewal, 14 (22%) querying physicians at initial licensure only; and 5 (8%) querying physicians at renewal only. There is no standard requirement for reeducation before reentry and the definition of inactivity differs between states.

Other health care professionals

The various professions have regulations regarding hours of practice, hours of CPD and in some cases, the content of CPD. The evidence supporting the specific hours and contents is not provided in the published outputs of any of the professional regulatory bodies.

Dentists

The GDC (2013) requires dentists to undertake at least 250 hours of CPD every five years. Dental care professionals must carry out 150 hours of CPD per five years. If dentists want to apply to be restored to the register after leaving they must provide evidence of having met the CPD requirements (GDC, 2013). Applications to be restored to the register after erasure by the professional conduct committee (PCC) must be accompanied by letters of good standing. There are recommendations about how frequently certain core subjects should be included in the CPD cycle, for example: medical emergencies (at least ten hours in every five year CPD cycle); disinfection and decontamination (at least five hours in every CPD cycle); radiography and radiation protection (at least five hours in every CPD cycle) (NPSA/NCAS, 2011).

Nurses and midwives

For nurses and midwives, the current guidance (NMC, 2011) says that all registrants must complete 450 hours of registered practice and 35 hours of learning activity in the previous 3 years. This is known as the PREP standard. The NMC says that if a person has previously been on the register but want to reregister after a break of at least three months they must fulfill the PREP standard or else attend a return to practice course. This applies to all returners. There is no published rationale for the specifics of the NMC's requirements, save that they are set within its legislation. Return to practice courses for nurses are run according to programme requirements set by the NMC. Barribal (2007) notes that these vary in duration between 5 days and 12 weeks. Duration depends on the course location rather than characteristics of the learner.

Opticians

Opticians must reregister with the GOC on an annual basis. This reregistration is termed retention. If an optician is applying for restoration to the GOC register they must demonstrate that they have gained 12 Continuing Education and Training (CET) points over the preceding 12 months (GOC, 2012; 2013). Optometrists and specialists must also demonstrate involvement in peer review over the past three years.

Pharmacists

The General Pharmaceutical Council requires registrants to record nine CPD activities per year (GPhC, 2010, 2011). Registrants renew their registration every year. If previous registrants want to return to the register after a break of over 12 months they must provide a portfolio of evidence to demonstrate current professional competence (GPhC, 2013). This portfolio should include a self assessment against the GPhC Standards of Conduct, Ethics and Performance (GPhC, 2012), a personal statement, a statement about how recent CPD activity has prepared the pharmacist for work within their scope of practice, supporting evidence for their statements and a personal development plan. The rationales for the specifics of the recommendations are not documented in the GPhC literature.

Professions regulated by the HCPC (previously the HPC)

The HCPC (2012, 2011) requirements for returners are for 30 days of updating if they are out for over 2 years and 60 days of updating if they take over 5 years out. This updating can take the form of supervised practice, private and formal study, with private study being permissible as the means of updating for no more than half of the study period. The HCPC describes these requirements as:

'a quality control mechanism aimed at mitigating the potential risks involved in returning to practice after a break, demonstrating that the returner is up to date and supporting fitness to practise. The returners to practice requirements are threshold requirements which may be exceeded by the requirements of others, such as employers.'

The HPC (2005) report on responses to its consultation on return to practice policy cites the legal basis for its actions on RTP as coming from Article 19(3) of the Health Professions Order 2001 (the 2001 Order). This allows the regulator to "require persons who have not practised for or during a prescribed period to undertake such education or training or to gain such experience as it shall specify in standards…" One of the specific questions in the consultation is about the periods of time out of practice that would require certain periods of time preparing to return. There was a range of responses, with some bodies calling for specific lengths of time in preparation for return per years out, and others calling for this to be more individualised. The HPC response to these comments was to set minimum requirements for all registrants, but to restate that its legislation does not allow for individual assessment or setting of programmes, nor does it allow for the different professions on the register to be treated differently. The consultation also asked about returners after long periods out (5 years plus) and found a consensus that further input would be required, with employers taking the lead on actively supporting such returners. There was no additional requirement set for returners who had taken more than 5 years out, save undertaking 60 days worth of updating The consultation also asked about registration renewals. The outcome here was a clarification that those renewing their registration every 2 years must have evidence of practice over those two years or else be subject to the return to practice requirements. Whilst the HPC consultation offers insight into (albeit dated) thinking on RTP, the consultation responses quoted are not linked to specific evidence on the impact of time out on skills or competence.

The College of Occupational Therapists (COT) guidance on RTP (2010a) refers to the HPC (as was) requirements. OTs are guided that the onus is on individual professionals to make a self assessment and to take a decision regarding the updating needed to meet the standard required to return to the register. The COT (2010b) offers advice to members about taking a career break and how to stay in touch and maintain networks and confidence whilst on a break. In its guidance there is no mention of the evidence for the impact of break on skills and competence.

Veterinarians

Regarding ongoing fitness to practise the Code of Professional Conduct for Veterinary Surgeons set by the Royal College of Veterinary Surgeons (2012) says:

'3.3 Veterinary surgeons must maintain and develop the knowledge and skills relevant to their professional practice and competence, and comply with RCVS requirements on the Professional Development Phase (PDP) and continuing professional development (CPD).'

Annual registration incorporates confirmation that the CPD policy has been adhered to. The recommended amount of time spent on CPD is 105 hours over 3 years, or 35 hours per year. The RCVS advises those planning to take time out of the profession to continue with their CPD. It advises those who have taken time out to attend a return to practice course. The evidence base for the specifics of the recommendations are not documented in the RCVS literature.

7.3.2 Reentry and remediation programmes

Papers on return to practice programmes tend to be case studies and tend to focus on the career outcomes for doctors and their evaluations rather than the evidence base for reentry course (Bower et al, 2010; Baker et al, 1997, Varjavand et al, 2012). There has been a substantial body of comment on reentry programmes in the USA and the UK. Humphrey (2010) undertook a review of remediation programmes internationally in a survey commissioned by NCAS. She found that few programmes evaluate the long term impact of remediation. She also cites figures on doctors with performance issues. This paper does not look at the specifics of performance concerns and does not discuss skills fade, rather it focuses on doctors in practice with performance problems. Hauer et al (2009) review the literature on remediation programmes across the medical curriculum. They found that the published literature consists of descriptive accounts of remediation programmes, with a lack of evidence about outcomes from remediation.

Vajrasand et al (2012) compare the reentry requirements between countries. They foundthat, as with the USA, Canadian provinces differ in their regulations and procedures for assessing physicians who want to return to clinical practice or change their scope of practice. Detail of the methods used to assess returning doctors (chart reviews, inspection visits (peer review), chart-stimulated recall, structured oral interviews is found in Goulet et al (2002) and Goulet et al (2010).

The UK situation is best described in reports on the Induction and Refresher/Returner Schemes for GPs set up in 2007 (Viney et al, 2006, 2007), and in guidance set by the Committee of General Practice Education Directors (COGPED) in 2008. This states that any international medical graduate (IMG), GP from other European Union countries, or United Kingdom physician out of general clinical practice for 2 years should undergo a programme of assessment, up to 6 months of supervised clinical practice, assessments and learning logs, and a final review.

Morison et al (2012) present findings from an interview study of GPs attending a returner programme at the Severn Deanery. This programme was set up as part of the DH scheme for any GPs who had been out of practice for more than 2 years. They say that programme students have to undertake a ‘triage assessment’ in order to determine their personal requirements. Their interviewees described various challenges faced on returning to practice, and called for more support around the process. They did, however, accept that an assessment of competence should be part of their induction. Hutchins et al (2006) report from interviews with participants in the GP Returner scheme at the London Deanery. They note a difference between the learning needs of returners versus other learners, for example registrars. They say that programmes must be tailored to their specific needs. Unfortunately there is nothing in this study on doctors’ level of competence at the start of scheme and at the end, save their rate of success at completing the course and returning to practice. Edwards et al (2007) in their descriptive paper about the same scheme also argue for there to be some awareness of returners as a unique blend of novice and expert. They say that gaps in knowledge and skills may be covered up.

Recent concerns about a forthcoming shortage of doctors in the USA have led to attempts to reengage non-practicing doctors. This in turn has led to an increase in returner programmes and some state and national guidelines about them. There is an ongoing work stream on this at the AMA. Kenagy, of the AMA, et al (2011) set out guiding principles for physician reentry programmes. He calls for collaboration across state boards regarding reentry programmes. There has been research undertaken to consider the effectiveness of such programmes. Mulvey et al (2008) survey doctors over the age of 50 about reentry into the profession. The focus here is about their requirements in terms of reentry programmes. Goulet et al (2007) report on outcomes of a remediation programme . They find a statistically significant impact of the programme on performance in terms of record keeping, clinical investigation plans, patient follow up, diagnostic accuracy. In another paper Goulet et al (2010) compare peer review(Structured Oral Interview) as a means of assessing poor performance versus a Script Concordance Test . They find the different methods yield different results and say this has an implication for how competence is assessed.

The 2011 NPSA/NCAS literature review looking at factors affecting dental practitioner performance considers the impact of time out in relation first to the increasing number of female dentists therefore increasing number of part timers and career breakers, and second in relation to meeting CPD requirements. It describes the getting back to practice (GBTP) courses for dentists who have been out of clinical practice for 'an extended period of time'. The specific length of time is not given. It says that there are retaining and returning advisers in the deaneries. Despite this, according to Buck and Newton (2002, UK), only a small proportion of dental practitioners attend these retraining courses before returning to practice. Seward's (2001, UK) (also reported in Murray, 2002) survey of 4,500 female dentists found uptake of and awareness of the dental KITS and Getting Back to Practice (GBTP) courses to be low. She found that only 41% of respondents were aware of KITS or the GBTP courses, and only 4% had used the schemes when on a career break.

The dental Retaining and Returning Advisors (RRA) and the Keeping in Touch Scheme (KITS) for UK career breakers scheme has been evaluated in several papers (Firmstone et al, 2007; Davies-Slowik et al, 2008; 2011). This scheme was instigated by the Department of Health to retain dentists in the workforce and increase workforce numbers. The evaluation studies include some discussion of the work done by the Retaining and Returning Advisers with poor performers as well as career breakers, despite poor performers not being part of the original remit. This work includes offering advice about CPD, potential networks of support, potentially supportive practice environments, mentoring and confidence building. Referral to the RRAs was via returners or poor performers being referred to deaneries by practices or primary care trusts. The evaluation papers found the RRA and the KITS to be providing effective and diverse support to dentists. Specific outcomes of their interventions on competence and revision of skills are not presented.

Nurse returners

There is a small body of literature looking at return to practice programmes for nurses. Given that one of the aims of such courses is to refresh nurses' skills in preparation for reentry into the profession, such works may include evidence of the impact of such courses on potentially diminished skills. Gould's (2005) literature review on nurses' return

to practice finds limited empirical work on return to practice. She does not search specifically for evidence of the impact of return to practice courses on returners' skill level.

As with doctors, US regulations on nurses' return to practice after a break differ between state boards. Some boards require a refresher course after 4 or 5 years, and others solely require evidence of CPD (Myers and Bushnell, 2007). Harding and Connolly (2012) describe a remediation programme for nurses run by the North Carolina state board. They describe referrals to the course as coming from managers or nurses themselves. As part of the course, nurses undertake a self assessment of competence. Details of the self assessment are not given in the study. One point of interest here is that it is the State Board, the regulator, that takes responsibility for the remediation programme.

Much of the research literature on return to practice is concerned with the experiences and opinions of nurses who have undertaken return to practice courses (Tanaka and Sakaguchi, 2008; Asselin et al, 2006; Barriball, 2007; Bullen, 2003, on midwives in Australia; McMurtrie et al, 2013 in Australia). They do not address the impact of the returner courses on any potentially diminished skills. Long and West (2007) review the literature on return to practice from an Australian nursing perspective. They focus on the characteristics of learners. Wilson and Compton (2009) review the literature on reentry to practice for addicted nurses post remediation or discipline. They do not look at competency issues, rather at the support needs and progress of this particular group. Jamieson and Taua (2005) describe findings from their survey of 32 New Zealand nurses who had attended a Competency Assessment Programme. They refer to the stipulation of New Zealand of the Health Practitioners Competence Assurance Act (MCNZ, 2004) that attendance at an approved Competency Assessment Programme is required for all nurses who have been out of practice for five or more years. The survey itself does not touch on skills fade, rather it asks nurses about their reasons for leaving and returning to the profession. This is similar to Durand and Randhawa's (2002) interview study of UK nurses.

Payne's (2010) mixed methods study looking at the experiences of midwives who had undertaken return to practice courses found that only one third of course attendees stayed on in the profession. Whether this was due to competency issues is not considered, although midwives tell her that one reason is that time out of practice has left them out of step with new approaches to the work. Similarly, Kirkhan and Morgan's (2006, UK) interview study cites midwives on return to practice courses as saying the courses were too short compared to the time they had been out. Similarly to the findings of reviews of doctors' returner courses, this study positions returner midwives as a particular set of learners with specific learner needs, and calls for a lack of presumption about their level of skill or knowledge.

10. Conclusion

Similarly to the AoMRC review, this review has found limited and mixed evidence about how skills decline over a fixed period of time. Health professionals may take time out from professional practice for various reasons. This time out may be accompanied by voluntary removal from the register for that profession. It may also be as a result of enforced removal from or suspension from the register. There is little known about the impact that this time out may have on the registrant's competence, performance and skills. Whilst the requirements for registration on returning may be set down in legislation, there is little evidence to demonstrate how exactly the specifics of those reregistration requirements were determined.

There is evidence that skills decline according to a curve, with the greatest decline being during the first few months, and subsequent decline being at a much slower rate. However, other studies contradict this.

Many studies of retention of specific skills measure retention at six, twelve, eighteen and twenty four months. There is some consensus between health professional stakeholders that two or three years out of practice should signify a need for reassessment and retraining prior to a full return.

There is limited evidence to determine exactly how time out of the profession affects doctors and other health professionals' skills. This limitation is due to there being a limited number of studies on this topic rather than there being poor quality or inconclusive evidence. The largest body of evidence here comes from tests of retention of specific skills learned through training, rather than from studies of health professionals before and after time out. Outside of medicine, skills fade has been a matter of concern for organisations requiring high reliability and a strong safety culture. Evidence from the military, in particular, shows that skills retention and fade are influenced by multiple factors, not just the individual.

Skills decay is a complex phenomenon. It is influenced by a range of factors. Health professional practice involves the performance of a range of skills in a range of contexts. These skills may decline at different rates for different people in different settings. The model of skill retention posited by military researchers weights individual, organisational, task, training and interval factors. Attempts to determine how these factors impact have shown they do influence skill retention, but how they interact has not conclusively been shown.

Future research to determine how best to assess and mitigate for skills fade when a practitioner returns to the profession should take account of individual circumstances and the range of influencing factors. There is a need for further research in this area, specifically looking at retention of global as well as specific skills and looking at retention of skills in experts as well as novices.

11. References

Academy of Medical Royal Colleges, 2009. **Remediation and Revalidation.** London: Academy of Medical Royal Colleges, 2012

Academy of Medical Royal Colleges. 2012c. **Return to Practice Guidance**. London: Academy of Medical Royal Colleges, 2012

Academy of Medical Royal Colleges, 2012b. **Return to Practice Background Document.** London: Academy of Medical Royal Colleges, 2012

Academy of Medical Royal Colleges, 2012a. **Remediation Working Group Report. 2012.** http://www.aomrc.org.uk/publications/ statements/doc_view/63-remediation-and-revalidation. html

Ahya, S.N. et al., 2012. Clinical Performance and Skill Retention after Simulation-based Education for Nephrology Fellows. **Seminars in Dialysis**, 25(4), pp.470–473.

Ali J, Cohen R, Adam R, et al.1996. Attrition of cognitive and trauma management skills after the advanced trauma life support (ATLS) course. **J Trauma** 40:860–866.

Ali J, Howard M, Williams J. 2002 Is attrition of advanced trauma life support acquired skills affected by trauma patient volume? **Am J Surg** 183:142–145

Ali J, Howard M, Williams JI.2003. Do factors other than trauma volume affect attrition of ATLS-acquired skills? **J Trauma** 54:835–841

Ali, J. et al. 2001 Comparison of Performance 2 Years after the Old and New (Interactive) ATLS Courses. **Journal of Surgical Research,** 97, pp.71–75.
Angel, H., Adams, B. D., Brown, A., Flear, C., Mangan, B., Morten, A., & Gruson, G. 2012. Review of the Skills Perishability of Police “Use of Force” Skills.
Arthur, W., Bennett, W., Stanush, P.L. & McNelly, T.L.1998. Factors that influence skill decay and retention: A quantitative review and analysis. **Human Performance**, 11(1), 57-101
Asselin, M., Osterman, P. & Cullen, H.A. (2006) In their own words: The experience of returning to acute care practice. **Journal for Nurses in Professional Development,** 22(3), pp.104–111.
Avisar, L. et al.,2013. Cardiopulmonary Resuscitation Skills Retention and Self-Confidence of Preclinical Medical Students. ISRAEL MEDICAL ASSOCIATION JOURNAL, 15(10), pp.622–627.
Azcona LA, Gutierrez GE, Fernandez CJ et al. 2002. Attrition of advanced trauma life support (ATLS) skills among ATLS instructors and providers in Mexico. J Am Coll Surg 195:372–377
Baker, M., Williams, J. & Petchey, R., 1997. Putting principals back into practice: an evaluation of a re-entry course for vocationally trained doctors. The British journal of general practice : the journal of the Royal College of General Practitioners, 47(425), pp.819–22.
Barriball, K.L., 2007. Evaluation of return to practice : the views of nurse returnees from three NHS hospital trusts. Journal of Nursing Management, 15(4), pp.433–441.
Beckers, S.K. et al., 2007. Retention of skills in medical students following minimal theoretical instructions on semi and fully automated external defibrillators. Resuscitation, 72(3), pp.444–50.
Blitvich, J.D. et al., 2003a. Long term retention of safe diving skills. Journal of Science and Medicine in Sport, 6(3), pp.348–354.
Blitvich, J.D. et al., 2003b. Retention of safe diving skills. Journal of Science and Medicine in Sport, 6(2), pp.155–165.
Boet, S. et al., 2011. Complex procedural skills are retained for a minimum of 1 yr after a single high-fidelity simulation training session†. BJA: The British Journal of Anaesthesia, 107(4), pp.533–539.
Bower, E.A. et al., 2010. Education to Return Nonpracticing Physicians to Clinical Activity : A Case Study in Physician. JOURNAL OF CONTINUING EDUCATION IN THE HEALTH PROFESSIONS, 30(2), pp.89–94.
Bristol, M.N. et al., 2008. Work-life policies for faculty at the top ten medical schools. Journal of women’s health (2002), 17(8), pp.1311–20.
British Medical Association. Maternity leave (for NHS medical staff), 2011. bma.org.uk/-/media/Files/PDFs/Practical%20advice%20at%20work/Working%20parents/maternity%20leave%20guidance%202011. pdf [Accessed 5 June 2013].
Brown, A.L., 2011. Workforce planning and flexible working in the NHS of the future. J R Coll Physicians Edinb, 41, pp.292–293.
Brown, J.B. et al., 2013. Surgical culture in transition: gender matters and generation counts. Canadian journal of surgery. Journal canadien de chirurgie, 56(3), pp.153–8.
Buck, D. & Newton, T., 2002. Continuing professional development amongst dental practitioners in the United Kingdom : how far are we from lifelong learning targets ?(2), pp.36–39.
Buddeberg-Fischer, B. et al., 2010. The impact of gender and parenthood on physicians’ careers--professional and personal situation seven years after graduation. BMC Health Services Research, 10, p.40.

Bullen,M., 2003. Overcoming the undersupply—supporting midwives return to practice. Aust. J.Midwifery 16 (4), 14–17
Burrows, P. et al., 2012. The Induction and Refresher scheme Simulated Surgery. Educ. prim. care, 23(5), pp.335–341.
Cahillane, M.A. & Morin, C., 2012. Skills retention in a complex battlefield management system: a pilot study.
Campbell, G., Rollin, A. & Smith, A., 2013. Cases relating to anaesthetists handled by the UK General Medical Council in 2009: methodological approach and patterns of referral. Anaesthesia, 68(5), pp.453–460.
Campbell, J. et al., 2011. Factors associated with variability in the assessment of UK doctors' professionalism: analysis of survey results. BMJ, 343, p.d6212..
Carroll, C.B. et al., 2007. The feminisation of British neurology: implications for workforce planning. Clinical Medicine (London, England), 7(4), pp.339–342.
Case, P., 2011a. Putting public confidence first: doctors, precautionary suspension, and the general Medical Council. Med Law Rev, 19(3), pp.339–371.
Case, P., 2011b. The good, the bad and the dishonest doctor: the General Medical Council and the "redemption model" of fitness to practise. Legal Studies, 31(4), pp.591–614.
Castellvi, A.O. et al., 2009. Maintaining proficiency after fundamentals of laparoscopic surgery training: a 1-year analysis of skill retention for surgery residents. Surgery, 146(2), pp.387–93. Chamberlain, J.M., 2011. The hearing of fitness to practice cases by the General Medical Council: Current trends and future research agendas. Health, Risk & Society, 13(6), pp.561–575.
Code of Professional Conduct for Veterinary Surgeons set by the Royal College of Veterinary Surgeons(2012)
College of Occupational Therapists, 2010a. Return to Practice Frequently Asked Questions, London: COT.
College of Occupational Therapists, 2010b. Returning to practice. Information for occupational therapists, their supervisors and managers.,
Committee of GP Education Directors (COGPED). 2011. GP Induction and Refresher/Returner Schemes, www, cog ped. org. uk/docu men t_st ore/1311754694dzwF_ cogped_induction_and_refresher-returner_schemes_ (revisedJun_2011).pdf
Crofts, J.F. et al., 2007. Management of Shoulder Dystocia: Skill Retention 6 and 12 Months After Training. Obstetrics & Gynecology, 110(5), pp.1069–1074.
Davies-Slowik, J., Bullock, A. & Frame, J., 2008. Retaining and Returning Advisers in England : A review of their first five years in supporting the dental workforce Final Report,
Davies-Slowik, J., Firmstone, V. & Frame, J., 2011. Educational support for the dental workforce: a review of the first five years of Retaining and Returning Advisers in England. British Dental Journal, 210(5), pp.E6–E6.
De Regge, M. et al., 2006a. Retention of ventilation skills of emergency nurses after training with the SMART BAG compared to a standard bag-valve-mask. Resuscitation, 68(3), pp.379–84.
De Regge, M. et al., 2008. Basic life support refresher training of nurses: Individual training and group training are equally effective. Resuscitation, 79(2), pp.283–287. Available at: 10.1016/j.resuscitation.2008.06.015.
De Win, G. et al., 2006. Determining the optimal frequency of skill labs for training and long term skill retention on endoscopic suturing. JOURNAL OF ENDOUROLOGY, 20, pp.A127–A127.
De Win, G. et al., 2013,The optimal frequency of endoscopic skill labs for training and skill retention on suturing: a randomized controlled trial. Journal of surgical education, 70(3), pp.384–93.

Deech R. Women Doctors: Making a Difference. Report of the Chair of the National Working group on Women in Medicine. London: Department of Health, 2009.
Dennick, R., 2003. Long-term retention of teaching skills after attending the Teaching Improvement Project: a longitudinal, self-evaluation study. Medical teacher, 25(3), pp.314–8.
Department of Health 2011. Report of the Department of Health Steering Group on Remediation. 2011. http:// www.dh.gov.uk/en/ (accessed 13 November 2012).
Department of Health, 2000. Modernising medical regulation: interim strengthening of the GMC's fitness to practise procedures: a consultation document D. of H. N. H. S. Executive, ed.
Donovan, J.J. & Radosevich, D.J., 1999. A Meta-Analytic Review of the Distribution of Practice Effect : Now You See It , Now You Don ' t. Journal of Applied Ps, 84(5), pp.795–805.
Durand, M.A. & Randhawa, G., 2002. Nurses' views about returning to practice after a career break. British journal of nursing (Mark Allen Publishing), 11(7), pp.477–485..
Ebbatson, M. et al., 2010. The relationship between manual handling performance and recent flying experience in air transport pilots. Ergonomics, 53(2), pp.268–277.
Edelman, D.A., Mattos, M.A. & Bouwman, D.L., 2010. FLS Skill Retention (Learning) in First Year Surgery Residents. Journal of Surgical Research, 163(1), pp.24–28.
Edin, P. & Gustavsson, M., 2008. Time Out of Work and Skill Depreciation. Cornell University ILR Review, 61(2).
Edwards, J., Macdonald, J. & Merriman, H., 2007. Returners as learners: a different species? A qualitative study. Educ. prim. care, 18(3), pp.354–363.
Einspruch, E.L. et al., 2007. Retention of CPR skills learned in a traditional AHA Heartsaver course versus 30-min video self-training: A controlled randomized study. Resuscitation, 74(3), pp.476–486.
Enk, C.D. et al., 2003. Diagnostic performance and retention of acquired skills after dermatology elective. International Journal of Dermatology, 42(10), pp.812–815.
Ericsson KA, Charness N, Feltovich PJ, Hoffman RR (eds), 2006. The Cambridge handbook of expertise and expert performance. Cambridge University Press, New York, pp
Ericsson, K.A., 2006. Chapter 38 The Influence of Experience and Deliberate Practice on the Development of Superior Expert Performance. In The Cambridge Handbook of Expertise and Expert Performance. pp. 685–705.
Finch, S.J., 2003. Pregnancy during residency: a literature review. Academic medicine : journal of the Association of American Medical Colleges, 78(4), pp.418–28.
Finlayson, a J.R. et al., 2013. Restoring professionalism: the physician fitness-for-duty evaluation. General hospital psychiatry, 35(6), pp.659–63.
Firmstone, V.R. et al., 2007. Supporting return to dentistry : a national evaluation of the Retaining and Returning Advisory Service. British Dental Journal, pp.413–417.
Freed, G.L., Abraham, L.M. & Brzoznowski, K.F., 2007. Inactive physicians: the state of our understanding. The Journal of pediatrics, 151(4), pp.431–4.
Freed, G.L., Dunham, K.M. & Abraham, L., 2009. Protecting the public: state medical board licensure policies for active and inactive physicians. Pediatrics, 123(2), pp.643–52.
General Dental Council (GDC), 2013. Continuing Professional Development for dental professionals, London: GDC.
General Medical Council. 2011. FAQ Responsible Officers. General Medical Council. http://www.gmc-uk.org/doctors/revalidation/faq_revalidation_p5.asp#10
General Optical Council (GOC), 2013. Enhanced CET from 2013 a guide for registrants, London: GOC.
General Optical Council, 2012. Enhanced CET Scheme. Principles and Requirements v2.1, London: GOC.

General Pharmaceutical council (GPhC), 2010. Standards for continuing professional development, London: GPhC.
General Pharmaceutical Council (GPhC), 2011. Framework for continuing professional development,
General Pharmaceutical Council (GPhC), 2012. Standards of conduct , ethics and performance, London: GPhC.
General Pharmaceutical Council (GPhC), 2013. Guidance on completing a return to registration application and providing a portfolio of evidence, London: GPhC.
Gershuni, V., Woodhouse, J. & Brunt, L.M., 2013. Retention of suturing and knot-tying skills in senior medical students after proficiency-based training: Results of a prospective, randomized trial. Surgery, 154(4), pp.823–9; discussion 829–30.
Gold, M., Jensen, P. & Jedrzkiewicz, M., 2005. Motherhood during residency training Challenges and strategies. Canadian Family Physician, 51.
Goodwin, G. A., 2006. The training, retention, and assessment of digital skills: A review and integration of the literature (ARI Research Report 1864). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.
Goodwin, G.A., B.C. Leibrecht, R.L. Wampler, S.C. Livingston, and J.L. Dyer, 2007.Retention of Selected FBCB2 Operating Skills Among Infantry Captains Career Course (ICCC) Students, (ARI Research Report 1872), US Army Research Institute for the Behavioral and Social Sciences, Arlington, VA, July 2007.
Gordon, H. & Szram, J., 2013. Paternity leave experiences of NHS doctors. Clinical Medicine, 13(5), pp.426–430.
Gould, D., 2005. Return-to-practice initiatives in nursing retention. Nursing standard (Royal College of Nursing (Great Britain) : 1987), 19(46), pp.41–6.
Goulet F, Gagnon R, Gingras ME. 2007 Influence of remedial professional development programs for poorly performing physicians. J Contin Educ Health Prof. 2007;27~1!:42–48.
Goulet F, Jacques A, Gagnon R, Charlin B, Shabah A. 2010. Poorly performing physicians: Does the Script Concordance Test detect bad clinical reasoning? J Contin Educ Health Prof 30:161–166.
Grace, El.S. et al., 2011. Physicians Reentering Clinical Practice: Characteristics and Clinical Abilities. Journal of Continuing Education in the Health Professions, 400(1), pp.49–55.
Gropper, A., Gartke, K. & MacLaren, M., 2010. Work-life policies for Canadian medical faculty. Journal of women's health (2002), 19(9), pp.1683–703.
Hamilton, R., 2005. Nurses' knowledge and skill retention following cardiopulmonary resuscitation training: a review of the literature. Journal of Advanced Nursing, 51(3), pp.288–297.
Harding, A.D. & Connolly, M.W., 2012. Remediation: a necessary function for employers to correct incompetence regarding clinical professional registered nurse practice. JONA'S healthcare law, ethics and regulation, 14(2), pp.48–52; quiz 53–54.
Harrison, J., 2008. Doctors' health and fitness to practise: assessment models . Occupational Medicine , 58 (5), pp.318–322.
Hauer, K.E. et al., 2009. Remediation of the deficiencies of physicians across the continuum from medical school to practice: a thematic review of the literature. Academic medicine : journal of the Association of American Medical Colleges, 84(12), pp.1822–32.
Hawley, J.M. & Foley, B.J., 2004. Being refreshed: evaluation of a nurse refresher course. Journal of continuing education in nursing, 35(2), pp.84–8.
Hays, R. et al., 2002. Selecting performance assessment methods for experienced physicians. Med Educ, 36(10), pp.910–917..
Health and Care Professions Council, 2012. Returning to practice. Information for professionals returning to the register., London: HCPC.

Health Professionals Council (HPC), 2005. Returning to Practice Your responses to the consultation , and our decisions Introduction The consultation Other regulators ' processes, London: HPC.
Health Professionals Council, 2011. Continuing Fitness to Practise, London: HPC.
Healy, A.F. et al., 2005. Skill training, retention, and transfer: The effects of a concurrent secondary task. Memory & Cognition, 33(8), pp.1457–1471.
Henik, A. et al., 2002. The Preservation and the Decay of Military Skills. final report of project: R&D 7699-RB-01,
Hiemstra, E. et al., 2009. Retention of basic laparoscopic skills after a structured training program. Gynecological surgery, 6(3), pp.229–235.
Hikosaka, O. et al., 2002. Long-term retention of motor skill in macaque monkeys and humans. Experimental brain research, 147(4), pp.494–504.
Hoffman, R. et al., 2011. Accelerated Proficiency and Facilitated Retention : Recommendations Based on An Integration of Research and Findings from a Working Meeting
Holdcroft, A. & Medical Women's Federation, 2013. Career Breaks for NHS and University doctors : An analysis of the WAM database, London: MWF.
Humphrey, C., 2010. Assessment and Remediation for Physicians With Suspected Performance Problems : An International Survey. JOURNAL OF CONTINUING EDUCATION IN THE HEALTH PROFESSIONS, 30(1), pp.26–36.
Hutchins, A. et al., 2006a. The General Practice Returner Scheme in London. Education for Primary Care, 17(1), pp.32–39.
Isbye, D.L. et al., 2007. Skill retention in adults and in children 3 months after basic life support training using a simple personal resuscitation manikin. Resuscitation, 74(2), pp.296–302.
Jackson, W.F.M. et al., 2012. Learning and Retaining Simulated Arthroscopic Meniscal Repair Skills. Journal of Bone & Joint Surgery, American Volume, 94-A(17), p.1631..
Jamieson, I. & Taua, C., 2009. Leaving from and returning to nursing practice: contributing factors. Nursing praxis in New Zealand inc, 25(2), pp.15–27. Kantak, S.S. & Winstein, C.J., 2012. Learning–performance distinction and memory processes for motor skills: A focused review and perspective. Behavioural Brain Research, 228(1), pp.219–231.
Kenagy, G.P. et al., 2011. Physician Reentry into Clinical Practice : Regulatory Challenges.
Khan, M.W. et al., 2014. Laparoscopic skills maintenance: a randomized trial of virtual reality and box trainer simulators. Journal of surgical education, 71(1), pp.79–84.
Kirkham M, Morgan RK (2006) Why Midwives Return and their Subsequent Experience. The Stationery Office, London
Kluge, A. & Frank, B., 2013. Counteracting skill decay : four refresher interventions and their effect on skill and knowledge retention in a simulated process control task. Ergonomics, 00(0), pp.0
Kohatsu ND, Gould D, Ross LK, Fox PJ. 2004. Characteristics associated with physician discipline: A case-control study. Arch Intern Med 164:653–658.
Kolozsvari, N.O. et al., 2011. Mastery versus the standard proficiency target for basic laparoscopic skill training: effect on skill transfer and retention. Surgical Endoscopy, 25(7), pp.2063–2070. Available at: 10.1007/s00464-011-1743-9.
Kopacek, K.B. et al., 2010. Pharmacy Students ' Retention of Knowledge and Skills Following Training in Automated External Defibrillator Use. American Journal of Pharmaceutical Education, 74(6), pp.1–8.
Kurien, M., Azmy, I.A.F. & Sanders, D.S., 2011. Going out-of-programme as a specialty trainee: procrastination or optimisation of training? Clinical Medicine, 11(6), pp.563–566.
Langan, J.C. et al., 2009. Registered nurse incentives to return to practice in the United States. International Journal of Nursing Practice, 15(5), pp.359–367.

Langan, J.C., Tadych, R.A. & Kao, C.-C., 2007. Exploring incentives for RNs to return to practice: a partial solution to the nursing shortage. Journal of professional nursing : official journal of the American Association of Colleges of Nursing, 23(1), pp.13–20.
Lekka, C. 2011. High reliability organisations A review of the literature, London: HSE.
Lent, B. et al., 2000 Promoting parental leave for female and male physicians. CMAJ: Canadian Medical Association Journal, 162(11), pp.1575–1576..
Leonard, B. & Martin, L., 2007. Literature Review on Skill Fade,
Li, Q. et al., 2013. Pre-training evaluation and feedback improved skills retention of basic life support in medical students. Resuscitation, 84(9), pp.1274–8.
Liebhardt, H., Niehues, J. & Fegert, J.M., 2012. Practical Approaches to Family-friendly Medical Studies. GMS Zeitschrift für Medizinische Ausbildung, 29(2), pp.1–16.
Linou, N. & Kontogiannis, T., 2005. A Training Approach to the Acquisition and Retention of Fault-Finding Skills: Making Instructions “Visible” on the Interface. International Journal of Human-Computer Interaction, 18(1), pp.59–84.
Locke, R. et al., 2013. Identifying poor performance among doctors in NHS organizations. Journal of Evaluation in Clinical Practice, 19(5), pp.882–888.
Long, J. & West, S., 2007. Returning to nursing after a career break: elements of successful re□entry. Australian Journal of Nursing, 25(1), p.49.
Maagaard, M. et al., 2011. Retention of laparoscopic procedural skills acquired on a virtual-reality surgical trainer. Surgical Endoscopy, 25(3), pp.722–727.
Madden, C., 2006. Undergraduate nursing students’ acquisition and retention of CPR knowledge and skills. Nurse Education Today, 26(3), pp.218–27.
Mahony, P.H. et al., 2008. Retention of knowledge and skills in first aid and resuscitation by airline cabin crew. Resuscitation, 76(3), pp.413–418. Available at: 10.1016/j.resuscitation.2007.08.017.
Malloch, K., 2013. Evidence-driven nurse remediation: competency validation. Nursing Administration Quarterly, 37(3), pp.272–274.
Mark S, Gupta J. 2002. Reentry into clinical practice: Challenges and strategies. JAMA 288:1091–1096.
Mashaud, L.B. et al., 2010. Two-year skill retention and certification exam performance after fundamentals of laparoscopic skills training and proficiency maintenance. Surgery, 148(2), pp.194–201.
Mayer, K.L., Ho, H.S. & Goodnight, J.E., 2001. Childbearing and child care in surgery. Archives of surgery (Chicago, Ill. : 1960), 136(6), pp.649–55.
McMurtrie, L.J. et al., 2013. Keeping our nursing and midwifery workforce: Factors that support non-practising clinicians to return to practice. Nurse education today, pp.7–11.
Meaney, P.A. et al., 2012. Training hospital providers in basic CPR skills in Botswana: acquisition, retention and impact of novel training techniques. Resuscitation, 83(12), pp.1484–90.
Medical Board of Australia, 2010. Medical Board of Australia Recency of practice registration standard,
Medical Council of New Zealand, 2004. Policy on doctors returning to medical practice after an absence from practice for three or more years,
Meretoja, R. & Koponen, L., 2012. A systematic model to compare nurses’ optimal and actual competencies in the clinical setting. Journal of advanced nursing, 68(2), pp.414–22.
Meretoja, R., Leino-Kilpi, H. & Kaira, A.-M., 2004. Comparison of nurse competence in different hospital work environments. Journal of nursing management, 12(5), pp.329–36.
Mitchell, E.L. et al., 2011. Evaluation of distributed practice schedules on retention of a newly acquired surgical skill: a randomized trial. American Journal of Surgery, 201(1), pp.31–39.

Mohammad, A., Branicki, F. & Abu-Zidan, F., 2014. Educational and Clinical Impact of Advanced Trauma Life Support (ATLS) Courses: A Systematic Review. World Journal of Surgery, 38(2), pp.322–329.
Morison, J. et al., 2012. GPs' experiences of the Returner (Induction and Refreshment) Scheme in Severn: a qualitative study. Educ. prim. care, 23(4), pp.255–262.
Mosley, C.M.J. & Shaw, B.N.J., 2013. A longitudinal cohort study to investigate the retention of knowledge and skills following attendance on the Newborn Life support course. Archives of disease in childhood, 98(8), pp.582–6.
Mulvey, H.J. et al., 2008. Pediatricians Over 50 Reentering Clinical Practice : Implications for Physicians and the Regulatory Community. , pp.7–12.
Murray, J.J., 2002. Better opportunities for women dentists : a review of the contribution of women dentists to the workforce. British Dental Journal, 192(4).
Myers, G. & Bushnell, K., 2007. Inactive nurses: making a comeback. Nursing management, 38(8), pp.16, 19.
National Audit Office (2003) The Management of Suspensions of Clinical Staff in NHS Hospital and Ambulance Trusts in England: Report by the Comptroller and Auditor General HC 1143. National Audit Office, London
NHS Careers. Returning to medicine.
http://www.nhscareers.nhs.uk/details/Default.aspx?Id=552 (accessed 30th October 2012).
Nicol, P. et al., 2011. Retention into internship of resuscitation skills learned in a medical student resuscitation program incorporating an Immediate Life Support course. Resuscitation, 82(1), pp.45–50. Nishiyama, C. et al., 2014. Long-term Retention of Cardiopulmonary Resuscitation Skills After Shortened Chest Compression-only Training and Conventional Training: A Randomized Controlled Trial. Academic emergency medicine : official journal of the Society for Academic Emergency Medicine, 21(1), pp.47–54.
NPSA /NCAS, 2011. Factors influencing dental practitioner performance : a literature review March 2011,
Numminen, O. et al., 2013. Professional competence of practising nurses. Journal of clinical nursing, 22(9-10), pp.1411–23. Nursing and Midwifery Council, 2011. The Prep handbook, London: NMC.
O'Leary, J., 2012. Comparison of self-assessed competence and experience among critical care nurses. Journal of nursing management, 20(5), pp.607–14.
Oermann, M.H., Kardong-edgren, S.E. & Odom-maryon, T., 2011. Effects of monthly practice on nursing students ' CPR psychomotor skill performance. Resuscitation, 82(4), pp.447–453..
Oh, J. et al., 2001. Retention and Use of Patient-centered Interviewing Skills after Intensive Training. Academic Medicine, 76(6), pp.647–650. .
Papadimitriou, L. et al., 2010. Distribution of pre-course BLS/AED manuals does not influence skill acquisition and retention in lay rescuers: A randomised study. Resuscitation, 81(3), pp.348–352.
Papalexopoulou, K. et al., 2014. Education and age affect skill acquisition and retention in lay rescuers after a European Resuscitation Council CPR/AED course. Heart & lung : the journal of critical care, 43(1), pp.66–71.
Parcsi, L. & Curtin, M., 2013. Experiences of occupational therapists returning to work after maternity leave. Australian Occupational Therapy Journal, 60(April), pp.252–259.
Payne, S., 2010. Why midwives fail to stay in practice following a return to practice course. British Journal Of Midwifery, 18(6), pp.376–381.
Peladeau, N., Forget, J. & Gagne, F., 2003. Effect of Paced and Unpaced Practice on Skill Application and Retention: How Much Is Enough? American Educational Research Journal, 40(3), pp.769–801.

Pemberton, J., Rambaran, M. & Cameron, B.H., 2013. Evaluating the long-term impact of the Trauma Team Training course in Guyana: an explanatory mixed-methods approach. American Journal of Surgery, 205(2), pp.124–199.
Perez, R.S. et al., 2013. Prevention of Surgical Skill Decay. Military Medicine, pp.76–86.
Phipps, D.L. et al., 2013. Career breaks and changes of sector: challenges for the revalidation of pharmacists. Research in social & administrative pharmacy : RSAP, 9(2), pp.188–98. Preisner, R. et al., 2012. Impact of web-based review on long-term retention of simulation-acquired knee and shoulder aspiration and injection skills. Journal of graduate medical education, 4(4), pp.460–6.
Proctor, R.W. & Vu, K.-P.L., Laboratory Studies of Training, Skill Acquisition, and Retention of Performance. CAMBRIDGE HANDBOOK OF EXPERTISE AND EXPERT PERFORMANCE, pp.265–286.
Quick, O., 2006. Outing medical errors: questions of trust and responsibility. Med Law Rev, 14(1), pp.22–43..
Rail Safety & Standards Board (RSSB), 2011a. Good Practice Guide : Competence Retention. T717: A model for competence retention in the rail industry (skills fade),
Rail Safety and Standards Board, 2011b. Operations and Management in the railway (skills fade):,
Randolph, P.K. et al., 2012. Measuring competence: collaboration for safety. Journal of Continuing Education in Nursing, 43(12), pp.541–549.
Riegel, B. et al., 2003. Characteristics associated with CPR and AED skill retention: Results of the public access defibrillation (PAD) trial. CIRCULATION, 108(17), pp.A1029–A1029.
Riegel, B. et al., 2005. Predictors of cardiopulmonary resuscitation and automated external defibrillator skill retention. American heart journal, 150(5), pp.927–32.
Romano, J.C., Howard, J.H. & Howard, D. V, 2010. One-year retention of general and sequence-specific skills in a probabilistic, serial reaction time task. Memory, 18(4), pp.427–441. Roppolo, L.P. et al., 2007. Prospective, randomized trial of the effectiveness and retention of 30-min layperson training for cardiopulmonary resuscitation and automated external defibrillators: The American Airlines Study. Resuscitation, 74(2), pp.276–285..
Routhier, F. et al., 2012. Efficacy and retention of the French-Canadian version of the wheelchair skills training program for manual wheelchair users: a randomized controlled trial. Archives of physical medicine and rehabilitation, 93(6), pp.940–8.
Royal College of Anaesthetists, 2012. Returning to work after a period of absence, London: RCAN.
Royal College of Surgeons of England, (2014) Pregnancy and Maternity, London.
Rubak, S. et al., 2008. A controlled study of the short- and long-term effects of a Train the Trainers course. Medical education, 42(7), pp.693–702..
Ruetzler, K. et al., 2011. Performance and skill retention of intubation by paramedics using seven different airway devices—A manikin study. Resuscitation, 82(5), pp.593–597.
Sanders, W.R. Cognitive Psychology Principles for Digital Systems Training, (Research
Saraç, L. & Ok, A., 2010. The effects of different instructional methods on students' acquisition and retention of cardiopulmonary resuscitation skills. Resuscitation, 81(5), pp.555–561. Available at: 10.1016/j.resuscitation.2009.08.030.
Sauer, J., Hockey, G.R. & Wastell, D.G., 2000. Effects of training on short- and long-term skill retention in a complex multiple-task environment. Ergonomics, 43(12), pp.2043–64.
Schuver-van Blanken, M.J. & van Bavelgem, J., 2000. Human Factors and aircraft maintenance training: A way to the future. Integration of human factors into aircraft maintenance training. NLR: Amsterdam. NLR-TR-2000-151.
Seward M. Better Opportunities for Women Dentists — A Review of the Contribution of Women Dentists to the Workforce. Department of Health, London, 2001.

Sheppard, L. et al., 2010. Returning to physiotherapy practice : the perspective of returners , potential returners and clinical supervisors. , pp.304–311.
Sinha, P., Hogle, N.J. & Fowler, D.L., 2008. Do the laparoscopic skills of trainees deteriorate over time? Surgical Endoscopy, 22(9), pp.2018–2025.
Skidmore, M.B. & Urquhart, H., 2001. Retention of skills in neonatal resuscitation. Paediatrics & child health, 6(1), pp.31–5.
Smith, A. et al., 2004. Trials of teaching methods in basic life support (4): comparison of simulated CPR performance at unannounced home testing after conventional or staged training. Resuscitation, 61(1), p.41. Available at: 10.1016/j.resuscitation.2003.12.014.
Smith, C. et al., 2012. Combining general practice with international work: online survey of experiences of UK GPs. JRSM short reports, 3(7), p.46..
Smith, K.K., Gilcreast, D. & Pierce, K., 2008. Evaluation of staff ' s retention of ACLS and BLS skills ☙ . Resuscitation, 78, pp.59–65.
Smith, N.P. et al., 2006. Is the grass greener? A survey of female pediatric surgeons in the United Kingdom. Journal Of Pediatric Surgery, 41(11), pp.1879–1881. Southgate, L., Campbell, M., et al., 2001. The General Medical Council's Performance Procedures: the development and implementation of tests of competence with examples from general practice. Medical Education, 35(s1), pp.20–28.
Southgate, L., Cox, J., et al., 2001a. The assessment of poorly performing doctors: the development of the assessment programmes for the General Medical Council's Performance Procedures. Med. educ. Suppl., 35(1), pp.2–8..
Southgate, L., Cox, J., et al., 2001b. The General Medical Council's Performance Procedures: peer review of performance in the workplace. Medical Education, 35(s1), pp.9–19..
Stefanidis, D., Korndorffer, J.R., et al., 2005. Skill retention following proficiency-based laparoscopic simulator training. Surgery, 138(2), pp.165–70.
Stone, K. et al., 2011. The management of poor performance in nursing and midwifery: a case for concern. Journal of nursing management, 19(6), pp.803–9. Stothard, C. & Nicholson, R., 2001. Skill Acquisition and Retention in Training : DSTO Support to the Army Ammunition Study, Edinburgh, Australia.
Stromski, C. et al., 2005. Short and long term skill retention after resident training in cricothyroldotomy. ANNALS OF EMERGENCY MEDICINE, 46(3), pp.S13–S13.
Tanaka, S., Serizawa, T. & Sakaguchi, C., 2008. Career redevelopment programmes for inactive nurses in Japan. Journal of clinical nursing, 17(24), pp.3296–305.
Tawalbeh, L.I. & Tubaishat, A., 2014. Effect of simulation on knowledge of advanced cardiac life support, knowledge retention, and confidence of nursing students in jordan. The Journal of nursing education, 53(1), pp.38–44.
The Health Foundation, 2011. High reliability organisations. evidence scan., London: The Health Foundation.
Traynor M, Stone K, Cook H, Gould D, M.J., 2013. Disciplinary processes and the management of poor performance among UK nurses: bad apple or systemic failure? A scoping study. Nursing Inquiry.
Varjavand N, Novack DH, Schindler BA. 2012. Returning physicians to the workforce: History, progress, and challenges. J Contin Educ Health Prof in press.
Varjavand, N. et al., 2012. Assessment of an innovative instructional program to return non-practicing physicians to the workforce. Medical teacher, 34(4), pp.285–91.
Vliney, R., Hastie, A. & Dennis, V. , 2006. An evaluation of the General Practice Flexible Career Scheme. Educ. prim. care, 17(5), pp.479–485.
Vine, S.J. et al., 2013. Gaze training improves the retention and transfer of laparoscopic technical skills in novices. Surgical endoscopy, 27(9), pp.3205–13. .
Viney, R. et al., 2007. The general practice Flexible Career Scheme in London: lessons learned. Educ. prim. care, 18(4), pp.488–500.

Wayne, D.B. et al., 2012. Code Status Discussion Skill Retention in Internal Medicine Residents: One-Year Follow-Up. Journal of Palliative Medicine, 15(12), pp.1325–1328.
Weaver, S.J., Newman-toker, D.E. & Rosen, M.A., 2012. Reducing Cognitive Skill Decay and Diagnostic Error : Theory-Based Practices for Continuing Education in Health Care. , 32(4), pp.269–278.
Weksler, N. et al., 2005. Insertion of the endotracheal tube, laryngeal mask airway and oesophageal-tracheal Combitube®. A 6-month comparative prospective study of acquisition and retention skills by medical students. European Journal of Anaesthesiology, 22(5), pp.337–340. Whiteman, J., Morris, P. & Halpern, H., 2013. Professional Support, London: the professional development unit supporting practitioner well-being, refreshment, remediation and revalidation. BMJ Quality Improvement Reports, 2(1), pp.u201038.w720–u201038.w720.
Wik, L. et al., 2002. Retention of basic life support skills 6 months after training with an automated voice advisory manikin system without instructor involvement. Resuscitation, 52(3), pp.273–279.
Wik, L. et al., 2005. Twelve-month retention of CPR skills with automatic correcting verbal feedback. Resuscitation, 66(1), pp.27–30.
Wilson, H. & Compton, M., 2009. Reentry of the Addicted Certified Registered Nurse Anesthetist. Journal of Addictions Nursing, 20(4), pp.177–184.
Wisher, R.A., Sabol, M.A. & Ellis, J.A., 1999. Retention of Military Knowledge and Skills. ARI Special Report 39, Alexandria, VA: US Army Research Institute for the Behavioural and Social Sciences.
Women in Academic Medicine, 2008.Developing equality in governance and management for career progression. London: British Medical Association, 2008
Woollard, M. et al., 2004. Skill acquisition and retention in automated external defibrillator (AED) use and CPR by lay responders: a prospective study. Resuscitation, 60(1), p.17.
Woollard, M. et al., 2006. Optimal refresher training intervals for AED and CPR skills : A randomised controlled trial. Resuscitation, 71, pp.237–247.
Yang, C.-W. et al., 2012. A systematic review of retention of adult advanced life support knowledge and skills in healthcare providers. Resuscitation, 83(9), pp.1055–1060. Available at: 10.1016/j.resuscitation.2012.02.027.
Yates, J. & James, D., 2010. Risk factors at medical school for subsequent professional misconduct: multicentre retrospective case-control study. BMJ, 340, p.c2040.
Yeung, J. et al., 2009. The use of CPR feedback/prompt devices during training and CPR performance: A systematic review. Resuscitation, 80(7), pp.743–751.
Yeung, J. et al., 2011. AED training and its impact on skill acquisition, retention and performance – A systematic review of alternative training methods. Resuscitation, 82(6), pp.657–664.