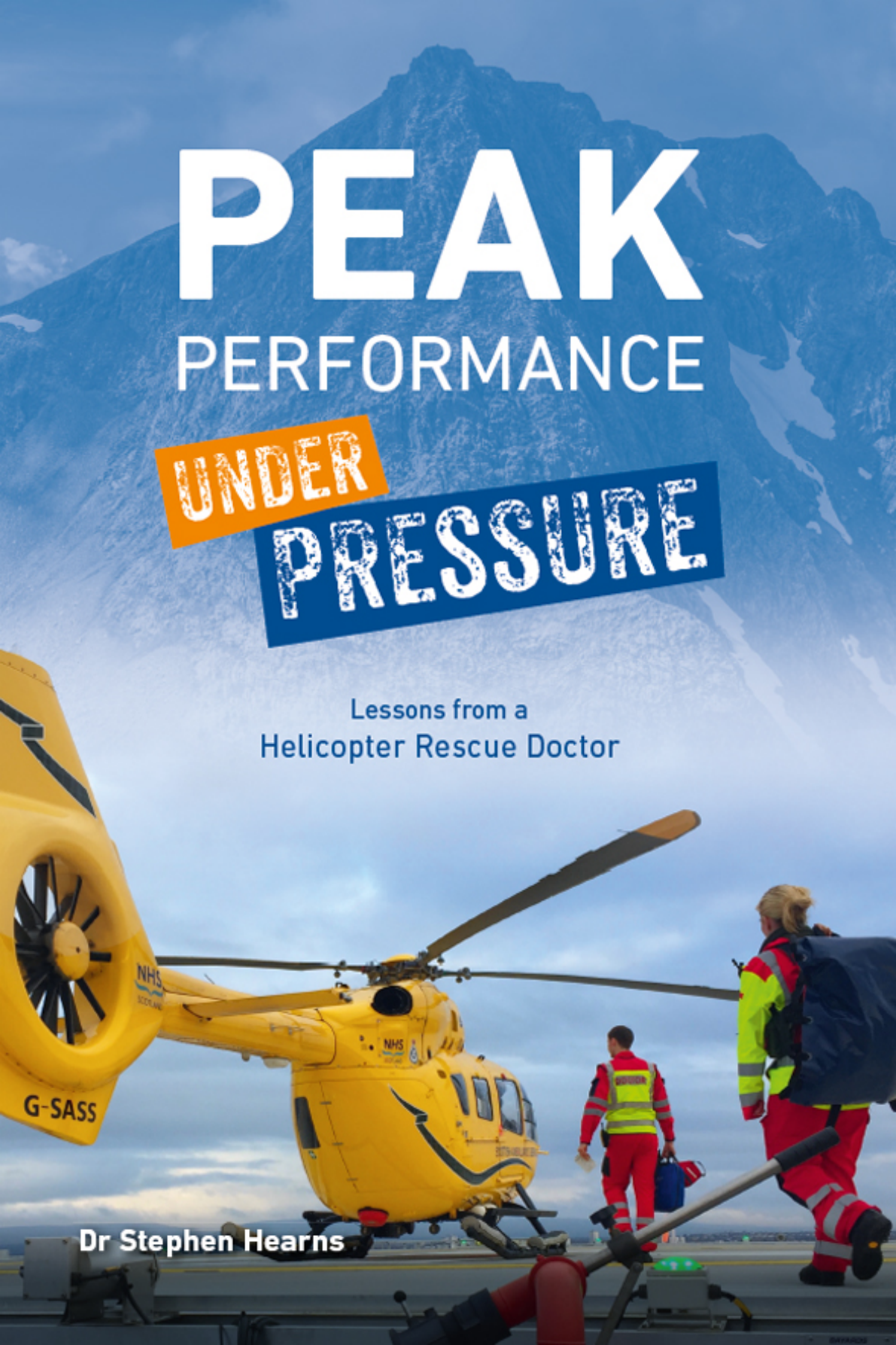
PEAK PERFORMANCE UNDER PRESSURE

Lessons from a Helicopter Rescue Doctor



Dr Stephen Hearns

Peak Performance Under Pressure

Lessons from a Helicopter Rescue Doctor

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About the Author

Stephen Hearns is a consultant in emergency medicine based in Glasgow. He has led the development of Scotland's EMRS aeromedical retrieval service since it was established in 2004. He leads a team of 50 helicopter consultants, paramedics and nurses. The team provide lifesaving critical care for seriously ill and injured people in 24 remote hospitals and at the site of accidents. They operate in high-risk and time-critical situations on ambulance service helicopters and planes, search and rescue aircraft and by fast response vehicles.

Stephen is a Fellow of the Royal College of Emergency Medicine (RCEM), the Royal College of Surgeons (RCS), the Royal College of Physicians (RCP) and the Royal Geographical Society (RGS).

Stephen has extensive experience of medical care in austere environments. He is a qualified mountain leader and has been an active member of the Arrochar Mountain Rescue Team for over 20 years. He has provided medical support to remote expeditions in arctic, mountain, jungle and desert environments. Stephen established the first expedition medicine course in the UK, training hundreds of medics in this area of pre-hospital care.

As part of his role with the EMRS team, Stephen is trained to manage mass casualty incidents. Over the past 15 years he has acted as medical incident commander at a number of high profile major incidents.

He has published numerous research articles relating to emergency medicine and remote pre-hospital care and has contributed chapters to a number of leading textbooks in these fields. Stephen regularly presents at UK and overseas conferences on the topics of retrieval medicine and performance under pressure. He led the establishment of the RCS Diploma in Retrieval and Transfer Medicine (DRTM) and is co-organiser of the annual retrieval conference, which attracts delegates and speakers from all over the world.

With his extensive experience of service development, leadership and safe operational systems for high stress environments, Stephen provides consultancy services and training to the oil and gas industry, energy transmission companies, police tactical firearms and diving units, aviation

providers, search and rescue organisations and government agencies in the UK and abroad.

Stephen is an advisor in emergency medicine to the Scottish Public Services Ombudsman (SPSO). He is regularly instructed as an expert witness in emergency medicine and pre-hospital care by the General Medical Council (GMC) and NHS Scotland's Central Legal Office (CLO) in cases of alleged negligence and in fitness to practise investigations.

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Dedicated to my mum and dad. Potential.

Introduction

All of us experience times when we are under pressure and where a high standard of performance is imperative. These are often high-stakes situations where errors may have catastrophic outcomes. For professionals such as emergency service first responders, healthcare providers, barristers and the military, performing under pressure is a regular challenge. Many of us can recall instances when the magnitude and complexity of the challenge overwhelmed us, and situations where there was limited time to make decisions or carry out practical tasks. We can recall our ability to process information being compromised and our capacity to communicate effectively being reduced. We can also remember being anxious and, sometimes, even experiencing a state of panic.

Excessive pressure compromises our ability to perform in these types of situations. It adversely affects how we perceive the problems we are facing, and our ability to take on board information and make rational decisions based on that information. Our ability to work effectively in a team also deteriorates. However, moderate amounts of pressure stimulate us, enhancing our cognitive performance and our ability to manage challenging situations.

In order to perform optimally under pressure, we need to understand what the pressures are and how they affect our behaviour. An understanding of the positive and negative effects of pressures is critical for high-performing teams and individuals. We require skills and tools to use pressure to our advantage: we need to own the pressure.

The Arc of Performance

This book discusses the relationship between pressure and performance and why we react the way we do under pressure. With the right level of pressure our performance can be enhanced. For example, athletes recognise the positive benefits of the pressure experienced in competition

in enhancing their performance. Too much pressure, however, leads to cognitive overload and stress. Three performance states are recognised: disengagement, flow and frazzle.[1] The relationship between pressure and performance is shown graphically as the arc of performance (Figure 1).

When we experience situations with little or no pressure, we have minimal stimulus to motivate us to perform to a high standard. This low arousal, low performance state is known as disengagement.

Increasing pressure in terms of complexity, time constraints and adverse consequences of failure provides us with motivation to increase our cognitive function, our communication ability and our proficiency in the completion of practical tasks. Our bodies secrete low levels of stress hormones. These hormones create a state of arousal and focused attention.[2] We perceive the situation as a challenge: it is difficult, but we have confidence that we have the knowledge, skills and resources required to achieve a safe and favourable outcome.

Psychologists refer to this state of arousal, motivation and optimal performance as the state of flow.[2–5] Performance is about attaining and maintaining the state of flow. Maintenance of flow is achieved by managing the pressures experienced by individuals and teams. Flow is about 'owning the pressure'.

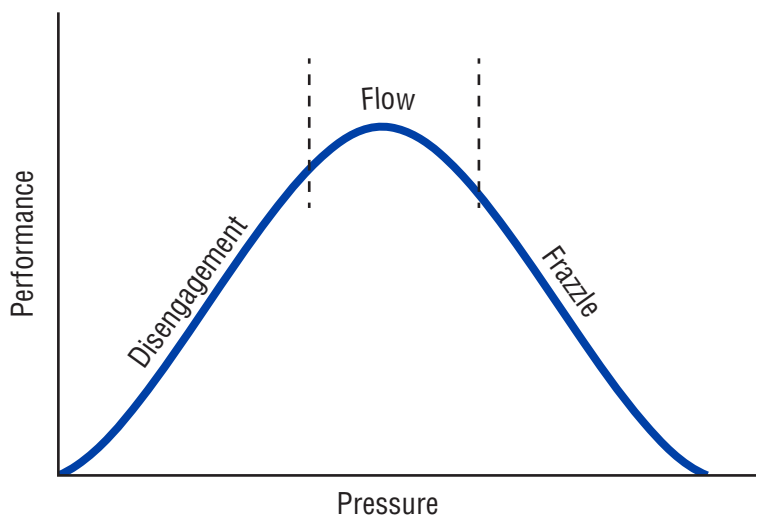


Figure 1 The Arc of Performance.
Source: Based on Yerkes RM and Dodson JD (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology,* 18(5): 459–482.

Further increases in pressure can, however, rapidly change our perception of a situation and compromise our ability to deal with it effectively.[2] We can move from seeing things as a challenge to seeing them as being a potentially harmful threat. We believe that the situation is too large and too complex for our personal abilities and the resources we have at our disposal. We experience a surge in the release of stress hormones. We react to these hormones by developing a 'fight-or-flight' response.[6] We project the situation as potentially ending badly for us. Our bodies prepare to physically defend ourselves or to run away. Once we are in this state of excessive pressure, our ability to make rational decisions, listen to other members of the team and carry out fine motor tasks seriously deteriorates and we enter the zone of frazzle.

In some situations of extreme pressure we can enter into a fourth state, that of freeze, or choking. In a state of freeze we lose the ability to make decisions or carry out motor tasks.[7]

The Pressures

When thinking about performance under pressure it is essential for us to take time to think about what these pressures facing us actually are. Understanding pressures helps us control them and use them to our advantage in achieving a state of high performance flow.

The pressures and stressors that affect our ability to perform can be divided into two categories: intrinsic and extrinsic. Intrinsic pressures are those relating to and created by the task itself. This most commonly relates to the technical complexity and magnitude of the challenge. Extrinsic pressures are those that surround the task. This might include having to undertake a task in a hostile environment or there being potentially catastrophic consequences to failure.

It is useful to consider intrinsic and extrinsic pressures in terms of giving a presentation. The intrinsic pressure is created by the talk itself, remembering what to say and when. The longer the presentation and the more complex the subject, usually the greater the intrinsic pressure will be. The extrinsic pressure is that which is brought about by standing in front of a large audience. Practising the talk alone in front of a mirror is much less pressured than giving it in an auditorium, despite the task objectively being the same.

The volume of information we receive visually and audibly from the situation and our team mates, which requires to be processed in order to make accurate decisions, is one of the most common pressures compromising performance. Excessive amounts of information being presented to us can

lead to a state of cognitive overload. Also, as described later in Chapter 3, 'Back Pressure – Barriers to High Performance', the context of how we receive this information can also lead to challenges in making accurate judgements due to cognitive biases.[8]

In addition to the total volume of information required for decision-making, the rate at which information is passed to us can add to the pressure. If information is coming from multiple sources simultaneously, this divides our attention. Tasks involving divided attention create a much bigger cognitive burden than those where our attention is focused on a single task or source of information.[9]

Having limited time to receive information, make decisions, communicate with our colleagues and carry out physical tasks also adds significant pressure to challenging situations.

Everyone operating in high-pressure situations is aware of the potential consequences of failure. Failure to make accurate judgements or perform tasks correctly can, in some cases, lead to physical harm to ourselves or others, or to financial or reputational damage.

A number of factors, including fatigue and adverse environmental conditions, can compromise our cognitive and physical ability and hence our ability to perform.

In challenging situations, it can be beneficial to offload decision-making and other tasks to other members of the team when possible. However, if we are working with a less experienced team, especially with people unfamiliar to us, delegation to reduce pressure can be unsafe or even impossible.

Unfamiliar, unserviceable or unavailable equipment can seriously compromise our ability to perform practical tasks. Similarly, a lack of well-structured cognitive aids can considerably affect our ability to recall vital information and make decisions. Cognitive aids are prompts which enable us to perform a task more accurately, for example checklists and guidelines.

Every situation and each professional discipline have their own unique pressures. A number of pressures are, however, common to the majority of challenging situations. A significant part of the ability to perform under pressure is awareness of these pressures and their optimal management, both in advance of the challenge and during it.

Cognitive Appraisal

A key part of owning the pressure is an understanding of how our brains appraise and perceive the magnitude and complexity of a situation

and our capability for dealing with it. This subjective interpretation of a situation is known as cognitive appraisal.[10] Assessing the situation as a difficult but achievable challenge helps to motivate us and create a state of high performance flow.[11] We can, however, make a judgement that the situation is insurmountable. We can sometimes even perceive it as a potential threat to our well-being. Perceiving the situation as an unachievable threat contributes to shifting us into the zone of frazzle.

Sometimes, such an appraisal of threat can be rational, objective and accurate. Sometimes, however, our judgement of a situation may be exaggerated and unjustifiably negative. Exaggerated cognitive appraisals of threat lead to avoidable compromises in our performance. Often these inaccurate judgements are due to our initial, emotional appraisal of the situation prior to us being able to make a rational assessment. Recognition of this, and an ability to manage our initial emotional response, is important for maintaining performance.

Metacognition

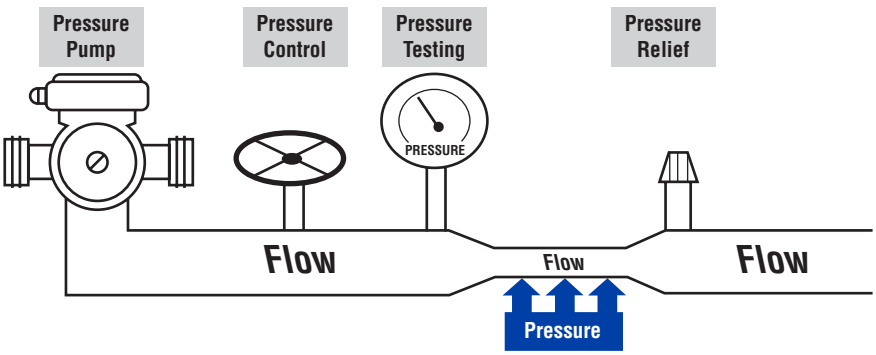
Similarly, an understanding of how our brain processes information and makes judgements and decisions is important. This is known as metacognition, i.e. thinking about thinking. According to psychologist, Daniel Kahneman, our brains use two types of cognitive process.[12] Analytical processing is required for unfamiliar and complex situations. Information and the options open to us are consciously considered before making a judgement. This type of decision-making is usually safe and accurate, but is slow and highly demanding of our limited cognitive capacity. Automatic processing, on the other hand, is fast and has minimal cognitive demands. This is based on pattern recognition, rapidly comparing the current situation to ones we have previously encountered. It can be used for familiar and predictable tasks and judgements. Performance under pressure can be enhanced by awareness of which type of cognitive processing is the most efficient for the situation we are dealing with.

Owning the Pressure

High-performing individuals and high-performing teams strive to attain and maintain a state of high-performance flow. They should have the skills to 'own the pressure', maintaining the optimal level of arousal and focus. They recognise the early signs of deteriorating performance due to excessive pressure and have the tools to regain personal composure and situational control. When required, they have the ability to move from the zone of frazzle to the zone of flow by owning the pressure.

This book uses an analogy from engineering to consider the relationship of performance with pressure and how pressure can be managed. Maintenance of precise pressures is essential for the safe and effective operation of mechanical devices, engines and pipe systems. Engineers design systems to generate and control these precise pressures in power stations, oil rigs, transcontinental gas pipes, aircraft engines and chemical plants. Similarly, high performing organisations need systems to manage the pressures faced by their teams.

We can consider four parts to high performance pressure management systems: the pressure pump, pressure control mechanisms, pressure testing techniques and pressure relief valves. We can use each of the four components to classify and describe the techniques we can use to optimise our performance when working under pressure.



Under Pressure

The first section of the book, 'Under Pressure' explores aspects of flow, frazzle and disengagement. It also analyses how we can be consciously aware of our own thought processes to aid our control of high-pressure situations, as well as looking at some of the obstacles we may face in our quest to achieve optimal performance.

The Pressure Pump

The whole system is continually pressured with the pressure pump. This maintains the pressure throughout the system at the desired level. In the context of team performance, the pressure pump may be thought of as the culture in the organisation, its strategic leadership and the optimal selection of team members.

The overall culture of the organisation is imperative for achieving high performance. This includes striving for continuous performance improvement through marginal gains. Open, just and psychologically safe cultures encourage individuals to speak up about challenges they have encountered, thus allowing the whole team to improve from the experiences of their colleagues.

As well as individuals and teams, whole organisations can be in long-term states which are similar to disengagement, flow or frazzle. On an organisational level, states of frazzle and disengagement are often due to mismatches of capacity and demand, poor leadership and weak organisational cultures. Organisations need to generate the right level of pressure in their systems to motivate their staff for optimal performance.

It is also essential that organisations ensure that the right people are appointed to high-pressure roles. Not everyone has the necessary attributes and attitudes for dealing with pressured, high-stakes tasks. Selection processes to identify and appoint these people are key to the success of a high-performance team. A large pool of applicants is a useful aid in identifying these individuals. Organisational branding and marketing play a significant role in attracting potential applicants to high-performance teams.

Leadership of high-performance organisations, made up of high-performing, independent thinkers, can be challenging. As well as having a clear vision of the direction of the organisation and its values, strategic leaders should support each member of their team in achieving their full potential. Effective leaders have the confidence to give ownership and control of the organisation's development to more junior members of the team through delegation and empowerment. Communication skills, personal coaching ability and appropriate demonstration of personal vulnerability are also key parts of high-performance leadership. Section 2, 'The Pressure Pump' analyses the impact of organisational culture, as well as strategic leadership and employee selection.

Pressure Control

Engineers put in place components to control and calibrate the pressure within systems. These components help keep the pressure high enough to maintain optimal flow and to avoid pressure levels becoming excessive.

In the context of high performance, pressure control measures include operational guidelines, checklists, equipment management systems, team

dynamics and frontline leadership, as covered in Section 3 of this book. Organisations require systems to manage how information and equipment are presented to individuals and teams. These need to be specifically designed for those who are expected to use it during high-pressure, high-stakes situations. When we perform under pressure we do not have sufficient time or cognitive capacity to locate information, consult lengthy instruction manuals or learn how to use unfamiliar equipment.

Guidelines have a number of roles in controlling pressure. They can be used for team training and staff induction. This ensures that everyone is aware of how to react to predictable, high-pressure situations, how to operate equipment and how to complete practical procedures. Checklists help ensure that mission-critical and high-stakes tasks are completed safely and thoroughly. Excessive pressure can often arise due to equipment failure or essential equipment not being available in the timescale required. Teams need to be supplied with equipment that has been rigorously tested and is accompanied by user guides and troubleshooting action cards. These are all vital components of the pressure control system. How teams work cooperatively and harmoniously and how they are led at an operational level are also key to maintaining optimal levels of pressure and avoiding frazzle.

Pressure Testing

Prior to a high-pressure mechanical system being put into operation, engineers test each part of the pump, each pipe, each valve and each joint to ensure that they have the ability to handle the pressures required. In the context of high-pressure teams, pressure testing means training and personal preparation. Section 4 covers 'pressure testing' emphasising how important it is for individuals and teams to be exposed to controlled levels of high pressure during training.

Preparation for high-pressure situations includes human factors training and teaching people to understand why and how they make decisions and behave under pressure. Predictable tasks and decisions can be repeatedly drilled until they become automatic processes with minimal cognitive demands. This frees up capacity for more complex and nuanced challenges.

Teams can simulate managing complex challenges as a group. These simulation sessions can also be used for 'stress inoculation', where teams are intentionally placed under high levels of pressure and practice strategies for managing that pressure. Each individual member of a high-performance team also needs to prepare themselves for the challenges

they may encounter. This personal preparation can include mental rehearsal, practising positive self-talk, maintaining physical fitness and the ability to manage fatigue and nutritional needs. The provision of clearly defined competencies for each member of the team is essential.

Pressure Relief Valves

Even with the most efficient pressure management systems, accumulations of excessive pressure can occur. We therefore need pressure relief valves for use in emergencies. Teams require the tools to regain situational control and personal composure.

Individuals and team members who find themselves in a state of high-pressure frazzle can use a range of techniques to regain personal composure. These techniques include slow, controlled breathing; cognitive reframing by temporarily exiting the situation and positive self-talk.

Situational control can be regained through rally points to confirm that all members of the team have the same perception of the situation and what action is required, i.e. achieving a shared mental model, making a list of prioritised actions and delegating these appropriately. Other techniques, outlined in this section, include making use of cognitive aids and outsourcing decision-making.

Summary

Supported by first-hand accounts of working with high-performance teams in the most demanding circumstances and environments, this book explains the measures and strategies that can be used in each part of the system from the pressure pump, pressure control, pressure testing stages and then, finally, to pressure relief. This book aims to discuss how pressure affects our ability to process information, make decisions, carry out complex tasks and work effectively as part of a team.

These principles can be applied by any profession, organisation or team members who want to achieve excellence when working in challenging circumstances. Given the right people, the right equipment, the right systems and the right culture, the levels of performance of a team in high-pressure situations can be remarkable.

The book finishes with a description of two critical care retrieval missions, based on my own experiences as a helicopter rescue doctor. The first is my account of my first ever helicopter retrieval. The levels of cognitive load, pressure and risk were excessively high due to the absence of any

pressure management systems. The second retrieval mission took place 20 years later when I was working as the lead consultant of Scotland's Emergency Medical Retrieval Service. Although more clinically challenging, the situation was safely and efficiently managed due to the team's ability to own the pressure.

Pressure is good for performance – if individuals and teams can own the pressure they can attain and maintain a state of optimal performance flow.

Section I
Under Pressure

Chapter 1
Flow, Frazzle and Owning the Pressure

On 31 July 2015, a private Phenom 300 jet took off from Milan to return to the UK. On board was Osama Bin Laden's stepmother and stepsister. When attempting to complete its landing on runway 25 at the Blackbushe Airport near London, the aircraft failed to stop and crashed into a car park. One of the wings separated from the fuselage and the plane was engulfed in flames. All those on board survived the initial impact but died in the ensuing fire.[13]

The causes of the crash were thoroughly investigated by the Air Accident Investigation Branch (AAIB).[14] The crash was judged to have resulted from the actions of the pilot. During the landing, the aircraft took emergency evasive action to avoid colliding with two other aircraft. The plane then started a descent that was too steep and too fast. The target threshold approach speed was 108 knots; however, the jet was travelling at 151 knots. The runway was 1100 metres long, but the plane landed so far down the runway that only 440 metres remained to bring the plane to a halt. With only this distance remaining, a controlled stop was impossible.

The weather was good at the time of the landing and no faults were found in the aircraft. The investigation found that the 57-year-old pilot had experienced a 'very high workload situation' as he made his approach. The aircraft's systems were giving the pilot multiple audible and visual warnings. In total, the plane's systems created 66 messages and alarms in the last three-and-a-half minutes of the flight.

Single-handedly, the pilot needed to fly the aircraft, land and communicate with air traffic control, as well as receive these warnings, process them and act upon them. The report concluded that the pilot's 'mental capacity could have become saturated, impeding his ability to handle new information and adapt his mental model'.

The AAIB report described the pressures on the pilot using terms including 'mental stressors', 'audio overload' and 'mental overload'. It also

stated that the pilot may have become 'fixated on his initial strategy – landing – and lacked the mental capacity to recognise that the approach had become unstable and should be discontinued'.

It appears that the demands placed on the pilot of this aircraft combined to seriously compromise his ability to fly and to land the plane safely. In retrospect, it would have been safer for the pilot to abandon the landing and 'go around' for another attempt. His ability to make this judgement was, however, likely impaired as a result of the pressures he was under.

Each of us has a limited capacity to receive information, make decisions and act upon them. Our cognitive capacity is finite. This is largely due to the limited size of our working memory.[9] The volume of information the pilot received and was required to process, on his approach to Blackbushe Airport, would have exceeded his capacity, leading to a state of cognitive overload. Our limited cognitive capacity, unfortunately, makes us prone to cognitive overload in challenging circumstances.

The pilot's cognitive appraisal and resultant emotional response to the excessive levels of pressure would also have adversely affected his ability to rationally assess the situation and to make accurate decisions. His body is likely to have experienced a fight or flight stress response,[6] which would have impaired his ability to execute the physical tasks required to make a safe landing. Overall, the pilot's performance during the approach and landing phase was likely to have been severely compromised by three factors: cognitive overload, his appraisal of the situation and the stress response produced.

Pressure and Performance

The incident at Blackbushe airport is an extreme example of cognitive overload and the emotional and physical responses created by excessively pressured situations. However, all of us, at certain points in our lives, experience circumstances with pressures that compromise our ability to make the right decisions and take the best course of action. In many of these situations, a failure to make the correct judgement or successfully complete a task can have significant negative consequences. These situations may include predictable events such as job interviews, sitting exams or standing up in front of an audience to give a presentation. Occasionally, some of us are also faced with sudden emergencies that require a state of calmness and control to keep us, and those around us, safe. Examples of these events might include being involved in a road traffic collision, someone nearby collapsing with a medical emergency or an unpredicted event suddenly compromising the function of our business.

Those working within the emergency services, such as first responders and pre-hospital clinicians, frequently find themselves in high pressure situations where they are expected to quickly take action and make decisions which may have significant consequences. If we wish to perform to the best of our ability in situations of pressure, we need to understand how we make decisions, why we behave the way we do when pressured and how our minds and our bodies react to situations we perceive as overwhelming or threatening. We need to recognise when we, or our colleagues, are becoming overloaded and experiencing excessive pressure. If we do develop frazzle, we need to have strategies to regain personal composure and control of the situation.

Cognitive overload

When dealing with these high-pressure situations our brains, unfortunately, have a finite capacity to receive and process information. Our working memory temporarily holds the information required for the decision or task we are currently undertaking.[9] If too much information is being presented to us, our working memory capacity becomes exhausted, leading to cognitive overload, inaccurate decision-making and failure of task completion.

Cognitive overload is more common in situations where information is being pushed to us from multiple sources simultaneously, i.e. when undertaking a task requiring divided attention.

A finite working memory limits our ability to make decisions, plan ahead, complete physical tasks and communicate. Part of the ability to perform under pressure involves regulating the amount and rate of information coming into our working memory, e.g. through the use of cognitive aids and communication techniques.

Cognitive appraisal

When faced with a high-pressure situation, our initial emotional response can make our performance, or it can break it. Our perception of the pressures facing us has a considerable influence over our ability to perform. How we perceive the magnitude of the situation, the risks involved and our personal ability to overcome them is known as cognitive appraisal.[10,11]

A key part of owning the pressure for high performance is understanding how we initially perceive high-pressure situations and how we can manage our resultant emotional response.

In a high-pressure situation it would be ideal if our brains paused to consider all of the information available and then made a rational, objective judgement of what was going on and our ability to deal with it. However, it takes time for the rational processing parts of our brain to assess the situation around us, the magnitude of the challenge and the potential risks involved. Before this objective situational assessment occurs, the emotional part of our brain tends to react almost instantaneously. This rapid situational judgement is a protective mechanism based on comparing the situation facing us with ones we've previously experienced. With limited time for assessment, our initial analysis is based more on an instinctive emotional response than a considered, logical assessment.

When our brains are initially appraising a situation, we subconsciously ask ourselves three questions:

1. What will success or failure mean for me?
2. How big is this problem?
3. Do I have the resources to achieve a successful outcome?

The cognitive appraisal process is almost instantaneous, and we have no conscious ability to control it.

When we are considering the potential outcomes of a pressured situation, we might decide that failure will result in harm to us. This could be reputational, financial or even physical harm. Alternatively, we might conclude that a successful outcome could be beneficial to our well-being.

Next, we subconsciously compare it to our previous experiences. How large is this problem in terms of time and resources required to deal with it successfully? How technically complex is this problem?

Once we have assessed the magnitude of the situation and the potential effects of success or failure, we need to consider whether we have the ability and the resources to deal with what is facing us.

There are two potential outcomes to the cognitive appraisal process. We can perceive the problem to be a surmountable challenge or an impossible to overcome threat to our well-being.

Appraising the situation as a difficult but achievable challenge helps motivate us and improves our performance. We appraise the problem to be large and difficult, but we believe that we have the necessary knowledge, skills and resources to achieve a favourable outcome. Appraisals of challenge help maintain a state of high-performance flow.

We can, however, make a judgement that the situation is overwhelming, exceeding our personal abilities and the resources available to us, i.e. a

cognitive appraisal of threat. Appraisals of threat generate a protective hormonal stress response and consequently, a state of 'fight or flight'.[15,16] This response results in a surge in the release of stress hormones including cortisol and adrenaline. Our bodies physically react to these stress hormones by preparing ourselves for physical conflict or to rapidly extricate ourselves. This state is not conducive to handling complex decision making, effective communication or carrying out fine motor tasks.

An appraisal of threat can be rational, objective and accurate. The problem may truly be too large or too complicated for us, and our team, to successfully deal with using the resources available to us. However, the rapid, initial cognitive appraisal process, based on pattern recognition, is prone to error if the current situation is in fact different from those we have previously encountered. Fearing potential harm, our emotional brain can exaggerate how difficult the situation is and wrongly perceive it to be a threat. Exaggerated and falsely negative cognitive appraisals lead to avoidable compromises in our performance. Recognition of this and an ability to manage our initial emotional response are important for maintaining effective, rational mental processing.

We can't change our initial cognitive appraisal of a high-pressure situation but we can use techniques to manage how we respond to it. Professor Steve Peters is an internationally renowned consultant psychiatrist and sports psychologist. Most notable is the work he has done with the hugely successfully Sky and British cycling teams. He is the author of the best-selling book *The Chimp Paradox*.[17]

Professor Peters describes our brain as being in two parts. There is a rational decision-making part and a part where responses are highly affected by emotions. He refers to the emotional part of our brain as our 'chimp'. The rational part of our brain makes decisions using evidence, uses perspective to objectively assess the situation and makes balanced judgements. It is more likely to arrive at an accurate appraisal. It is, however, slow at doing so. The chimp on the other hand is fast. It is quick to jump to conclusions and is protective to the point of being paranoid. It tends towards catastrophic thinking and makes irrational, emotive decisions. Unfortunately, the information our brains receive from the environment and the people around us goes to the chimp before it reaches our rational brain. The resultant cognitive distortion can push us to take irrational and erroneous actions before we have time to rationally appraise the true nature of the situation facing us.

Peters explains that we are unable to control our chimp. It is, however, possible to understand how it works and to manage its output. He

describes the chimp as giving us suggestions, not commands. With insight and practice we can consider what the chimp is 'telling us', then use rational thinking to decide whether to act upon its suggestions or not. We have to exercise our chimp by letting it run through its immediate response to situations, while waiting patiently for rational processing to start.

The ability to manage our initial cognitive appraisal and emotional response to situations is a fundamental part of owning the pressure. Techniques for managing our emotional response in this way are discussed in Chapter 14, 'Personal Preparation for High Performance'.

Stress Response – Fight or Flight

If we perceive a situation as a potential threat, either appropriately or as a result of an exaggerated cognitive appraisal, our bodies prepare to take defensive action. Our sympathetic nervous system is activated, causing the release of two stress hormones: cortisol and adrenaline.[6] These cause physiological changes throughout our body. The changes prepare us for either a physical confrontation or an attempt to extricate ourselves from the situation, known as a fight or flight response. Sometimes this is the correct response to protect us from harm. As discussed above, however, sometimes the situation isn't as hazardous as we initially perceive it to be and the response is unnecessary and detrimental to our performance ability.

Perceptions of threat cause our hearts to beat faster in order to supply our muscles with sufficient blood and oxygen for sudden movements and prolonged activity, i.e. violence or running. Our breathing rate increases in order to maximise the amount of oxygen entering the blood. Our pupils widen. Our muscles tense. We start to sweat. Our peripheral vision is compromised. Our ability to hear decreases. At extremes, we have a desire to empty our bladder and bowels to reduce weight while fleeing.

These physiological changes are intended to improve our ability to defend ourselves from physical attack and to run away. The changes to our vision and hearing make us focus intently on the danger directly in front of us and prevent us from being distracted by peripheral stimuli. However, these changes are inappropriate for many modern-day situations. For instance, the fight or flight hormones compromise our ability to undertake fine motor tasks due to excessive muscle tension; they make us prone to snap judgements; they impair our ability to make measured decisions and to communicate effectively with our team. Our large pupils and tense, pugilistic posture can make us appear frightened and hostile – which does not inspire confidence and cooperation from other members of the team. The effects on our senses impair our ability to maintain situational

awareness of the environment around us. Stress also compromises our ability to access our explicit long-term memory in order to recall facts.

In cases of extreme pressure, we can completely lose the ability to make decisions, communicate or take in our surroundings. This is known as choking or freezing.[7] Freezing is thought to be an instinctive defensive and coping mechanism when facing an overwhelming threat to our well-being. It may be protective by reducing our ability to feel pain and distress from the situation. Our lack of action in fighting back may cause an attacker to perceive us as not posing a threat, losing interest in harming us. Our lack of movement may also help in camouflaging our position, resulting in us being overlooked by an assailant.

High-performing individuals recognise the early signs of cognitive appraisals of threat and the resultant personal stress responses. They use the techniques discussed in Chapter 15, 'Reducing the Pressure from Frazzle to Flow', to regain personal composure and situational control. They can also recognise stress and frazzle in their teammates and help manage the pressures on them, bringing them back into a state of flow.

The performance arc

Excessive amounts of pressure due to cognitive overload and an appraisal of threat compromise our ability to perform. However, moderate levels of pressure are beneficial to our ability to make decisions, work as part of a team and complete practical tasks.

Two psychologists, Yerkes and Dodson, conducted an experiment in 1908, examining the effects of pressure on mice when placed in a maze.[1] They measured how long it took the mice to reach the centre of the maze. Without any external stimuli, the mice would eventually meander their way to the middle. The researchers then started giving the mice low-voltage electric shocks when they took a wrong turning. This simulated a moderate level of pressure. With low-voltage shocks, the ability of the mice to move quickly to the centre of the maze, taking correct turns, improved. However, when the voltage was increased further, i.e. the stimuli experienced by the mice increased beyond a certain point, the mice began to move around frantically. With high levels of stimulus their behaviour became erratic and their ability to get to the centre of the maze deteriorated.

From this experiment, the theory of pressure and performance has since been developed. Psychologists have created a model similar to that shown in Figure 1.1. This has become known as the inverted U theory or the Yerkes-Dodson law. Some also describe the relationship as an arc.[2] I like

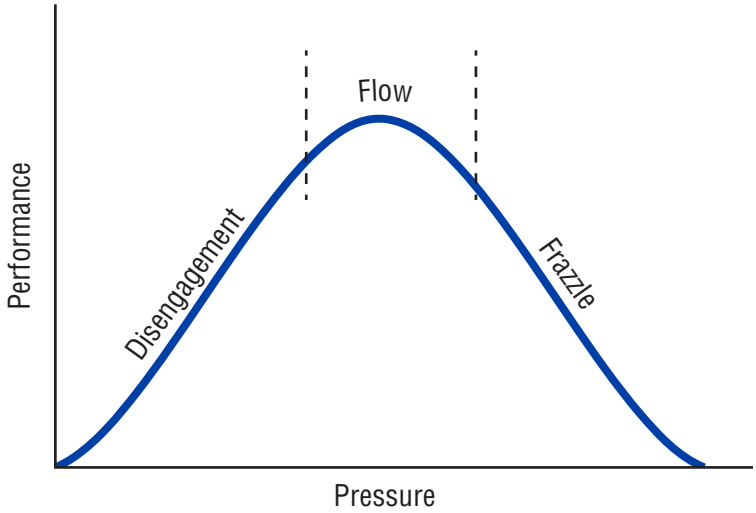


Figure 1.1. The arc of performance.
Source: Based on Yerkes RM and Dodson D (1908) The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology,* 18(5): 459–482.

to think of the graphical relationship of performance and pressure as the arc of performance (Figure 1.1).

Leading psychologist and author Daniel Goleman describes the arc as follows: 'The relationship of stress to performance captured in the Yerkes-Dodson law shows that boredom and disengagement trigger too little of the stress hormones … and performance lags. As we get more motivated and engaged, good stress brings us to the optimal zone, where we perform at our best'.[2]

A comprehensive review of the effects of stress on cognition was published by Sandi in 2018.[18] This article concluded that mild levels of stress improve cognitive function. It was also found that high levels of stress impaired the ability to complete tasks requiring complex reasoning. A study of trainee surgeons by LeBlanc et al. found that moderate levels of pressure enhanced their technical surgical technique under examination conditions.[19] Another study showed that focused attention during task completion was enhanced by increased pressure.[20]

The optimal amount of information requiring processing, tasks to be completed and a perception of the situation as a challenge leads to a state of mental arousal with improved mental ability. Excessive cognitive load, perceptions of potential threat and stress-induced activation of our

sympathetic nervous system are, however, detrimental to our ability to perform in high-pressure situations.[18]

On the performance arc, three states of performance ability in relation to the level of pressure are recognised: disengagement, flow and frazzle.

Disengagement

With low levels of stimulation our ability to perform complex tasks is reduced. This state, on the left side of the arc, is known as disengagement. When disengaged, our stress hormone levels are minimal and we experience low levels of stimulation, motivation and arousal.

This low performance state of disengagement can be applied to individuals, teams and even whole organisations.[2] Maintaining sufficient levels of stimulation and motivation to avoid disengagement is fundamental to maintaining optimal performance.

Flow

With increasing levels of cognitive load and stimulation our performance improves. We become more aroused and our attention more focused. Our mental processing and physical abilities improve. Our decision-making, innovative ability and psychomotor ability increase to an optimal level. With increasing pressure, our minds become engaged with the task in hand. We achieve a state of optimal arousal and optimal performance.[2]

Psychologists refer to this performance sweet spot as the state of flow. The term was first described by psychologist Mihály Csíkszentmihályi in a publication in 1990. He described the state as 'being completely involved in an activity for its own sake. The ego falls away. Time flies. Every action, movement, and thought follows inevitably from the previous one, like playing jazz. Your whole being is involved, and you're using your skills to the utmost'.[4]

This state of high performance with an optimal level of pressure is also referred to as eustress, i.e. good stress. The term *eustress* was first described by Hungarian psychologist Hans Seyle. As an endocrinologist he was interested in how pressure caused the release of hormones such as cortisol and adrenaline and what effects these hormones had on patients.[21]

Systems allowing us to manage pressure to attain and maintain a state of flow are the goal of high-performing organisations. If we have the ability to own the pressure and use it to our advantage, we can achieve high-performance flow.

Flow is when we are professionally at our best. We are capable of making the most accurate decisions. Our ability to undertake physical tasks is efficient, fast and safe. We communicate effectively with the rest of the team and make the best use of the assistance available from our colleagues in dealing with the situation. When we are in a state of flow our abilities to innovate and to plan are at their highest.

Flow is the zone where we, and our teams, strive to achieve the highest levels of performance. The state of flow is a pleasant, even desirable, state of being. It's often the result of years of experience, learning and knowledge acquisition. We know we're handling the problem as well as anyone else in our field of expertise. This performance sweet spot is partly what attracts individuals to high-pressure professions.

Goleman describes our cognitive abilities when in the zone of flow as 'a state of maximum cognitive efficiency. Getting into flow lets you use whatever talent you may have at peak levels'.[2]

Frazzle

Further increases in pressure and cognitive load, beyond the state of flow, however, start to impair our ability. When the cognitive load increases, our limited cognitive capacity is exceeded and we become overloaded. Our brains cannot process the large volumes of information being generated by the situation and we may fail to make accurate decisions.

When the pressure becomes excessive, we can also develop negative emotional responses. In the state of flow, we perceive the situation we are facing as a challenge. With focused effort we see the challenge as surmountable. With increasing pressure, however, our emotional brain starts to change its perception from one of challenge to one of threat. This, in turn, causes the development of a stress, or fight or flight, response.

This state of excessive pressure, cognitive overload and stress is referred to as frazzle. In a state of frazzle, we find it difficult to make accurate judgements, communicate effectively or complete practical procedures efficiently.

When we reach the zone of frazzle our insight into our own psychological state is impaired. We find it difficult to rationally appraise the circumstances we've found ourselves in and may lose perspective of the situation. Without having practised suitable coping strategies in advance, it can sometimes be impossible for us to regain our composure and control of the situation. When we find ourselves in a state of frazzle it is possible for us to develop a negative feedback cycle, i.e. the more overwhelmed

we feel, the greater the physical stress response, leading to a downward spiral in our ability to perform or to regain control.

However, it can be possible for us to manage frazzle with the use of appropriate strategies to regain personal composure and situational control. These techniques are explained in Section 5 'Pressure Relief Valves'.

If we find ourselves in a state of overloaded, stressed frazzle on a frequent basis, this is harmful to our long-term mental and physical health. Repeated episodes of acute stress can lead to chronic anxiety and long-term stress.[22] Acute stress is the kind of pressure we experience on a daily basis as a result of individual tasks or work challenges; however, if these acute stresses recur over a long period of time, they create what psychologists refer to as an allostatic load. Eventually our bodies adapt to these chronically elevated stress hormone levels. As a result, we can develop chronic stress. The quality of our sleep may become disrupted. Our immune system is compromised, and we become susceptible to infection. Over time, our blood pressure can become elevated, which increases the risk of heart disease or a stroke.

High-performance organisations can create systems and cultures that actively prevent their teams from entering into states of high-pressure frazzle. Organisations should endeavour to develop strategies to allow their staff members to regain control and composure if they do move into a state of stress and overload.

Evidence for and against the Inverted U Theory of Pressure and Performance

The nature of the relationship between pressure and performance has been examined and debated by psychologists for many years. There is much evidence to support the inverted U relationship or arc model as described above. Some studies have, however, demonstrated a linear relationship, i.e. increasing pressure and stress incrementally impairs our cognitive function, without an initial improvement in performance. These studies don't tend to support the concept of there being positive benefits of mild to moderate stress.

However, when considering the evidence in favour of the linear relationship between pressure and performance one needs to consider the findings of a large review article, by Muse, Harris and Feild (2003),[23] which was critical of the methodology used in almost all of the experimental studies that were supportive of a linear relationship rather than an inverted U model or arc. In their opinion, the studies supporting the linear relationship were

biased for a number of reasons. First, they found that most researchers neglected to study the effect of low levels of pressure on performance. Second, they were of the opinion that the stress used in many studies had a negative connotation which, in itself, could adversely affect performance in the subjects being studied. They concluded that, 'based on our review we vehemently oppose suggestions to scrap the inverted U theory'.[23]

Firing on All Cylinders – Owning the Pressure

Maintaining a state of flow is dependent on owning the pressure. High-performance organisations achieve the right level of motivational pressure for their staff, avoiding disengagement and frazzle.

Johnny is a Royal Marines Commando. He achieved this status following a gruelling selection process that tested his physical fitness, stamina and discipline. He is also a specialist in firing mortars. These high explosive devices must be fired at enemy positions with exacting precision, always in situations of personal danger and under high pressure. Johnny leads a six-man Royal Marine mortar team. In combat situations the team members need to assemble their equipment in minimal time, often under hostile fire. Pin-point accuracy is crucial when deploying these weapons, even if the team members can't see their target physically.

The consequences of Johnny making an error when under pressure are likely to be catastrophic. He could seriously injure or kill members of his own side. Inaccurately directed mortars have in the past killed friendly forces – a 'blue on blue'. If Johnny's team consistently misses the enemy target, this increases the chances of his marine teammates being killed by the enemy from that location.

Johnny described how he feels when his team members are preparing to fire their mortars in a combat situation. He talked of the imperative to be accurate, and fast. He described the considerable pressures on him and his team in terms of time, risk and decision-making, and of the consequences of failure. With such little room for error, he and his team need to be optimally trained and have the best possible equipment. The mortar team need the best systems of operation. They need to use the pressure positively. Allowing excessive pressure to compromise their performance simply isn't an option.

Johnny and his team of Royal Marine Commandos have been specially selected for their artillery firing abilities. They have spent years training and

drilling. They have their own communication techniques that they use in high-pressure combat situations. Their mortar setup and aiming are supported by a number of checklists and cognitive aids to judge distance and calculate angles of fire. They know that the rest of their colleagues are relying on them, and that the team have got each others' backs. Johnny knows that reaching a state of flow optimises his team's performance. He described this state as 'good pressure': 'You feel focused, intensely focused'.[24]

Developing systems and strategies to own the pressure in the zone of high-performance flow is the key. Not only do training, teamwork and communication play an integral part in combat situations, Johnny's experiences also demonstrate how having an awareness of how varying levels of pressure can place us into the three states of arousal and that this can be crucial for achieving the best possible levels of performance. We explore aspects of how we should best *think* under pressure in the next chapter and how this contributes to reaching our desired state of flow.

Learning points

- Three main factors limit our ability to perform under pressure:
  - Limited cognitive capacity compromising our ability to process information and make decisions,
  - Our initial emotional response or cognitive appraisal prior to us being able to generate a rational, analytical analysis of the situation,
  - Our stress response physically compromising our ability to react appropriately.
- In high-pressure situations our brains have a finite capacity to receive and process information. When the pressure becomes excessive, we can start to perceive the situation as a threat rather than a challenge.
- Our performance in relation to varying pressures can be considered in three categories: disengagement, flow and frazzle. In order to perform optimally our aim is to achieve and maintain a state of flow.
- Flow is achieved with moderate levels of pressure. Moderate pressure can be beneficial. However, excessive pressure compromises our ability to make decisions, communicate and complete high-stakes tasks successfully.

- When the pressure becomes excessive, we can start to perceive the situation as a threat rather than a challenge. We must be aware of cognitive appraisal and how our minds and bodies respond to the perception of threat.
- Attaining flow is about owning the pressure. We can own the pressure through pressure testing, pressure control, maintaining our pressure pump and knowing what our pressure relief valves are.

Chapter 2
Thinking under Pressure

A fundamental element of performance is the ability to receive and interpret information in order to make decisions and carry out physical tasks. To optimise our performance, it is useful for us to understand how we store and recall information. We should also have an awareness of our cognitive capacity. An understanding of how we make decisions in different circumstances is invaluable. This is known as metacognition, i.e. thinking about thinking.

Partly due to our limited working memory capacity, our cognitive ability is not always sufficiently powerful to handle the large amounts of information which need to be managed in modern, high-pressure situations. We are, therefore, prone to cognitive overload. Knowing what type of cognitive processing to use in different situations is important for decision-making efficiency and for minimising the cognitive load we place on ourselves. Mechanisms to control how fast and by what method information is passed to us are also vital.

Many people talk about the ability to undertake multiple tasks simultaneously, but are we really capable of multitasking in challenging situations? It is, therefore, useful to have an awareness of how our brains cope when we are faced with simultaneous decisions and practical tasks.

Implicit and Explicit Memory

It is useful when considering how we make decisions and carry out physical tasks to think about how the information we need to use is stored and how we access it. Memory can be divided into two main types: long-term memory and short-term memory. Long-term memory can be further divided into explicit memory and implicit memory.

A key part of our short term memory in terms of performance is our working memory. We use our working memory when making a decision

or to process information on a particular task we are performing. The original studies examining working memory showed that most of us had the capacity to remember a number with a maximum of only seven digits.[25] This significantly limits our ability to receive information and make judgements when managing complex high pressure situations. This is particularly relevant if the information is simultaneously coming from multiple sources.

Explicit memory is a type of long-term memory that we use to consciously and intentionally recall previously learned information. Two types of explicit memory are episodic memory and semantic memory. When we remember events that have happened to us in the past we are using our episodic memory. Our semantic memory is used for storage of factual information. For example, we use our semantic memory when sitting academic examinations. We actively and consciously recall the information we have learned while preparing for the assessment.

Implicit memory is long-term memory we access subconsciously. It is used for information and tasks we have learned to carry out automatically. One part of our implicit memory is procedural memory. Tying our shoe laces or using the controls of a car are examples of implicit procedural memory.[26]

When we are experiencing high levels of pressure, research has shown that the function of our explicit memory is reduced. This means that our ability to consciously recall facts that we have learned is compromised. Our implicit memory, however, functions more effectively under pressure.[18] When training for high performance it is therefore important to make optimal use of our implicit memory because we can rely on this more than explicit memory when working under pressure. Repeated drilling of practical procedures, or overlearning them, creates an implicit procedural memory for their execution. This means that they can be reliably undertaken, even in high-pressure situations. Similarly, we need to be aware that our ability to recall facts and information stored in our explicit memory will be reduced when we are stressed, hence the need for written cognitive aids.

Cognition and the Modern Age

The human race has been in existence for over 200,000 years. The pace of change in our lifestyles has been relatively slow until recent times. The information presented to us and our cognitive demands has also been relatively low. However, over recent decades the amount of information we are subjected to has increased significantly. One study of 2,000

smartphone users carried out in 2014 showed that, on average, they used their devices 221 times every day.[27]

Dr Richard Byyny discusses this in his paper 'Information and Cognitive Overload: 'We are in an age of information overload. The internet, emails, apps, spam, tweets, social media, texting, Facebook, Instagram, memes, news feeds, online videos, updates and myriad other forms of information have significantly increased the information directed at us, as well as those in which we request to participate'.[28]

For the first 199,000 years of our time here on earth the volume of information we needed to process, and the complexity of our decision-making, was relatively basic. Most high-stakes decisions were binary judgements: when facing attack by the neighbouring tribe do I run away, or do I stand and fight?

It is only in the past few hundred years that decision-making has become more complex. With the invention of electricity, supercomputers and heart transplants, there has been a sharp increase in what we expect of our brains in terms of data processing and cognition.

In modern times we are faced with very different challenges and pressures: the volume of information available to us has increased hugely; the amount of data we receive that requires processing has risen exponentially; the tools and technology we use are increasingly complex.[29] Expectations placed upon us in terms of performance are also different – the measure of success is no longer simply survival. The rate of development of these pressures has outstripped our ability to evolve and develop our cognitive performance abilities. Arguably, our brains are not yet optimally configured to deal with modern high-pressure situations, such as landing a jet aircraft single-handedly in the midst of a complex emergency.

Similarly, the way we responded emotionally to the world around us was, historically, effective in protecting us from physical harm. We were able to sense danger almost immediately and to react to it instinctively. These emotional responses and stress reactions have been invaluable in keeping us safe from predators and physical attack. We are primed to protect ourselves from risky situations. We instinctively perceive some situations as threats and react to them without the need for conscious, rational thought.

These instinctive emotional reactions can, however, lead to physiological and psychological changes that are detrimental to our ability to deal with the complex, pressured situations we are faced with in modern professional life. They can compromise our ability to deal with challenging

situations that require calm, rational decision-making and fine motor skills for task execution.

In order to manage high-pressure situations effectively we need to understand how to make the best use of our brain's limited cognitive capacity. We should also be aware of which type of decision-making process we are using, and which type is the most efficient for differing situations.

Thinking, Fast and Slow

We tend to take the path of least resistance and time when it comes to thinking, making judgements and arriving at decisions. It is beneficial in evolutionary terms to be able to process information and act upon it with minimal use of our limited cognitive capacity and in the shortest time possible. When prehistoric man was facing attack by a sabre-toothed tiger, if he stood and consciously thought about the options for evading the attack before deciding upon a course of action he would have been eaten before he could process the information and make a judgement.[7] Our brains have, therefore, developed the ability to perceive potentially dangerous situations instantaneously and react almost immediately.

In complex, high-pressure situations, however, this type of reactive, instinctive processing can frequently lead us into erroneous judgements and decisions, and into taking the wrong actions. These situations call for a slower, more measured and considered type of decision-making.

How we process information and make decisions can be divided into two main types of thinking: fast, intuitive, automatic thinking and slow, considered, analytical thinking. Daniel Kahneman's book, *Thinking, Fast and Slow*,[12] describes how we use these two cognitive processing methods.

Automatic processing

High performers are aware of when it is best to allow rapid, automatic processing to handle familiar, low-risk situations and when it's necessary to switch to considered, analytical thinking for nuanced and high-stakes circumstances. They know the strengths and weaknesses of each type of processing.

Our brains make most judgements based on experience of similar situations that we have encountered in the past. We recognise familiar patterns of incoming information and react to them in an instinctive manner: I've experienced this situation before, the problem is 'x' and the correct course of action is 'y'.[12]

This decision-making method is known as automatic and intuitive processing. It is fast and consumes very little of our cognitive capacity. In the majority of situations, this method of processing brings us accurate decisions and the correct course of action. For routine, low-risk tasks it's an ideal method of thinking. It is very useful and efficient for familiar situations we have experienced multiple times before.

As well as for decision-making, automatic processing is also useful for undertaking repetitive and low-risk physical tasks. Repeating and drilling the tasks over and over again allows us to complete them automatically using our implicit procedural long-term memory.

Automatic processing for decision-making is, however, prone to error. These errors are due to the fact that we are inclined to assume that the current situation is identical to the previous situation we have encountered and dealt with by taking a certain action. If information from the current situation doesn't completely fit with the previous situation we tend to instinctively and subconsciously ignore that incongruous information. Unfortunately, this can lead to us making the wrong judgement. Automatic processing tends to ignore ambiguity in the information we receive.

Analytical processing

In challenging situations, when the consequences of misjudgement are more serious, it is hazardous to rely on error-prone automatic processing for decision-making. For complex and unfamiliar problems, analytical or controlled decision-making is crucial. Information is carefully gathered, options are consciously evaluated and a conscious decision on the action to be taken is made. In doing so we also make use of our explicit long-term memory.

The incidence of errors with analytical, controlled processing is lower as we carefully carry out an assessment of the risks of each option. We also analyse each piece of information available to us to ensure that we are not inaccurately judging the situation due to decision-making traps called cognitive biases (see Chapter 3, 'Back Pressure – Barriers to High Performance'). Information that appears ambiguous and inconsistent is carefully scrutinised and clarified.

Analytical processing, although accurate, is slow and highly demanding of our limited cognitive capacity. This leaves little or no spare capacity for other decisions and tasks. For example, when landing at the scene of a car accident, helicopter ambulance pilots recognise that they will need to engage analytical processing. They must focus on the terrain around them, the position of the aircraft, the wind direction and the aircraft's controls. They have no spare ability to process any additional information that is

not required for completion of the landing. In advance of commencing the approach, they recognise that they are likely to become task fixated and let the rest of the crew know that they are going to be fully focused on the landing. They refer to this as 'going heads in'. They also request that a sterile cockpit is established – the sterile cockpit rule refrains the crew from non-essential activities during critical stages of the flight and stops unnecessary talk and distractions in the helicopter. The pilot's full cognitive capacity can then be used for analytical processing of the landing site and to control the aircraft.

Automatic or analytical?

In routine, low-stakes and low-risk situations, the speed and minimal demands of automatic thinking make it an ideal way for our brains to process information. In these circumstances, although there is a greater chance of error, using this method of thinking is worth the risk. In high-stakes situations, when errors can lead to serious adverse consequences, this processing modality carries too much risk. In these situations, analytical processing is necessary to maintain safety.

For many tasks it is possible for us to practise and adapt our processing modality from analytical to automatic. When we initially learn to drive we have to consciously think about what our feet are doing with the pedals, which gear we are in and what is happening on the road around us. All of our cognitive capacity is taken up processing this information and deciding what action to take. This is a typical example of an analytical processing task. Over time, with repeated practice, our driving performance largely becomes an automatic process, allowing us to drive the vehicle without conscious thoughts. Less cognitive bandwidth is used, leaving us with the capacity to listen to the radio or speak to a passenger.

Metacognition and Multitasking for Performance

Processing multiple tasks

In high-pressure situations it would be ideal if our brains could process multiple decisions and tasks simultaneously. Unfortunately, the great majority of us are unable to multitask. What we actually do is rapidly alternate between separate tasks.[9] This can give the appearance of us doing more than one thing at once, but actually we are focusing attention on one task for a short period before moving on to the second task and then back to the first. This rapid alternation between multiple tasks is

prone to error. It also takes longer to undertake two tasks by alternating between them than to complete each one in series. This is due to time spent repeatedly refocusing our attention. This is especially the case if the tasks are novel, complex or similar to each other.[9]

When we alternate between two tasks, in addition to the cognitive demand of both tasks, we have a third demand of coordinating the processing of the two tasks. This further limits our ability to deal with complex, high-pressure decision-making and task completion.

Even when two demanding tasks are undertaken separately, one after the other, the ability to deal with the second task immediately after the first is impaired. When we are focused on one problem the brain suppresses information coming in from the second stimulus. This delays and compromises our ability to move on to handling the second task. We have limited ability to engage with two complex tasks in quick succession. Psychologists call this 'attentional blink'.[9]

A very small proportion of the population do, however, have the ability to truly multitask. One study, which examined the ability of people to drive a car and talk on a mobile phone at the same time, found that 2.5 per cent of the 200 people tested were able to do so with proficiency. The authors of the study termed these individuals 'supertaskers'.[30]

Rapidly alternating between tasks is more efficient if they only require automatic processing. One of the solutions for improving our ability to deal with situations involving high cognitive demands is to transform the execution of some tasks from demanding analytical processing to automatic processing. This is done by identifying predictable tasks, detailing the various steps in their completion and repeatedly drilling them during training until we are able to complete them automatically. This is also known as overlearning.[31] Although most of us can't truly undertake multiple tasks simultaneously, with practice our brains can more efficiently alternate between a number of automatically executed tasks.

The more tasks we can render automatic and intuitive through drilling and practice, the more we can achieve while still only consuming minimal cognitive capacity. Repeated practice through drilling and simulation is a key component of reducing pressure and improving individual and team performance.

Metacognition and performance

Individuals experienced in high-pressure performance should have insight into how they process information arising from the challenges facing

them. They should have awareness of the tasks that can be efficiently and safely managed with automatic processing. They also need to know which decisions need a slower, more methodical analytical approach. This awareness is known as metacognition, i.e. thinking about how we think. High performers know when they need to switch between processing modalities to maintain safety and efficiency.

The skills of metacognition can be developed through simulation accompanied by expert debriefing and coaching. Performance can be improved by repeatedly drilling predictable tasks in order to develop automatic processing that carries a lower cognitive load.

Learning Points

- We have two main types of decision-making – fast, intuitive, automatic processing and slower analytical processing. Each has strengths and weaknesses in differing situations.
- High performers understand when to use each type of cognitive processing and are able to switch between the two, depending on the type of task they are dealing with. Being aware of the different modalities of thinking is known as metacognition.
- Very few of us can truly multitask. Serial task management is more effective than switching between various tasks.
- Training and drilling can transform procedures which require analytical processing to those which need only automatic processing.

Chapter 3
Back Pressure – Barriers to High Performance

Our ability to make decisions and carry out motor tasks can be impaired by a wide range of factors. This chapter highlights some of the barriers that can impede our effective decision-making cognitive processes. For example, cognitive biases can lead us to judge situations incorrectly and take the wrong course of action. Fatigue and environmental conditions can seriously compromise our cognitive, physical and communication abilities. Interruptions also render us prone to making errors, especially during prolonged tasks.

Awareness of these challenges helps us prevent them from affecting our performance and compensate for them if they do occur. If uncontrolled, these issues can contribute to individuals moving into a state of excessive pressure and frazzle.

Cognitive Biases

Awareness of how cognitive biases affect our judgement and decision-making when under pressure is crucial for high-performance teams. An extensive review of cognitive biases and their effect on military performance by the US military in 2015 stated, '… it will be critical for the Army to train, educate and develop its personnel to understand and cope with these cognitive biases appropriately'.[32]

James was a 40-year-old smoker. He ran a small distribution company. One day, after moving some heavy boxes from his storage unit to his van, he developed pain in his left shoulder. The pain became progressively worse, so he called an ambulance. The paramedic assessed James and carried out a heart tracing ECG. The paramedic interpreted the ECG as being normal, and told James that the pain in his shoulder was a muscular strain caused by lifting, advising him to take painkillers. James took some co-codamol tablets he had been previously prescribed for back pain.

A few hours later, James still had pain in his shoulder. He was also feeling nauseous. His wife took him to the emergency department at the local hospital. There he was assessed by a triage nurse. This is an experienced nurse who has the responsibility for making an initial assessment of the patient's condition and deciding how urgently they need to be seen by a doctor. In the UK, triage nurses allocate each patient a triage category, or grade of urgency, ranging from 1 to 5. Triage category 1 means that they are critically unwell and need to be seen by a senior doctor immediately. Category 5 means that their condition is minor, and they can safely wait for an extended period of time before being seen. The nurse also allocates an area of the department where the patient will be assessed. This can range from the minor injuries area, through majors (abdominal pain, heart problems, seizures, etc.) to the resuscitation room.

James told the triage nurse that a paramedic had assessed him earlier and had made a diagnosis of a muscular strain. The nurse listened to the history provided by James and placed him in the queue to be seen in the minor injuries area of the department. The nurse allocated James a triage category of 4. A triage category of 4 indicates that the patient's condition is not urgent and is most commonly used for musculoskeletal injuries. The nurse didn't measure James' vital signs or request a further ECG.

An hour later, James was seen in the minor injuries area of the emergency department. The junior doctor who came to see him was on duty for minors that day. He had already seen ten patients with wounds, ankle sprains and broken wrists. As well as James, he was caring for two other patients at the same time. Before going to see James, he read on the front of his card that he was a category 4 patient and that he had developed shoulder pain lifting boxes. When the doctor came to see James he was sitting in a chair and was fully dressed.

The junior doctor took a thorough history from James, noting his pain, the precipitant of the pain and his nausea. The doctor also made a diagnosis of a muscular strain. He attributed James' nausea to a side effect of the co-codamol he had taken earlier. Being aware that shoulder pain can be a symptom of angina or a myocardial infarction (heart attack), the doctor obtained an ECG tracing. This showed some subtle abnormalities, but was not clearly diagnostic of heart disease.

The junior doctor discussed the case with a more senior colleague and showed her the ECG. The junior doctor had been with James for 20 minutes. He summarised the case to his senior colleague in two minutes. The senior doctor agreed with his diagnosis.

James was discharged with more painkillers and a diagnosis of a muscular shoulder injury. Two hours later, he collapsed at home in a state of cardiac arrest due to heart disease, which had been misdiagnosed.

Ideally, we would accurately and objectively interpret all of the information available to us when making decisions and judgements under pressure. Unfortunately, however, our minds can subconsciously misinterpret or even ignore some of the information that is being presented to us. These 'cognitive biases' frequently lead to errors and are common causes of compromised performance, especially when operating under pressure.[8] Examples of cognitive biases include the priming effect, anchoring bias, confirmation bias, framing bias, availability bias, the Dunning-Kruger effect and the serial-position effect.

Decision-making errors due to cognitive biases are particularly common in high-pressure situations where we are forced to make judgements and decisions based on information that is incomplete, inaccurate and constantly changing. This is made worse by having to make decisions within limited time periods or when fatigued. When we have less time, we often don't have the opportunity to actively seek out all of the information that is available, or to clarify ambiguous data. This leads us to making decisions based on partial and misinterpreted information. Similar to automatic processing and emotional appraisal, to minimise time and cognitive workload, our minds also tend to 'jump to conclusions' without appraising the full facts. This predisposes us to making errors arising from cognitive biases.

Priming effect

Our thoughts and perceptions of a situation even before it happens or before we become involved can influence our emotions and judgement. Thinking back to the earlier case study, in James' case, the junior doctor had been rostered to see minor injuries for the duration of his shift. This will have influenced how he would have judged problems presented to him during that shift and while working in that area of the department.

The triage nurse's initial judgement led to priming bias affecting the junior doctor and his senior colleague's judgement. Seeing a patient in the minor injuries area with a triage category of 4, the doctor understandably perceived the problem to be a minor one, even before they entered the consultation room. If the nurse had thought that a heart problem was likely with James' symptoms, he would have been placed in the majors area of the department and be seen by a doctor who was on shift that day dealing with more serious problems. He would have been undressed before the doctor saw him, had his vital signs measured and would have

had a repeat ECG tracing. This may have improved the chance of an accurate diagnosis being made.

Priming bias is a particular risk for emergency responders as they travel to the scene of an incident. If emergency responders think the situation will be serious and may have a negative outcome, this can affect their perception and their behaviour on arrival. Alternatively, if we think that the situation will be minor, or even a false alarm, but it is in fact a serious incident, there will be a delay before reaching a state of optimal performance as we reappraise the situation and change our perception. It takes time to move from a state of disengagement to one of flow. The priming effect can compromise our assessment and our performance in the initial stages of challenging situations.

Anchoring bias

When we are presented with a problem in which another person has already been involved, it is useful for us to find out what their interpretation of the problem is. This, however, leads to a tendency for us to agree with their assessment. We 'anchor' to their judgement. This is known as anchoring bias. Anchoring bias occurs when we place too great an emphasis on a single piece of information which was made available to us at the start of an encounter.

Anchoring bias can cause a failure to objectively consider all of the evidence subsequently available.

Anchoring bias is a common cause of misdiagnosis in emergency medicine. The emergency physician is the person with ultimate responsibility for making a diagnosis and prescribing the right treatment for patients. However, as in James' case, the patient has usually been assessed by a paramedic and a triage nurse prior to the doctor seeing them. The paramedic's diagnosis influenced the judgement of the nurse and, in turn, this affected the decision-making of the two doctors. Each clinician's opinion was influenced by the people who had already made a clinical judgement about James' symptoms. This is also known as diagnostic momentum.

Framing effect

Similarly, placing James in the minor injuries area and labelling him with a low triage category set the scene for a number of cognitive biases that subsequently adversely affected his care. Placing a patient in the minor

injuries area contextualised the situation for the doctor. This led to a decision-making bias known as the 'framing effect'. James was presented, or framed, to the doctor as having a minor injury. This strongly influenced their subsequent judgement of his condition. It lowered the chance of the doctor considering the patient's symptoms to be due to a more serious condition.

The junior doctor took a history from James and examined him for 20 minutes. He then sought advice from a senior emergency physician. He summarised his findings and provided his opinion with regard to the diagnosis and treatment plan in a couple of minutes. It is likely that the junior doctor was seeking ratification of his judgement from his senior colleague. There is a natural tendency for the content of his description of James' symptoms and signs to concentrate on features that supported his judgement of muscular strain. Based on the information provided, this would have led to the senior doctor being less able to make an objective judgement. How the junior doctor framed the situation biased the judgement of his senior colleague.

Confirmation bias

Confirmation bias occurs when we make our mind up prematurely about the cause of a problem. We may continue to receive further information about the situation, some of which is not consistent with the diagnosis. However, confirmation bias causes us to subconsciously discount this additional information because it doesn't fit with our existing assessment.

In James' case, if the doctors had not been influenced by the opinion of the preceding clinicians and had considered heart disease to be a likely cause of his symptoms, they would have examined his ECG tracing in detail. They would have been actively seeking an abnormality in the tracing to support their clinical judgement. However, as they had already judged the problem to be a minor one, unrelated to his heart, they placed less emphasis on his ECG. As a result, the minor changes in his heart tracing were ignored as they were incongruous with their diagnosis. Despite having an abnormal ECG, James was misdiagnosed partly as a result of confirmation bias.

Nausea is a symptom of angina and a heart attack and not usually associated with a muscular strain. Objectively, the doctors should have considered whether James' nausea was a symptom of heart disease. However, they ascribed it to being a side effect of co-codamol.

Availability bias

We can also make errors in our assessment of problems due to availability bias.[33] This happens when we associate what we see with previous similar experiences, especially recent ones. We conclude that the problem is the same as the previous one, which superficially appeared to be the same.

In emergency departments, muscular strains are very common. Heart attacks are much more infrequent. Especially as the doctors who cared for James had been exclusively seeing minor injuries prior to his arrival, availability bias was likely to have affected their judgement about the true nature and severity of James' condition.

The serial position effect

Another error trap when working in teams and receiving verbal or written information from another individual is the order effect or serial position effect. As humans, we have a tendency to focus and put weight on the things that are at the start of the communication and at the end.[34] We pay less attention to information in the middle. Structured briefing and communication methods help reduce the risks of the serial position effect. This is discussed further in Chapter 9, 'The High-Performing Team'.

Cognitive biases and decision-making under pressure

How information about a problem is presented to us and the setting it is presented in are critical to how accurately we make judgements and decide on courses of action.

In my experience as an emergency medical consultant, I have, on previous occasions, been instructed by solicitors who sought an opinion on the standard of care provided in a number of alleged medical negligence cases where patients with life-threatening illnesses have, unfortunately, been misdiagnosed as having a minor condition due to a series of cognitive biases. Sadly, a number of patients were discharged who later died. No individual involved was incompetent or not trying to perform to the best of their ability. Unknown to them at the time, cognitive biases had, unfortunately, altered their judgement and decision-making ability. Awareness of these biases and insight into when we are most at risk of falling prey to them helps to reduce the negative effects on our performance.

When operating in high-pressure situations we are *all* prone to errors due to cognitive biases. As a result of our natural tendency to make

judgements based on recognisable patterns and the influence of other people's opinions, we are susceptible to making errors. An awareness of the effects of priming, framing, anchoring, availability and confirmation biases is essential to avoid significant errors in challenging situations.

Minimising the effect of bias traps

If these bias traps are all around us, how can we try to avoid them and minimise their effects on our decision-making under pressure?

Simply being aware of the existence of cognitive biases is effective in reducing their impact on our decisions and judgements. Being aware of what circumstances make us prone to each type of bias error is useful. A team which is familiar with the relevant terminology will also help us to be aware of the potential pitfalls and when to be especially vigilant. This knowledge can be re-enforced by discussing bias traps during debriefs. We should continuously ask ourselves: Did we fall foul of any bias traps during that last task? Were there any times when we were at risk of making an error due to a cognitive bias? Bias traps should also form part of any root cause analysis following a significant event being reported. The importance of debriefing and feedback in optimising performance is also covered in Chapter 13, 'Simulation and Competency Assessment'.

There is, counter-intuitively, an argument that having more experience makes us more vulnerable to many types of bias trap. This is because experts are more likely to make use of automatic processing when dealing with what appear to be familiar problems. This rapid decision-making, with minimal information, means we are less likely to probe deeply and actively consider other options. When we are in situations we recognise as being bias prone, trying to move from automatic to analytical thinking is more likely to detect potential errors. Metacognition can reduce errors due to cognitive biases.

It is effective to ask other members of the team to cross-check your decision-making, your calculations and the safe completion of practical procedures. Another useful strategy is for you and the rest of the team to ask disconfirming questions. Once we've assessed a problem and reached a decision, it's easy to look at additional incoming information and to tell yourself that this new information supports or confirms your original assessment. However, what is more effective in preventing bias traps is to consciously ask yourself, 'Does this *not* fit with the mental model I have? Is this information *not* consistent with my diagnosis of the issue? Would I normally expect this new information in this scenario?'

If you are working as part of the team, encouraging other team members to verbalise disconfirming questions is likely to be more fruitful than having an internal dialogue with yourself. It's good practice to build in planned times to ask these types of questions during rally points or 'cognitive pauses'. For example, in an emergency medical retrieval setting the team members do this before anaesthetising patients. The pre-anaesthesia checklist prompts the team leader to discuss the interpretation of the patient's condition and the need for anaesthesia with the rest of the medical professionals involved.

Building bias traps into simulation can also be effective in increasing awareness among the team, improving communication as a mitigation tool and practising techniques to reduce decision-making errors.

Bias traps are a common source of erroneous decision-making when working under pressure.[8] Their effects can be minimised by awareness of their existence and the relevant terminology, being conscious of when analytical processing is required and cross-checking of decisions during rally points. Teams can become more familiar with the various types of cognitive biases by including them in simulation training and in debriefs.

The Dunning-Kruger Effect

A further potential issue, especially when working with individuals who are unfamiliar to you, is the Dunning-Kruger effect.[35] This describes the fact that inexperienced individuals tend to overestimate their abilities. This is also known as unconscious incompetence. The effect can be due to novices having had little or no experience of decision-making error or task failure. Their ability to assess risk and judge how much confidence they should have in their evaluation of certain situations is limited, leading them to underestimate the severity of problems and try to undertake procedures that they are not competent to handle.

Incompetence of this kind also affects other members of the team who are reliant on the person's judgement in order to make their own assessments, leading to diagnostic momentum further down the line. In high-pressure situations, these inexperienced individuals may communicate their opinion regarding the situation with considerable confidence and credibility. This easily leads to the severity of the problem being underestimated and the wrong course of action taken. Similarly, they may be happy to be delegated a task they don't have the expertise to complete.

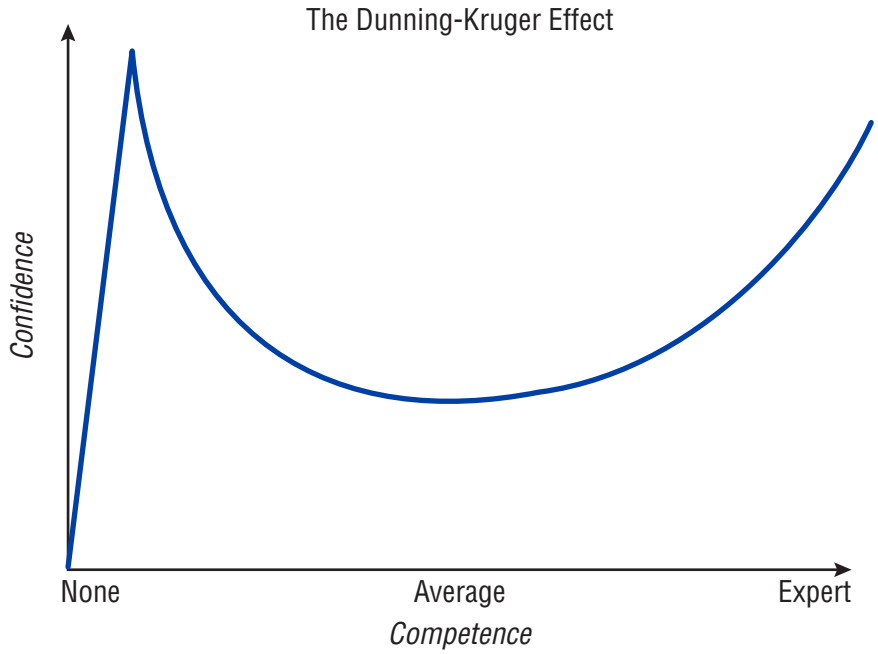


Figure 3.1. The Dunning Kruger effect.
Source: Kruger J and Dunning D (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77(6): 1121–1134.

In high-risk engineering disciplines, especially the aviation, nuclear and oil and gas industries, it is essential for the ability of engineers to be assessed for each individual task they have to undertake. Every part of a safety critical procedure is carefully detailed. Formal assessments of competence to complete the task are carried out in simulated environments. Only then can the task be delegated to that person. In high-stakes situations we need to have confidence that those we are delegating tasks and decisions to actually have the competence to see them through successfully.

Fatigue

Prolonged periods of activity or unpredicted emergencies during the night are frequent in military, rescue and medical practice. The resultant sleep deprivation, both acutely and chronically, affects our ability to perform.[36,37] A review of all US naval mishaps from 1990 to 2004 found

that fatigue was the most common contributory factor.[38] Similar studies of medical errors in hospital have shown significant increases in error rates when staff were sleep deprived.[39]

Sleep deprivation and poor sleep quality significantly impair our cognitive and physical performance.[40] Psychologists describe two types of sleep deprivation. Acute total sleep deprivation occurs when we experience a prolonged period of being awake. Chronic partial sleep deprivation occurs when we have a number of nights with poor quality sleep or sleep periods that are shorter than we need.

The need for sleep is driven by two processes: homeostatic and circadian.[41] Homeostatic mechanisms create the need for sleep as periods of wakefulness increase. Circadian rhythms, the body's in-built clock, alter hormone levels at different times of the day, which create feelings of tiredness or wakefulness.

A study of US Navy Special Forces SEALS revealed that fatigue adversely affected a number of cognitive functions, including visual vigilance, reaction time and alertness.[37]

When fatigued, an overall reduction in alertness and attention is related to frequent, brief moments of inattentiveness or micro sleeps. These are more likely during prolonged, simple and monotonous tasks such as driving or monitoring a set of machine controls. Fatigue also has the effect of impairing the function of selected parts of the brain. The decrease in function in these areas has been demonstrated on functional magnetic resonance imaging. The frontal lobes are particularly vulnerable to sleep deprivation. Functions of the frontal lobes include attention and the short-term working memory, which are both important for performance of complex tasks.

Fatigue has the following effects on our ability to gather information, make decisions and carry out physical tasks.

- **Auditory and visual attention:** Our ability to detect, listen to, see and process information passed to us verbally and visually is impaired.
- **Selective attention:** The ability to concentrate and focus on individual tasks becomes poorer.
- **Executive functions:** The frontal cortex of the brain is responsible for controlling the brain's function when shifting between different tasks. This involves moving attention from one task to another and inhibiting information that isn't required for the task in hand. The brain's ability to shift from one task to another is compromised with sleep deprivation.

- **Decision-making:** Sleep deprivation reduces our ability to reason and make decisions. Fatigue has been shown to reduce our ability to recognise and respond to increasing complexity in decision-making. Innovation, the ability to create new behaviours and responses based on experience, is also impaired. Therefore decision-making becomes more rigid when we're tired.
- **Emotional processing:** Changes in facial expression are less easily recognised and understood by subjects who are tired. When given a range of solutions to interpersonal problems and conflict, fatigued individuals will tend to take the path of least resistance.
- **Risk taking:** Fatigued individuals have a reduced ability to assess risk and are more likely to undertake activities and make decisions that involve risk of harm.
- **Planning:** Studies in military subjects have shown that when given complex tasks that require planning, their outcomes deteriorated when they were tired and the time to complete the task lengthened.
- **Memory:** Tests have shown that our capacity to develop short-term, working memories that are required when undertaking complex tasks is poorer in those who are not adequately rested. This resulted in a higher frequency of errors being made. We are also poorer at retrieving information we already have stored in our long-term memories.
- **Insight:** Our ability to assess how well we are performing is impaired when we are sleep deprived. Our ability to pick up errors also deteriorates. Some studies have shown increased confidence in producing answers to problems. One experiment showed higher confidence when the answer was wrong than when it was correct![42]

What causes fatigue?

It's not simply the duration of being awake that leads to fatigue-induced performance impairment. Activity levels during the period of deprivation also play a significant part. Physical and mental exertion for prolonged periods add to levels of tiredness. Members of the EMRS are on call for 24-hour periods. They spend a 10-hour day shift on base and are then on call for 14 hours over night. Levels of fatigue are greater when called out overnight if they have responded to emergency calls during the day, when compared to days when they've had no daytime activity.

The timing of the activity is also an important factor. Following a period of sleep deprivation, completion of a task in the middle of the night is

more challenging than completing it during the day, even after the same period of being awake. This is due to the effect of our circadian rhythms. Our circadian rhythms are our internal body clocks and are controlled by a part of our brain called the hypothalamus. On a 24-hour cycle, our hypothalamus prompts us to sleep at the end of the day and wake in the morning. It is also our circadian rhythms that cause us to experience jet lag when moving between time zones.

Studies have shown that the amount of sleep required by different people to maintain a state of alert wakefulness differs.[40] They also show that people have differing susceptibility to sleep deprivation. There is some evidence to suggest that sleep deprivation is better tolerated by older people – cognitive function deteriorated further with fatigue in younger subjects. People who are physically fit are also less susceptible to impaired performance with sleep deprivation. For those of us involved in aviation, aircraft noise, vibration and flying in unpressurised cabins also adds to fatigue levels.[43]

Fatigue calculators

Having insight into the fact that we are fatigued is essential when deciding to undertake complex or hazardous tasks. Being able to objectively assess the degree of fatigue would be ideal. This is especially important as, paradoxically, our ability to judge our level of tiredness and cognitive impairment is compromised when we're tired.

Fatigue calculation tools aim to objectively assess whether we are in a fit state to undertake tasks. A number of fatigue calculators are used in military and aviation settings. These tools attempt to objectively quantify the level of our fatigue and suggest how our cognitive function may be impaired according to how tired we are. The calculators consider factors such as how much sleep we have had in the preceding days and how long we have been awake for. Using this information, our level of fatigue can be quantified.[36]

It's not uncommon in the EMRS to be approached about undertaking a prolonged, medically complex aeromedical retrieval when they have been on duty for a prolonged period. Using a fatigue calculation tool allows the team to objectively assess whether they are in a fit state to undertake the retrieval mission and care for the patient safely.

How to cope with fatigue

There may be merit in training ourselves for fatigue. This training is akin to stress inoculation and is commonly used in the military. During

training exercises, military personnel are intentionally sleep deprived to induce fatigue. They develop awareness of the signs of fatigue in themselves and their colleagues. They also develop insight into how their decision-making, risk assessment, judgement and physical capabilities are affected.[44]

If we anticipate a period of acute sleep deprivation, how can we prepare for it to minimise the effect on our performance? Taking a 90-minute nap in the afternoon preceding a night without sleep allows us to experience one full sleep cycle. This goes some way to replicating the benefits of a full night's sleep. Sleeping for only 30 to 90 minutes means we are likely to wake when in a deep phase of sleep and for us to gain significantly less benefit.

A period of exercise in the day preceding an all-night period of work is also beneficial in maintaining alertness, as is adequate hydration and ingestion of foods rich in protein. It's tempting to ingest carbohydrates to boost blood sugar levels. This is beneficial for short periods, but results in insulin release that can have a sedative effect. Caffeine, used in moderation, is beneficial as a stimulant to boost wakefulness and alertness. The US military examined the effect of caffeine on fatigue and concluded that: 'Even in the most adverse circumstances, moderate doses of caffeine can improve cognitive function, including vigilance, learning, memory and mood state. When cognitive performance is critical and must be maintained during exposure to severe stress, administration of caffeine may provide a significant advantage. A dose of 200mg appears to be optimal under such conditions'.[37] Restricting caffeine use in the period before a potential sleep deprivation renders us more responsive to the beneficial stimulant effect.

If we do find ourselves sleep deprived, but still having to perform to a high standard, there are a number of contingencies we can employ. If it's possible, taking a 20- to 30-minute nap is helpful in reducing fatigue and improving our cognitive abilities. If we sleep for less than 30 minutes we are less likely to enter a deep sleep phase. If we do, due to sleep inertia we will wake up feeling more tired and cognitively impaired than we were before we went to sleep.

Fresh, cool air, bright lights and short periods of light exercise are also beneficial. If we are working as a team it's important to let our colleagues know that we are fatigued. This allows cross-checking of decision-making and task completion.

Experiments have shown that in emergency circumstances, or when given warning of an impending task, the brain can make an active effort to succeed in the task when its function is impaired by sleep deprivation. This is known

as attentional focusing. This can be seen on functional magnetic resonance imaging scans as increased thalamic activity to maintain alertness.

We must ensure we take the opportunity to fully recover from periods of acute or chronic sleep deprivation. Sleep following a period of deprivation is called recovery sleep.[45] The quality of recovery sleep is better than normal sleep. Periods of light sleep are shorter, and the duration of deep REM sleep is greater. Recovery from chronic sleep deprivation takes longer than from acute deprivation. Research evidence on how our cognitive abilities recover from sleep deprivation is not strong.

Organisations should regularly review their shift patterns, staffing numbers and timing of their activity to identify circumstances when fatigue is likely. Periods when individuals do work for excessively long periods should be audited. Instances of fatigue should also be recorded in post-task debriefs.

Interruptions

When completing complicated tasks and decision-making under pressure, our attention should ideally be focused on processing information and completing each consecutive step in physical procedures. Interruptions and the resultant divided attention in these processes adversely affects our performance.

A study by K. M. Kellogg,[46] carried out in a United States level 1 trauma centre, showed that emergency physicians were interrupted 15 times every hour. That's once every four minutes. For 85 per cent of the time, interruptions were due to personal approaches and the remainder were phone calls. When one considers that these doctors undertake an average of 114 tasks and decisions per hour, it's obvious how interruptions can lead to error and compromised performance. Interruptions when processing information or running through a mental list of actions is likely to cause steps to be omitted and information to be misinterpreted.

As described earlier, during periods of high cognitive load and risk, pilots ask for a 'sterile cockpit'. Other members of the crew are not allowed to speak or distract the pilot unless it's a time-critical safety issue. This allows them to focus on flying the aircraft without the risk of being interrupted at a crucial moment.

Members of the team should be aware of the risks of interrupting a colleague when they are working through a problem, interpreting complex information or undertaking a difficult practical task. Interruptions should

be ignored, in a sensitive manner, unless they are urgent. If a person is interrupted during a task they should consciously consider the potential implications of being interrupted. Ideally, restarting the process from the beginning is the safest way to avoid a resultant error.

Control the Environment

Another challenge that commonly compromises performance is the operational environment. Environmental conditions, including noise, heat, cold and being wet detract from people performing at their best as they become increasingly uncomfortable. Their focus is distracted from the task in hand and becomes directed at the pressures of the environment. Vital cognitive capacity is consumed while thinking about personal discomfort. Poor environmental conditions also place time pressure on us to complete the task and move into more pleasant conditions.

In order to perform to a high standard in austere environments, it is important that teams are physically fit, are given optimal clothing and train regularly in environmental conditions they may be called upon to operate in.

Environmental pressure is a considerable challenge in mountain rescue operations.

There are 70 mountain rescue teams in the UK. Each has an area of the country for which it is responsible for providing a search and rescue service. In approximately half of the call outs, a person or group has become lost or has failed to return at an expected time.[47] In the remainder, a person at a known location has been injured or become stuck in a precarious position. The most frequent factors which lead to people becoming lost, overdue and injured are poor weather and reduced visibility at night. Mountain rescue team members, therefore, have to operate for prolonged periods, carrying heavy loads in extremely poor weather conditions.

Mountain rescue teams must attain and maintain a wide range of skills, including navigation, technical rescue, off-road driving, advanced first aid, use of communication equipment and working with helicopters. They also have to be competent in the use of an extensive amount of specialist equipment. However, mountain rescue teams in the UK are made up of volunteers. Teams may consist of a range of people including tradesmen, farmers, social workers and engineers. No one has a full-time job training and operating as a mountain rescuer. Training is carried out on a part-time basis, often only once or twice a month.

Mountain rescuers must, therefore, be physically fit and capable of operating to a high standard in very hostile conditions, even when fatigued. Equipment has to be physically carried for prolonged distances. The ability to manage the pressures of the environment in order to maintain performance is crucial.

Investing in optimal clothing to minimise the effects of environmental stimuli is necessary for all teams who are expected to work outdoors. Training and simulating in bad weather are also necessary for conditioning.

Dr Eddie Crawford has been a member of the Arrochar Mountain Rescue Team for 20 years. When a mountain rescue call comes in during the winter, especially at night, within the space of an hour he can move from being in a warm house to being lowered from a helicopter on to an icy and windy mountainside. If Eddie has been in the mountains in similar conditions in the days preceding the callout, he describes feeling more comfortable and confident in these conditions. He describes his ability to navigate, plan, undertake technical rescue tasks and care for a patient as only being minimally affected by the environment around him. If, however, it's been a prolonged period since he has been on a mountain in the Scottish winter, being exposed to the environmental conditions takes up a lot of his cognitive bandwidth and his confidence is significantly reduced. It also takes him much longer to acclimatise and optimise his clothing for the conditions. He is aware of how much his ability to make decisions and carry out practical tasks deteriorates.[48]

Forgetting to take one single piece of personal protective equipment can cause serious detriment to the completion of a complex task. A few years ago, I completed a winter mountain leader training course in the Cairngorms. This is an intense six-day course covering aspects of moving safely on steep snow and ice, navigating in limited visibility, rope techniques and digging snow anchors. The course culminates in digging and spending a night in a snow hole on the top of a mountain. During the course, one person in the group forgot his ski goggles. In blizzard conditions, it was impossible for him to look at a map or a compass, tie a knot or even walk in a straight line. He struggled to look after his own safety. It would have been impossible for him to lead a group of mountaineers or deal with an emergency situation.

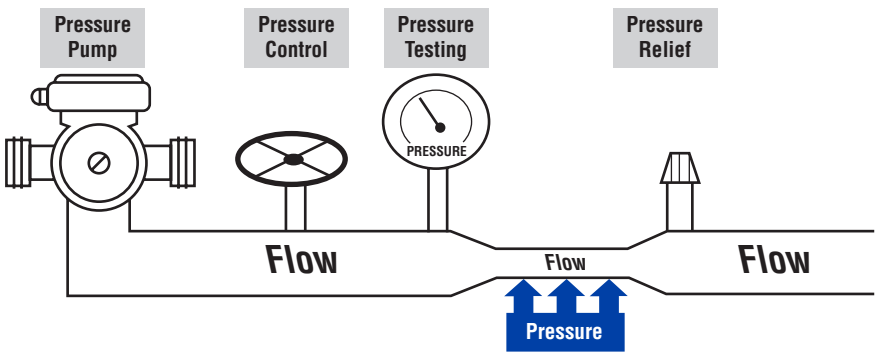
Training in and acclimatising to austere environments, maintaining physical fitness and ensuring appropriate clothing and equipment are carried are all paramount for high-pressure situations. Controlling the environment is critical to owning the pressure.

A broad range of factors can compromise our ability to perform to a high standard in pressured environments. High-performing teams are cognisant of the risks of bias traps: they try to minimise the effects of fatigue, reduce interruptions to a minimum and take steps to control their operational environment.

Learning points

- Bias traps, the Dunning-Kruger effect, fatigue, interruptions and the environment can all impair our ability to perform optimally.
- Bias traps include the priming effect, the framing effect, anchoring bias, confirmation bias, serial position effect and availability bias.
- Lack of experience can sometimes result in over-confidence about personal judgement and skill.
- Various tactics can help defend against bias traps: awareness, knowledge of relevant terminology, debriefing, meta-cognition, cross-checking, disconfirming questions, cognitive pauses and simulation training
- Fatigue compromises our ability to perform under pressure. Fatigue calculators can assist with mitigating the risks of fatigue impairing performance. It can be reduced with naps lasting 20 or 90 minutes. Caffeine and high protein foods are effective. High performers should also be aware of the concept of attentional focusing for short periods.
- Interruptions during cognitive processing leads to errors and essential steps being missed from decision-making processes and practical task completion.
- Cold, moisture, vibration and noise impair our ability to perform in high-pressure situations.
- The correct clothing is important for maintaining performance in challenging environmental conditions. Physical fitness and environmental conditioning are also essential.

Section 2
The Pressure Pump



In order for individuals and teams to perform well under pressure they require the support of the whole organisation. Their ability to own the pressure to achieve high performance in challenging situations is dependent on the culture of their organisation, its leadership and how effectively the organisation has selected individuals to create highly performing teams. The right level of pressure throughout the organisation is required to achieve optimal performance.

Chapter 4
Cultures of Excellence

Teams striving for high performance need to recruit the right people, supply optimal equipment, invest in training and develop effective systems for managing pressure. Combining all of these components, however, doesn't always result in peak performance. High-performing organisations strive to foster cultures that encourage and develop individuals and teams to achieve their full potential. Open, just and supportive cultures of shared experience and learning are necessary. High-performing teams have pride in their organisation and have shared values and goals. To achieve optimal performance, individuals should feel valued, respected and psychologically safe. Excellence and continuous improvement are at the heart of high-performing organisations' ethos and daily operations.

Royal Marines Sniper

The Royal Marines are internationally revered as an elite military force. Potential Royal Marine Commandos must complete one of the longest and most physically demanding military selection processes. Their coveted Green Beret is worn with pride. As well as performing the role of infantry soldiers, marines are trained to be deployed amphibiously. They are also specialists in arctic and mountain warfare. Marines may progress to the Special Boat Squadron, the Special Forces unit of the Royal Navy.

A small number of high-performing individual marines are selected to develop a range of specialist combat skills. Wayne was a Royal Marines Commando for seven years. Following the initial gruelling selection process, Wayne was nominated to be considered for specialist training as a sniper. This process involved tests of marksmanship, field craft, navigation and concealment. Having passed these tests, potential snipers then have to complete an intense eleven-week training course. Snipers in the Royal Marines have a number of roles. As well as being used to attack

specific enemy targets, they employ their skills of covert movement and concealment to perform reconnaissance tasks to gain intelligence prior to larger military units attacking enemy positions.

Snipers work in pairs. There is a sniper and a spotter. On some missions, an additional two marines are also deployed to provide protection to the sniper and spotter. The spotter has a role in assessing the distance to the target, the wind speed and the change in elevation. Using this information, the sights on the sniper's rifle are meticulously calibrated. On complex tasks, multiple sniper teams may be used in the same area for reconnaissance and for attacking targets. Effective coordination and synchronisation of multiple teams is vital.

Having demonstrated excellent performance as a sniper, Wayne was promoted to second in command of a sniper team. In this role, he was responsible for mission planning, identifying the optimal observation location, preparing his team, navigation and maintaining the well-being and safety of the group on operations.

Wayne describes the pressures of the role as being considerable.[49] He reveals there was a constant need to keep yourself and your team hidden from the enemy and from local civilians. The consequences of being seen during operations would have been potentially fatal for him and his team mates. Once an objective had been identified, failing to have a shot on target could compromise days of planning and future operations that were dependent on the sniper being successful. Standard operating procedures dictated that never more than two shots could be fired at an objective. With two shots, the enemy would become aware of the general direction the shots were coming from. Any more than two shots and the position of the sniper team would be identifiable.

With their field craft, navigation and concealment skills, snipers are also used for reconnaissance behind enemy lines. During reconnaissance missions the sniper team needs to identify enemy locations, troop numbers, weapon types and vehicle types. This intelligence is then passed back to commanders who are planning assaults on those locations. Often, there is time pressure to gain this information. Getting to the observation points in the required time is frequently almost impossible as surrounding enemy combatants are in the vicinity. The terrain often means that vantage points are suboptimal, making accurate information gathering a challenge.

Information gained during reconnaissance missions allows the attacking units to plan what troop numbers are required and what air and artillery support is needed. Errors by the sniper troops in their reconnaissance intelligence could seriously compromise the success of the future

operation and, more importantly, endanger the lives of their colleagues. Similarly, if they falsely identify a location as a military target when, in fact, it is populated by civilians, innocent people could be caught up in a firefight or an attack from the air. Dozens of colleagues' and civilians' lives would potentially be put at risk in the event of an error.

I talked to Wayne about how the culture within the Royal Marines encourages individuals to perform to the highest standards possible, even under intense pressure. He attributed a considerable part of the culture as being due to *esprit de corps* – a shared spirit of camaraderie and solidarity. Marines are taught about the history, campaigns and victories the corps has achieved since 1755. Examples of individual bravery and excellence in the face of danger and adversity are shared and celebrated.

Members of the Royal Marines are proud of their personal physical and mental toughness, which is required to pass the selection process. There is mutual respect for their colleagues who have also achieved the same high standards. Wayne described how standards of preparation, appearance and performance are expected by marine officers and by marines themselves, at all times: 'You have pride in the Green Beret'. When working with other regiments, Royal Marines always strive to demonstrate their skills, resilience and discipline. Healthy competitiveness is a useful part of a high-performance culture.

A genuine sense of teamwork and a reliance on each other is obvious within the Royal Marines. As well as core fighting skills, each member of a patrol has additional personal specialist skills. Each member of the patrol is dependent on their team mates to achieve the objective of the mission, and for their personal safety. When working in hazardous environments, each member of the team knows what is expected of them. Each marine is also aware of the clearly defined competencies of their team mates and what their role will be when they come under attack. Responses to immediate threats are drilled until they become automatic, intuitive reactions. Shouting a key word such as 'contact right' will elicit an immediate set of actions from the patrol. Everyone knows their role in the team. Wayne discussed a strong motivation for personal high performance as simply 'not wanting to let the other lads down'.[49]

Being well supported by the organisation and the perception of being well supported by other marines is vital, described Wayne. The Royal Marines clearly invest in training and in the development of skills and knowledge of every member of the corps. Through effective leadership, the potential of each marine is identified and developed. In order to perform optimally during operations, each Royal Marine needs to have

confidence that planning is detailed, intelligence gathering is optimal and contingency plans will be effective. Marines are also well equipped to carry out the job asked of them: 'We need to know we have the latest and most effective equipment to keep us safe and allow us to do our job on operations to the best of our ability'.[49]

Wayne also talked passionately about the sense of purpose in the marines during operations. Having clear, common goals, i.e. overcoming the enemy and protecting your colleagues, is vital to motivate everyone to perform to the highest standards, especially when under pressure.

Organisational Learning and Marginal Gains

High-performing organisations actively seek to continually improve the quality of their performance. Organisations with cultures which embrace reflective practice, share examples of success and learn from errors can identify areas where performance improvement can be achieved. This ethos of continual refinement and achieving marginal gains provides our teams and individuals with the knowledge, skills and systems to achieve their full performance potential.

The Tour de France is arguably one of the toughest sporting competitions in existence. Riders and teams compete for three weeks over a course stretching for thousands of miles. Each stage tests abilities of endurance, climbing, sprinting and time trialling. As well as having strong enough riders, a professional cycling team has to put in place hundreds of components of their tour campaign, from nutrition, mechanical support, lightweight equipment, coaching and route reconnaissance through to masseurs and sports science support.

No team has performed better in the past decade than Britain's Sky Cycling Team. The team, along with Britain's national team, won numerous Olympic and world championship track cycling medals, and has had repeated success in the grand tours. The concept of marginal gains has played a major part of Sky's success. The team's director Sir David Brailsford was meticulous about every individual part of the team's preparation, no matter how small. Brailsford ensured that each aspect of the team's preparation, and performance in competition, was continually reviewed: training, diet, bikes, support vehicles and psychological support. If there was potential for improvement in any of these areas, then time and resources were invested to achieve that improvement. Each of these small, marginal gains accumulated to bring about significant improvements in speed and team performance during races.[50] That's why they won consistently.

Significant Event Management

High-performing organisations encourage learning from their team's experiences. They make reporting of good practice and episodes where performance could have been better as easy as possible.

The EMRS has a significant event reporting system as a function of the team's smartphone app. This allows members of the team to submit an episode report in less than a minute, even when the team is in flight. The system makes it almost effortless for individuals to report potential learning points. The team has a culture that actively encourages reporting, meaning that even minor issues are centrally recorded, investigated and shared among the full team.

Individuals will quickly become demotivated from reporting episodes if there is a perception that no one values the reports, or fails to investigate them, or that they don't lead to changes in practice. Therefore having a clearly identifiable individual with responsibility for report management is needed. Feeding back investigation information to the reporter and to the team as a whole is a significant motivator for others to report episodes in the future.

Traditionally, organisations have only encouraged reporting of seriously adverse incidents and have only seen learning potential in these types of episodes. Increasingly, however, leaders see value in reporting, analysing and sharing examples of when performance has been particularly good. As well as helping to change systems, communicating these positive examples of practice acts as inspiration to the full team. High performance is positive and should be celebrated.

Performance Measurement

Data recording is essential for measurement of performance. High-performing organisations take sufficient time to carefully consider the metrics they record. Metrics should ideally be operationally relevant and a true measure of team performance. Metrics recorded by other similar organisations should be taken into consideration to allow comparison of operational effectiveness and safety. Clear and unambiguous descriptions of what has to be measured and recorded are essential to ensure that data recording is complete, accurate and precise.

Audit and quality performance indicators (QPIs) can sometimes be negatively perceived by teams. This may be because the values measured are regarded as operationally irrelevant or the standards are set at an

unachievable level. Investing sufficient time to establish operationally important QPIs and achievable targets will pay dividends in the long run. Engaging the full team in creating and reviewing QPIs is essential to achieving ownership and buy in.

Getting the balance correct in terms of volume and frequency of audit of performance can be difficult. If audits take place too frequently, the results will have less meaning. Auditing less frequently can mean that outputs carry greater weight for the teams and are more likely to result in changes in practice to improve performance. Organisations commissioned to undertake external audits should, ideally, have relevant operational experience and credibility in the eyes of the team.

Reflection for Performance Excellence

London's Air Ambulance is a world leading organisation which provides the highest possible levels of pre-hospital trauma care, with teams working under intense pressure and risk 24 hours a day. The doctor and paramedic team can access the 12 million people in London within 20 minutes by helicopter or fast response vehicle. The team undertake lifesaving critical care procedures at the scene of the patient's accident. Prior to the service being established, many of these clinical procedures had only been carried out in the emergency department or operating theatre. These interventions include open chest surgery for heart stabbings, blood transfusions and inserting balloon catheters into the main artery in people's abdomens to prevent them from bleeding to death.

The pressures on the team in terms of time, environmental conditions and the risks of medical procedure failure are immense. Optimal selection and training of paramedics and doctors who work with the service are critical to their ability to perform in these circumstances. The capability to safely undertake these procedures as a team of two, in the street, has come from decades of reflective practice and continual attention to detail.

London's Air Ambulance promotes an open, honest and just culture. Continuous improvement through marginal gains is at the core of the service achieving the highest quality of medical care in the most challenging situations. Each month, the service dedicates a full day to clinical governance and peer review. Around a hundred healthcare professionals, many from outside the service, are invited to attend the clinical review event. The focal point of the day is a longitudinal audit of a challenging pre-hospital trauma case. The team members who cared for the patient

present the case, from the time of the initial 999 call until the patient arrived at the hospital. In an open and transparent manner, each aspect of the case is analysed in detail. Examples of good practice are applauded. Aspects of the case that could have been managed better are identified and openly discussed. The reasons for the team's actions are scrutinised in terms of human factors, systems, equipment, communication and training. Learning points and action plans for improvement of the team's systems, and for the clinicians involved, are agreed upon in light of the mission audit.

These clinical governance days allow London's Air Ambulance to continually evolve and improve in terms of performance. The open and frank nature of their clinical governance days sets the tone for the service's overall culture and attitude towards clinical excellence.

As well as full team in-depth reviews of clinical cases, London's Air Ambulance service mandates structured debriefs after every mission. This allows the doctor, paramedic and pilots to talk over the mission starting from the time of activation. Navigation to the incident scene, landing of the aircraft, communication and the clinical care delivered to the patient are all discussed. During these case debriefs, it's unusual for significant issues to be raised that require major changes to the systems of the service. However, following almost all missions, small learning points are raised and discussed. These points are useful in improving the performance of the members of that team when they have to deal with similar cases in the future.

Giving staff training in how to debrief constructively and sensitively is essential for high-performing teams. Providing a structure for debriefs is important to prevent excessive time being spent on single issues. Many helicopter retrieval services ask their staff to complete written post-mission debrief records. A member of the team will be tasked with regularly reviewing these debrief lessons in order to identify whether there are any recurring learning points that the wider team would benefit from.

A tool that is increasingly seen as valuable for reflection and learning is event video recording. Paramedics and doctors in Edinburgh have made considerable improvements in the management of out-of-hospital cardiac arrest in the past five years. This is largely down to improved training, performance audits, pre-designated team roles and a cardiac arrest management checklist. The project leaders have also introduced badge camera filming of cardiac arrest management.[51] During the resuscitation, one of the team will be filming and audio recording each person's actions, teamwork and communication. Following the case, the team sit down

and review the footage. Lessons for the whole system can be identified, especially when recurring problems are found. More importantly, however, individuals can witness how they themselves perform, behave and communicate. Vital lessons to improve individual performance can be gained.

Psychological Safety and Just Cultures

Encouraging individuals and teams to report incidents and reflect on personal practice during debriefs and open forums requires organisations to be perceived as 'psychologically safe'. People are unlikely to be open and to engage with reflective practice if they fear negative consequences of doing so. In psychologically safe teams, individuals feel accepted and appreciated. They also feel that their performance is respected. They understand that speaking up about potential errors is more likely to have a positive impact on the team than a negative impact on them as an individual.

Former Royal Navy officer Angela Lewis described to me the open culture within the service.[52] Operating ships, aircraft and nuclear submarines all around the world is a complex task that carries innumerable risks. She described how the navy actively encouraged people to speak up and report incidents when things went wrong or could have been done better. Crews have low thresholds for reporting occurrences and there are clear lines of responsibility for investigation. Angela described how people who spoke up were not blamed or ridiculed.

As the Royal Navy is such a large and geographically dispersed organisation they centrally record incidents that have been reported. These are then communicated as frequent safety bulletins to every ship, submarine and base around the world. This has proven to be an effective method for ensuring whole system learning and in maintaining safety. Seeing this safety bulletin on a regular basis also actively motivates navy personnel to report incidents they themselves encounter.

Creating a just culture is an important part of psychological safety. Sidney Dekker discusses the need for just cultures in high-performing organisations in his book by the same name.[53] In organisations with just cultures people know that unintentional errors will not result in punitive action. This encourages individuals to speak up and discuss their performance. However, people are not immune from disciplinary action if there has been wilful neglect of procedures. Angela described an important part of this principle in the Royal Navy when she said that people were 'never wrongly punished'.

James Reason, an expert on human factors and error, classified errors in a publication in 1990.[54] He described instances when actions are unintentionally not carried out as they were supposed to be as 'slips', e.g. forgetting a step in a process due to an interruption. Lapses occur when steps are consciously omitted because the person thinks they are not necessary. These are conscious, intended omissions, which the person believes will not lead to harm. At-risk behaviour, however, occurs when the person understands what needs to happen but actively decides not to comply, despite the possible consequences. Organisations with just cultures are likely to respond negatively and punitively only when at-risk and reckless behaviour has occurred.

Debriefing incidents where errors may potentially have been made can be challenging. During reflective practice and debrief sessions we need to be aware of the concept of cognitive dissonance. This occurs when an individual may have performed suboptimally. Cognitive dissonance describes the feelings of the person when they reflect on their performance, or information comes to light that reveals their error.[55] The person may resist suggestions that their performance could have been better. Often, they will cite how the circumstances of the task rendered optimal performance impossible. This behaviour partly stems from a fear of criticism, punishment or loss of status.

Changing Culture

Creating systems and teams to optimise performance under pressure in a newly established organisation can be a challenge. Introducing and developing safe systems in an organisation that has already been operating for some time with an established team is likely to be considerably more difficult. Individuals working in established teams often have the belief that things already work as well as possible and that there is little need for change. Challenging that belief and introducing a culture of excellence can be far from easy.

In *The Checklist Manifesto*,[56] American surgeon Atul Gawande describes the change in culture required when the World Health Organization (WHO) introduced the pre-operative surgical checklist. Despite significant rates of potentially avoidable surgical complications, incorrect procedures and wrong-side surgery being carried out, many surgeons, nurses and anaesthetists resisted this simple measure to reduce adverse events occurring. It required years of evidence gathering and persuasion to convince those who were rejecting change that improvements were needed.

When we started the EMRS in 2004, only a handful of the team members had worked with an aeromedical retrieval service. Most had little or no experience of how such organisations operated. I had spent the previous six months working with London's Air Ambulance and whilst working there I had become immersed in a culture of safe systems and effective clinical governance. Standard operating procedures, checklists, incident reporting systems and reflective practice were fundamental parts of their open culture. Naturally, we adopted all of these practices for the new service in Scotland. New members of the team required no persuasion to accept these standards and systems as the way an aeromedical retrieval service operated. These were a group of self-selecting individuals who, although experts in their base hospital specialties of emergency medicine, anaesthetics and intensive care, had minimal pre-hospital and retrieval medicine experience. They recognised the challenges and the hazards of using their medical skills in this environment and welcomed a structured framework for doing so.

As the service has developed, new members of the team have embraced the safe systems culture of our service. When we recruit staff and when people visit our base, it's clear that this is how we operate. The systems we have in place attract people who want to work in a structured, safe environment. They respect and support our culture of continuous improvement and the processes we have in place to maintain patient and team safety, which allow us to perform to high standards when under pressure. There's also a pride in the team in that we have all jointly created these systems and have shared ownership over them.

We are fortunate in the retrieval service to have the time, the resources and a full team who are committed to our safe systems to allow us to operate in the way that we do. In larger and already established organisations, it can be significantly more difficult to introduce and develop these systems due to restrictions of time, finance and more traditional attitudes to governance and safety.

In order to have a high-performing team, one needs team members who are experts at what they do and who are highly capable, autonomous decision makers. They have to be able to process the information they receive, evaluate it and decide on what actions they take based on that information. These are fundamental skills for performing well under pressure. These individuals can't simply be asked to do things differently; they can't be informed that the service they work for is going to start adhering to standard operating procedures, using checklists and reporting minor occurrences. These individuals should have personal insight into the need to make these changes and to actively support them.

So how do we change people's attitudes to introducing and using safe systems within the wider team? Professor John Kotter, a leadership expert from Harvard Business School, describes his process for making effective change within organisations:[57]

- Create a sense of urgency.
- Build buy in from the team.
- Form a strategic vision.
- Enable action by removing obstacles.
- Generate short-term gains.
- Build on the short-term wins.
- Anchor the changes.

The first step is to create urgency. Members of the team should see the need for change and to want it to happen. Looking at current service performance can be a catalyst for encouraging the team to consider the need for improvement. This may be in the form of discussing quality performance indicators and the reasons for suboptimal results. It can be based on team reviews of actual examples of suboptimal team performance. Critically examining adverse events also promotes identification of system weaknesses and the need for change. Each of these will help members of the team develop insight into the need to improve your team's ways of working.

The introduction of regular quality improvement meetings can be useful. These events may consist of discussions about recent performance, a presentation of quality performance indicators and a review of significant events that have been reported and analysed.

Kotter's second step is to form a powerful coalition of supporters. To achieve the buy in of the full team, it's important that the development of improved systems is perceived as being owned by everyone. This might involve drawing up a list of system parts that need to be developed and dividing that work among all members of the team. It's important to allocate tasks according to each individual's expertise, interest and productivity. Over time, the full team develops a shared feeling of ownership and responsibility for the service's systems and the team's performance.

Next, Kotter describes identifying short-term gains, easy wins and longer-term objectives. Easy wins help gain buy in from the team members and motivate them to put the effort into achieving the larger, more challenging changes.

Kotter talks about the need to create a vision for change. One method is to identify a service that performs a similar role, and has exemplar operating systems and a culture that embraces them. Exposing members of the organisation to examples of high-performing teams and people who have pride in working with and developing these systems is likely to be inspiring and motivational. Once the organisation has a vision of the culture it aspires to, it is vital that the leader describes that vision in detail and communicates it to the team.

Finally, it is vital to celebrate and have pride in the changes that have been achieved. It is important to promote the new culture both internally and as part of the branding of the organisation.

An effective pressure pump is a key part of maintaining the correct level of pressure throughout a high-performance organisation. The culture within the organisation is one of the most important components of the pressure pump. The performance of a team is more than simply the sum of its component parts, i.e. people, equipment and systems. High-performing organisations inspire pride in performance, are reflective, strive for continual improvement and are open and psychologically safe environments to work in.

Learning Points

- High-performing organisations have cultures that encourage and develop individuals to achieve their full potential.
- Individuals need to feel valued and respected.
- Pride in the organisation is important for commitment and performance.
- Clear and shared goals for the task and the team are required.
- Rigorous selection processes create mutual respect among those who are chosen to be part of the team. Each individual knowing that they can rely on their team mates is important.
- Clarity of expected standards and competencies is important. People need to know what to aim for. Each individual is aware that their role is vital for overall team performance.
- High-performance organisations are learning organisations. They actively seek feedback from their teams and have effective and easy-to-use significant event management systems. They review incidents in an open and positive manner. Learning is shared throughout the team.

- Psychologically safe organisations make people feel confident to speak up about events where performance could have been better and about their own personal development needs. Individuals understand that speaking up about an event is more likely to have a positive impact on the team than a negative impact on them as an individual.
- Systems to identify and achieve marginal gains are key to continuous performance improvement. Post-event debriefs, performance indicators, audit and in-depth event reviews help identify marginal gains.
- Performance metrics should be operationally important.
- Cognitive dissonance can make debriefing incidences of suboptimal performance challenging.
- Video recording is increasingly seen as a vital tool for debriefing and team learning.
- Enhancing the culture in established teams can be challenging. Team members may lack insight into how things could be improved. They may also be reluctant to commit to the work required to do so. Members of the team should realise the need for change in culture. This can be achieved by constructively reviewing existing performance and observing other high-performance teams. Each member of the team should feel that they have control and ownership of change.

Chapter 5
Strategic Leadership of High-Performing Organisations

High-performance organisations need high-performing strategic leaders. These leaders should have a clear vision of the direction and the destination of the organisation. In performance terms, they can see the potential for excellence in individuals and their teams. They understand what is required to achieve this potential. Attaining high performance necessitates a range of leadership skills. It requires the trust, respect and confidence of the full team. This comes from credibility, a reputation for personal technical ability and effective communication skills. Empowering the team through delegation of the right responsibilities to the right people results in ownership, pride and continual progress towards excellence. In groups of high-performing individuals, an open, democratic leadership style with shared strategic decision-making is most effective. Leaders must have the energy and commitment to continually motivate the team towards performance improvement through identifying and achieving marginal gains.

The pressure pump is the part of the pressure management system which maintains the pressure throughout the whole organisation. Effective leadership is one of the key components of the pressure pump within high-performance teams.

The Iceberg Model

Gaining the full commitment of everyone in the team and allowing each individual to achieve their personal potential is vital in creating systems and environments where performance can flourish. Optimising everyone's contribution to organisational effectiveness is essential. How leaders value and treat individuals in their organisation is key.

Psychologists describe a 'psychological contract' between leaders and team members.[58] There are two sides to the contract. On one side of the contract is what the leader needs and what the individual can provide; on

the other side is what the individual needs and the leader can provide. An iceberg can be used as a model for this contract (Figure 5.1). Superficially, above the surface, the leader pays a salary on one side and the employee works the hours they are paid for in return. This can be perceived as an

Figure 5.1. The iceberg model of the psychological contract.
Source: Reproduced with the kind permission of BusinessBalls.com.

external, visible psychological contract between the two parties; however, there are also numerous 'invisible' inputs and rewards underneath the surface on both sides in terms of levels of commitment and performance. On the employer's side this may include benefits such as security, work-life balance, training or variety in the employee's job role; whereas on the employee's side this may mean exceeding expectations when set a target and making the effort to go the extra mile for better results.

In many service and manufacturing industries with low skilled staff there isn't much more below the surface in terms of commitment and performance of the employee and the non-financial rewards provided by the leader. In organisations undertaking demanding, high-stakes tasks, however, what goes on beneath the surface is fundamental to achieving optimal performance.

Organisations with effective leaders and skilled teams who are striving for performance excellence have much more going on 'under the waterline'. These include personal commitment by individuals to the organisation and its goals, as well as the kind of rewards and recognition provided by the leader. Effective leaders demonstrate that they value the people in their teams and wish them to develop their full potential. They do this by providing and resourcing training and qualifications. Promotion to positions of greater responsibility is based on merit and on transparent, just, decision-making. Organisations striving for high-performance supply their teams with equipment that is fit for purpose and provide a high-quality, functional working environment.

Employees who demonstrate commitment and a positive attitude to improving performance are given respect and flexibility. Successful leaders appreciate that healthy work-life balances improve productivity and staff retention. Individuals given respect and autonomy seek out and embrace greater levels of responsibility. They take pride in developing their specialist areas of expertise. Those who feel that they are valued and are being invested in by the organisation in turn value the organisation and give loyalty and commitment in return.

Allocating suitable levels of autonomy and responsibility to the wider team, however, carries a degree of risk. Effective leaders are willing to take these risks and have confidence in the ability of their teams. Motivating teams to go the 'extra mile' in achieving optimal performance requires investment and trust in them. It also requires leaders who have the confidence to delegate decision-making for service development. Leaders who are uncomfortable with taking risks through delegation, due to a lack of trust, are likely to fail to optimally develop their team.

The parts of the psychological contract below the waterline are not written into formal contracts. These are informal concepts that are perceived by the team and by the leader. Leaders need to demonstrate to members of the team that they are valued, respected, trusted and being invested in. Publicly celebrating an individual's academic success, a promotion or their completion of a service improvement project are valuable in communicating this ethos to employees.

Organisations and leaders who demonstrate successful and productive psychological contracts retain valued staff and attract people with the right aptitudes and attitudes to apply to work with the team. Members of the team who perceive their role as being sought after, with oversubscribed recruitment processes, value their position and increase their commitment even more.

The Hierarchy of Needs

The psychologist Frederick Herzberg put forward a 'two-fact theory' relating to employee motivation.[59] This was based on a study of engineers and accountants in Pittsburgh. The principles are very similar to the iceberg model. According to Herzberg, people are more motivated by responsibility, advancement and recognition of achievement than by the size of their salary. He describes how we all have an intrinsic psychological need to perform worthwhile, meaningful tasks, to make decisions and to feel valued and important. People also want to feel that they belong to a community.

Our motivational needs are described in Maslow's hierarchy of needs.[60] Maslow divides our needs into five categories:

- **Physiological** – in our context this relates to employment conditions.
- **Safety** – having job security and having the skills to do the job.
- **Value** – being trusted, respected and valued.
- **Esteem** – performance and achievement are appropriately recognised and rewarded.
- **Self-actualisation** – our desire to achieve and to leave a legacy.

High-performing leaders are attuned to the characters of the people in their team and the psychology of how to motivate them to achieve the best outcomes for them as individuals, and for the organisation as a whole. They understand what individuals need to motivate them to achieve optimal performance.

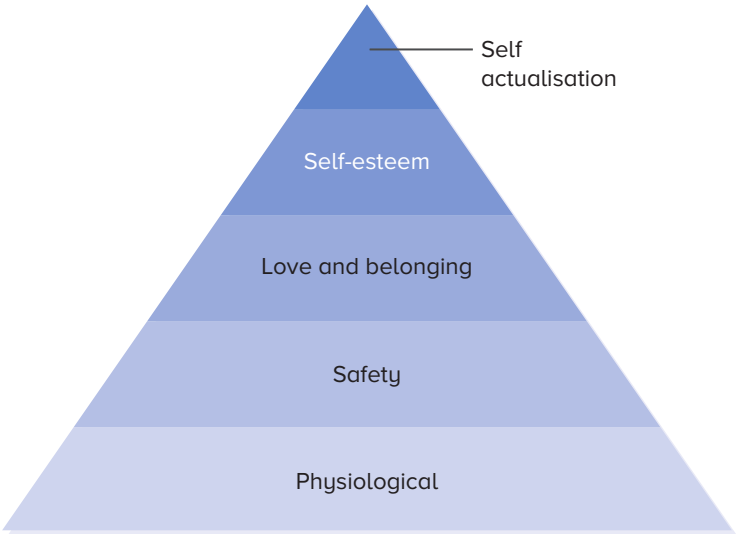


Figure 5.2. Maslow's hierarchy of needs.

Empowerment – Leadership of Leaders

Teams expected to perform to a high level in challenging circumstances are made up of individuals who are highly intelligent and highly trained and are capable of independent decision-making. Many of these people are themselves expected to have effective leadership abilities.

These individuals are, therefore, not amenable to autocratic, top-down leadership styles. A lack of openness and transparency by those in senior positions is ineffective in motivating these types of individuals. Leaders of such teams are more likely to thrive with open, democratic leadership styles and meritocratic systems. Teams like these appreciate being informed early about potential changes and developments. They want to form their own opinions, to be able to contribute to decision-making and help guide the future of the organisation.

High performers are also capable of taking autonomous responsibility for areas of service management and development. Empowering individuals by giving them such responsibilities is effective in utilising all of the talent available to develop the organisation. Coming back to their hierarchy of needs, it also makes them feel valued.

The EMRS has over 30 consultants. These consultants are specialists in intensive care and emergency medicine. Each doctor has completed five years of medical school followed by ten years of post-graduate training to

reach the grade of consultant. On top of this, they then have, on average, ten years of experience working at consultant level. Each of these doctors is expected to have skills in managing an overflowing emergency department or a large intensive care unit full of critically ill patients. One might imagine that forming these 30 strong leaders into a cohesive team and leading them would be a challenge. Over the past 15 years, using the principles of empowerment and delegation of service development responsibilities, this has actually not been the case.

From the outset of the service, each consultant adopted responsibility for an area of service operation and development. Individual consultants have taken responsibility for issues such as equipment, significant event management, training, major incident planning and dealing with the media. The question of who is responsible for what is clear to all members of the team. These responsibilities have created a feeling of ownership of the whole team, by the whole team. Through weekly team briefs and quarterly service updates, everyone in the team is aware of what's happening in a particular area. Each person can see that their colleagues are constantly refining how the team performs in their area of responsibility. This also motivates others to push for marginal gains in their own area of responsibility.

When L. David Marquet took command of the USS Santa Fe in 1999, it was the worst performing submarine in the United States Navy. On taking command of the vessel Marquet radically changed the way it was led and managed.[61] Prior to him taking charge, an autocratic, top-down, system of command had existed. This resulted in poor decision-making and low morale. People felt undervalued and weren't motivated. The rationale behind the changes he made was to move decision-making to where the knowledge and experience were. He created a culture and a system that allowed the lower ranks to take responsibility for the submarine. Marquet emancipated and empowered each and every member of the highly talented crew. With this ethos Marquet transformed the USS Santa Fe into the best-performing submarine in the fleet. His journey is excellently described in his best-selling book *Turn the Ship Around!*[61]

Marquet impresses upon the reader that trust is essential for emancipation and empowerment. The leader must trust each individual member of the team to act autonomously and make decisions as they see fit. Team members also need to feel trusted. There is still a requirement for a leadership hierarchy and for senior officers to ultimately take responsibility for the actions of the crew, which is still possible while empowering and giving responsibility to more junior members of the team.

Marquet talks about effective delegation as part of the empowerment process. Individuals being delegated responsibility for key areas of the

service need to have the competency to take that responsibility. They also need to have the drive, motivation and organisational skills to see each task through. This is a fundamental part of effective leadership in high-functioning teams. The leader needs to know each individual member of the team and what they are capable of. They have to invest in each person by providing the resources and time required for training and personal development. As Marquet says: 'I learned the hard way that control without competency is chaos'.[61]

Coaching to Improve Performance

A significant role for the leader in achieving optimal performance from individuals is coaching. This can be done formally or informally by leaders. Many leaders mistake coaching sessions as opportunities to advise people how to do things. Coaching sessions are about supporting members of the team to develop their own abilities and to make their own decisions. Open questioning is key to effective coaching.

A few years ago, I received professional coaching from a former military search and rescue pilot. The pilot had been trained to coach pilots who were experiencing challenges during flight training programmes in the Royal Navy. Before they introduced coaching, the military relied almost solely on formal technical assessments to select and assess aviators during training. However, with a more modern approach they realised that some individuals who were previously high achievers experienced periods when they were not making the grade during assessments. Historically, this led to some pilots being unable to complete the training programme. This resulted in the loss of significant numbers of talented potential pilots, and made poor economic sense. That's when they started to train performance coaches for their flying schools.

Pilots who had experienced a dip in performance were referred to these coaches. Using their coaching skills, the reasons for the individual's change in technical ability was usually readily identified and solutions for improvement established. The coaches then worked with the pilots to support them in putting the solutions into practice. Often the reduction in performance was due to family issues or a loss of confidence, i.e. issues that were frequently transient and could be worked through with the help of the coach.

As well as improving individual performance, coaching can also be used to support people in planning and completion of service development projects. In this way emancipation and empowerment are encouraged. Coaching episodes, as part of a project, start by having the coachee

describe the challenge facing them. The problem is talked through and the component parts are each identified and carefully defined.

One technique at this stage is to encourage the person to look at the problem from the perspective of others. The next stage is to examine potential solutions. Each of the solutions are talked through and evaluated. Ideally, the most promising and feasible solution is identified by the person being coached. Following this, the actions required to achieve that solution are broken down and listed. Potential blocks to achieving the solution are explored and work arounds discussed. The session should finish with clarification of what's been discussed and what the steps moving forward should be.

Coaching can also be used as part of operational debriefing. Skilful coaching techniques are required for this. This is especially the case if the person coaching was not involved in the event. It's easy for the coach to form inaccurate mental models of what happened and what their perception of the 'correct' actions to take were. Coaching in these situations should be much more about facilitation, encouraging the coachee to evaluate what they did, to consider other possible actions and to identify learning points for the future.

The debrief coaching sessions should start with the coachee describing what happened. Clarification of details should be sought when required. The coach should ask about what the person saw, heard and said, and how they felt. They should be asked about why they did what they did and what other possibilities there were. The temptation to directly state other possible courses of action or comment negatively on what the person did should be avoided.

If carried out properly, coaching can be a powerful leadership tool to develop potential in individuals and maximise their contribution to the aims of the team.

Leading Change to Improve Performance

Continual change to achieve improvement in performance is essential for any high-pressure organisation. However, people do not always instinctively welcome change. They are often content with ways of working that they know well and feel comfortable with. They can perceive new systems negatively and may be resistant to contributing to the work that is required to make the change.

Well-thought-out and sensitive leadership throughout the change process is important in order to avoid demotivating the team, losing credibility and, paradoxically, compromising performance.

Communication, perception and empowerment of the team are key to implementing change. As a relatively new service, change is a regular feature of the EMRS. Keeping the team fully informed is important in implementing these changes. At the EMRS, we strive to communicate potential future changes to the team at the earliest stage possible. The drivers for the change are explained, the potential options provided and likely timescales described. The team are then asked about their opinions on the change and, just as importantly, how they personally feel about it.

We try to break large change projects down into smaller parts. Responsibility for planning and implementing each part is delegated to individual members of the team or to short-life working groups. This gives the team a feeling of ownership and control over the change and ensures that the change achieves optimal benefits for the organisation.

Morale can be adversely affected by frequent episodes of change. The timing of change is crucial to maintain buy in from the group; it can become more difficult to get enthusiasm and the commitment if 'change fatigue' occurs.

Communicating with the Team

High-performing professionals need to be informed about service developments and provided with honest and accurate information about team performance and progress. A failure to inform the team can lead to disengagement and disenfranchisement. Poorly structured systems of communication also run the risk of important operational information not being received.

A well-thought-out internal communication system is invaluable. Some organisations simply rely on email to communicate individual pieces of information. In the retrieval service, we found that we often encountered periods when the number of emails being sent by members of the team was so high that important pieces of information were missed easily. Many individuals were also sending their emails to incomplete or out-of-date distribution groups.

As a result, we developed a simple weekly team brief system. Rather than each person sending individual emails to the group, they forward them to the team administrator who collates them into a weekly briefing. This ensures that information is disseminated to the full team. Every member of the team reads the weekly brief thoroughly. We have also recently introduced a quarterly service update system. All 50 members of the team have their own area of responsibility for service development.

Four times a year they summarise the progress and changes that have been made in their area in the preceding quarter. We've also found use of 'WhatsApp' groups or group messaging systems to be invaluable for team communication.

Resilience

High-performing teams are often placed into demanding situations. These situations can be emotionally and psychologically challenging, and can adversely affect their well-being. Awareness of these risks in the team is important, as are the systems to provide support when it is needed.

My colleagues in the emergency department, the retrieval service and the mountain rescue team are regularly exposed to emotionally and physically demanding incidents. These can be due to prolonged periods of work, carrying out physically demanding tasks in challenging weather and sometimes having to place themselves at risk of physical injury. They also have to care for people who have just experienced life-changing injuries or where people have died as a result of a traumatic event. All of these stresses can have an impact on their personal well-being.

On 29 November 2013, a Scottish Police helicopter crashed into the roof of a crowded pub in Glasgow, the Clutha Bar. The pilot of the aircraft and the two police officers on board were killed. Seven people in the bar also died and 31 were injured; many of them seriously.[62] The emergency services responded on a large scale – 125 fire fighters attended the scene. I myself attended, along with ten other doctors, paramedics and nurses from the EMRS who were all working alongside the ambulance service. When we arrived at the scene the scale of the incident was almost overwhelming. The situation was made even more difficult because we were colleagues and friends of the helicopter crew. The aircraft operated from the same base as our own helicopter and the pilot, Captain Dave Traill, was one of our air ambulance helicopter pilots.

A year later, the driver of a lorry lost control of his vehicle in the centre of Glasgow.[63] The vehicle struck and killed six people who were out doing their Christmas shopping. Again, our team responded to the scene.

The effects of these events on our team were considerable. The combination of being exposed to these scenes, the frustration of not being able to do more to save people's lives and the grief of losing colleagues were immensely challenging. Unfortunately, at this time we had no formal process in place to support our team. Informal social events helped, as did debriefing sessions that allowed us to talk through what happened and

how we could improve how we responded as a service. Our colleagues at the local Royal Navy search and rescue base also kindly offered to run some TRiM peer support sessions for us.

The Trauma Risk Management (TRiM) support system was initially developed by psychologists working with the Royal Marines. It is a trauma-focused peer support system aimed at those who are likely to face traumatic situations as part of their day-to-day role. The principle is that a number of marines in each unit undergo training in helping fellow marines who have experienced traumatic events, usually in combat situations. The TRiM practitioners are trained to listen to their team mates and to identify specific features of what they are experiencing. These might include flashbacks, insomnia or irritability. For most people these symptoms are a normal reaction to the events they have experienced. In most circumstances the practitioners can provide reassurance that these symptoms will be short-lived. If the symptoms are there for more prolonged periods, or more serious symptoms develop, they can make a referral for a formal psychological assessment.

The military have found the TRiM system very helpful as service personnel are more likely to open up and talk things over with a fellow soldier, who may understand more about the kinds of trauma they face as part of their job role, rather than to take themselves to see a doctor or a counsellor.

As well as exposure to single incidents that are particularly traumatic, high-performance teams may experience burnout from repeated and prolonged exposure to high-pressure situations. Symptoms of burnout include unhappiness, hopelessness and exhaustion. Individuals can become disengaged from the work of the team, their motivation deteriorates and they can demonstrate blunted emotional responses. Leaders of high-performance teams should be vigilant for these types of symptoms developing in colleagues who have been chronically exposed to pressure.

The emotional and psychological demands on leaders in supporting their teams and maintaining operational capability in the aftermath of these types of events can't be underestimated.

Maintaining Leadership Motivation and Inspiration

Starting a new venture as a leader is usually a time of enthusiasm and energy. Maintaining the drive and motivation for prolonged periods is, however, difficult. This is especially the case when the organisation is constantly having to adapt and change, or external factors are forcing

changes that are not wholly welcomed. A number of strategies can be used to help maintain the necessary level of motivation and enthusiasm.

Taking the time to visit other similar organisations can be highly inspirational. Over the past 15 years I've been lucky enough to spend time with helicopter retrieval services all over the world. Leaders of key helicopter services have created an informal network for sharing ideas and developments, and for peer support. The retrieval service in Scotland has also established an annual retrieval medicine conference. This brings international retrieval leaders to Glasgow to speak about their experiences. All of these encounters provide inspiration and motivation. They also serve to remind us that colleagues on the other side of the world are facing the same challenges as we are.

Coaching and mentoring from respected senior colleagues can be important to reassure yourself that you are handling problems appropriately and to provide guidance. These sessions are also useful for putting certain issues into perspective when you are placing too much negative emphasis on them.

Although leadership through empowerment and delegation is the way forward with high-performing expert teams, as a leader one must try to manage one's expectations for other people's productivity. It's easy to become disappointed and frustrated when people don't do what you expect, in a timescale you think is achievable. The '70/30 rule' often holds true: 70 per cent of the service development work will be done by 30 per cent of your team. Often there's little you can do to change this fact.

Overall, organisations need to manage the pressure they place upon their teams and individuals. A key part of the organisational pressure pump is effective strategic leadership. High-performance teams are made of up of high-performing individuals. Many of these will be effective leaders in their own right. They are motivated by respect, responsibility and personal development. Leaders gain commitment and loyalty through empowerment and emancipation of their teams. High-performance teams welcome open and honest communication, and the ability to steer the direction of the organisation.

Coaching skills are key to effective leadership. Coaching can be used for personal development, project support, performance management and event debriefing.

High pressure can lead to stress and burnout. Leaders need to be aware of and vigilant for features of these conditions in their colleagues. High-performance organisations benefit from peer and psychological support systems.

Learning Points

- High-performance leaders require a clear vision of the direction and the destination of the organisation.
- Effective strategic leaders have the respect, trust and confidence of the full team. This is a result of credibility, technical excellence and communication skills.
- High performers thrive under open, democratic leadership cultures.
- Empowerment and delegation result in pride, ownership and continual progress towards excellence.
- The iceberg model of the psychological contract describes how team members will give optimal commitment and performance if their abilities are fully developed by the leader and they are given respect, autonomy and flexibility.
- Leaders must be willing to take calculated risks in delegating decision-making and autonomy.
- Effective leaders have an awareness of what individual members of their teams need in order to optimally perform and develop their full potential. These are described in Maslow's hierarchy of needs: safety, value, esteem, self-actualisation and the right working conditions.
- Good leaders are good coaches. They use coaching techniques to support the progress of projects being undertaken by their team and to allow people to reach their full potential.
- Well-designed communication systems are important to keep everyone informed of developments and allow them to contribute to decision-making.
- High-performing teams are made up of high-performing individuals who need to be kept informed and to have influence over change within the organisation.
- Burnout is a particular risk for strategic leaders of high-performance teams.
- Actively maintaining residence, inspiration and motivation is important.

Chapter 6
Selecting High Performers

Dr Gareth Davies is the medical director of London's Air Ambulance service. He leads a team of pilots, doctors and paramedics who, every day, perform to the highest standards in high-risk and time-pressured situations. In 2017, this service organised the first ever UK performance psychology conference for medical professionals.[64] At the event, Dr Davies opened his presentation by stating that, in his experience, '90 per cent of a team's performance is dependent on selecting the right people' with the right aptitudes and the right attitudes.

Even with optimal equipment, organisational culture, cognitive aids and training, if we don't have the right people we won't achieve our performance potential. A sensitive and specific selection process to identify individuals with the necessary abilities is a vital part of all high-performance organisations. Selection is a key component of each organisation's pressure pump.

Identifying individuals with the ability to cope effectively in pressured, high-stakes situations with high levels of cognitive load is challenging. What personal attributes and aptitudes are necessary for these types of situation and how do we identify the right people prior to recruiting them, investing valuable training resources and placing them in high-risk environments?

Royal Air Force High-Performance Selection

Many professions require the ability to perform to a high standard under pressure. These may involve the necessity to process multiple pieces of information, function optimally in challenging environmental conditions and make time-critical decisions or perform physical tasks that may have devastating consequences if carried out incorrectly. Very few roles, however, place all of these demands on one individual at one time. One such profession is that of a Royal Air Force (RAF) pilot.

The demands placed on RAF pilots in combat situations are immense. These aviators are required to fly the aircraft, navigate, communicate with air traffic control and deploy weapons. At the same time, they must evade enemy aircraft and attacks from ground forces. The consequences of a split-second misjudgement can be catastrophic. Selection is key to producing pilots who have the ability to perform to the highest possible level while under extreme pressure. It's paramount that all individuals training to be pilots have the necessary aptitudes, attitudes, commitment and physical ability.

The Royal Air Force selects, trains and deploys three categories of pilot: helicopter, fast jet and multi-engine. Helicopter pilots are trained to fly one of a range of rotary aircraft, including Chinook and Puma helicopters. Some of the more demanding roles for these pilots include search and rescue missions and Special Forces support roles. During recent conflicts, the Chinook helicopter was selected as the transport platform for the Medical Emergency Response Team (MERT). In this role, pilots fly a team of specialised pre-hospital medical clinicians, supported by a group of force protection soldiers, to evacuate injured military personnel. Resuscitation of these service personnel is carried out in flight. These missions are always time critical and frequently involve challenging, low-level flying conditions and landing under enemy fire.

Fast jet pilots undertake extremely high-pressure flying roles in Typhoon combat aircraft. These aircraft operate at speeds of up to 2,500 kilometres per hour. Flying at these speeds places considerable amounts of physical and physiological pressure on the body. Operational requirements often necessitate these aircraft being flown at low levels. This flying requires ultrafast reaction times and the highest levels of spatial awareness and dexterity. Each aircraft is equipped with a complex array of navigation, communication, reconnaissance and weapons equipment that need to be operated by the pilot. Fast jet aviators are trained to undertake air-to-air combat and ground attack missions. Considerable amounts of incoming information need to be constantly processed in minimal amounts of time.

The Royal Air Force also trains specialist pilots to fly large, multi-engine aircraft. These include the Hercules C-130, the Globemaster C-17 and A400 aircraft. The roles of these pilots are varied and highly demanding. These aircraft are capable of carrying large amounts of equipment and personnel. Pilots must be capable of flying these huge aeroplanes at low level and landing them on runways as short as 1,000 metres. During prolonged sorties, pilots must have precise psychomotor and spatial awareness skills to allow in-flight refuelling from tanker aircraft. These aircraft are also used to deploy airborne troops in support of Special

Forces parachute operations, for humanitarian aid and for surveillance and reconnaissance missions. During recent conflicts in the Middle East, these pilots flew critically injured troops and clinical teams from the RAF's tactical medical wing, and from military bases in Afghanistan and Iraq back to the UK for definitive surgical and intensive care.

The responsibilities placed on military pilots are immense, as are the consequences of suboptimal performance. Selection of the right individuals with the appropriate attributes, commitment and attitudes is paramount to maintain safety and to ensure that the correct people are provided with the training opportunities to carry out these demanding roles. Every pilot completes an initial five months of officer training. This is followed by specialist, role-specific training lasting for a further two to three years. It costs millions of pounds to train each RAF pilot. It is therefore essential that, from the outset, training opportunities and resources are directed at those with the ability and commitment necessary to complete the full training programme.[65]

Accordingly, the Royal Air Force has developed one of the most sensitive and specific selection processes in the world. The RAF's Officer and Aircrew Selection Centre (OASC) is based in Lincolnshire at RAF Cranwell. The centre provides aptitude testing facilities that select pilots for the Royal Navy and the Army, as well as the RAF. The OASC mission statement is, 'To be the UK centre of excellence that selects candidates with the best potential to successfully complete training as officers, non-commissioned aircrew and SNCO controllers and join the productive strength of the Royal Air Force'.

I was fortunate to visit the facility and learn about the rigorous selection process from the centre's commanding officer, Wing Commander Andy Ross.[66] Selection of potential officers and pilots is a full-time role for 41 staff members at the centre. These include four highly specialised occupational psychologists, occupational health clinicians and a team of 25 selection officers. The centre is capable of assessing over 2,000 potential officers and pilots per year during the officer selection process. Of these, approximately one in three progresses to appointment and training. Additionally, over 5,000 Tri-Service candidates can complete aptitude testing each year.

The centre performs its role to an extremely high standard. For every 100 potential officers who make it through selection, 98 will progress to completion of training and frontline duties. Similarly, following three days of assessment, the centre is able to identify potential military pilots with a 98 per cent positive predictive value. The ability of the Royal Air Force to accurately select individuals with the potential to perform under high pressure is revered by military forces internationally. How do they select high performers so precisely in a matter of only a few days and what attributes do they look for during the selection process?

Initially, potential air force officers and aircrew must successfully complete an online application process and a preliminary interview at their local careers office. Following this, they undergo three days of selection tests at OASC at RAF Cranwell. Day one is fully computer based, testing each applicant's aptitude for roles within the RAF. The second day is an intensive series of group and individual exercises. Day three is for an interview, physical fitness assessment and a medical examination.

The computer-based aptitude tests (CBATs) assess a broad range of aptitudes, cognitive abilities and skills in potential officers and aviators. Sitting at a computer terminal for a full day, each candidate must complete a large number of specially designed assessments. These tests must be completed within tight time limits. Cognitive abilities are tested with exercises involving short-term recall, numerical reasoning, verbal reasoning, arithmetical ability and multitasking ability. A range of other aptitude skills are also measured, including psychomotor ability, vigilance, spatial memory and spatial reasoning. These computer-based tests have been continually refined since they were first developed for the RAF by Cambridge University in the Second World War.

The CBATs allow specific selection, at an early stage, of individuals who are suited to specialist roles, based on the strengths of their personal aptitudes. Each aptitude is scored automatically by the computerised assessment system. These scores are then compared to scores that have been found to be necessary for each specialist role, e.g. pilot, weapons systems officer or air traffic controller. An air traffic controller, for example, requires exceptional levels of spatial reasoning and spatial memory to safely coordinate the flights of multiple fast flying aircraft. Weapons systems officers need a high degree of numerical reasoning and mental arithmetical ability. The minimal scores required in each area of aptitude testing for each specialist role are continually quality assured. Candidates are continually assessed throughout their training with the RAF. For the small number who ultimately fail to successfully qualify for a specialist role, their aptitude scores at the point of selection are scrutinised and, if necessary, the scores needed by future applicants for that role are refined. Thus, the accuracy of the selection system is continually improved.

At the end of day one, a decision can be made not to allow candidates who failed to achieve a predesignated minimum standard to progress to the next stages of assessment. These individuals are given a detailed one-to-one debrief of their performance.

Day two of OASC selection comprises a wide range of group exercises, individual tests and command tasks. These take place in a purpose-built hangar with dozens of permanent testing stations. These exercises

assess decision-making, communication and leadership abilities, i.e. the attributes necessary to become an RAF officer. Candidates are divided into small groups of five or six. Group discussions and planning exercises assess each person's ability to communicate effectively, assess problems and influence the rest of the group. In group planning exercises, candidates have 20 minutes to individually read and process a large volume of information about a particular problem. Following this, they meet with the rest of the group, discuss the problem, identify possible options and arrive at a consensus with regard to the best course of action within 25 minutes.

Individual tasks test each person's ability to assimilate large amounts of information in limited amounts of time, to formulate a range of options and to make a judgement with regard to the best course of action.

In the hangar-based group exercise, each team must complete a range of tasks within set time periods. In some of these exercises one person will be allocated the role of a team leader. Others are termed 'leaderless' tasks. The behaviours and interactions of each group are closely monitored by two selection officers throughout the day.

During day three, each candidate is interviewed by two different selection staff. In these 30-minute interviews their relevant life experience is explored and their commitment to a career in the Royal Air Force is assessed. Each question is carefully scripted to avoid bias and ambiguity. Following this, each individual must complete a physical fitness test. All candidates must also complete a general medical assessment. Those deemed to have the potential for specialist roles have an additional medical, specific to the requirements of that role.

The Royal Air Force's selection process has evolved over many decades into the highly effective system that is now in operation at RAF Cranwell. The improvements in safety and the reduction in unsuccessful completion of officer and specialist training courses have been considerable. With a highly developed and quality assured selection process, the RAF can identify individuals with the ability to perform optimally in situations with extreme high pressure, in only three days.

What Makes a High-Performing Team Member?

I asked some of my colleagues from retrieval and mountain rescue to consider people they regularly work with on complex, highly demanding tasks. I asked them to think about who consistently performs well under

pressure. How would they describe the person's aptitudes and their abilities? How do they interact and behave when under pressure?

Despite responses being returned independently, there was a strong correlation in the traits and behavioural characteristics listed.

Emotional intelligence was seen as vital for performance under pressure. All cited that those with an ability to perceive, acknowledge and empathise with how other members of the team were feeling were most effective at getting the most from their team mates. They managed to detect early signs of anxiety, fatigue and low confidence levels.

The full team believed that an understanding of human factors and how we behave under stress was important. Training in human factors allows us to have insight into behaviour in ourselves and others, and of bias and error traps. This insight, combined with the terminology to describe how we behave, is vital in maintaining performance and safety. When overload does occur, those asked described how important it was to recognise this was happening in themselves and in their team mates.

Communication ability was seen as a vital skill in high-pressure performers. Effective team mates had a range of communication styles they could call upon during a task. Detailed, discursive communication was important when situations were complex but not time critical. Conversely, the ability to give didactic, brief instructions using closed loop communication was essential when the team was experiencing high levels of pressure. For team leaders, an ability to give concise, but comprehensive, briefings and handovers was a key attribute.

The ability to actively listen to colleagues, even when your hands are full and you are experiencing multiple distractions, was highly respected. Processing suggestions for actions and changes of plan when already cognitively burdened was an ability observed in the highest performers. Those who performed poorly at this were often seen to dismiss suggestions from colleagues without fully considering what they were saying. Conversely, some people, when overloaded, would simply acquiesce to the suggestion without fully considering the implications.

How individuals perceived, evaluated and handled risk was important in many high-stakes situations. An ability, through personal previous experience and gaining the opinions of the full team, to objectively assess the potential risks of each action and compare them to the risks of alternative actions, and the consequences of inaction, is vital to the safe and efficient handling of demanding situations.

Resilience in coping with setbacks during challenging situations was described as important for maintaining confidence and optimising the effectiveness of the full team in solving the problem. Many described how their colleagues reacted when something went wrong, or how they felt let down by someone not performing to expectations. Those who were overtly critical and displayed signs of anger or exasperation immediately lost a degree of respect from the team and had to work hard to regain control. In these circumstances, communicating in an abrasive manner, even unintentionally, led to disengagement of that individual with the loss of potentially useful further assistance. The ability to take the setback on the chin, reframe and move on was cited as being a highly desirable trait. Those who demonstrated self-control when a situation was deteriorating were respected by their team mates.

The teams frequently encountered times when large amounts of new information required processing. Some described how their most effective colleagues clearly had their own personal systems to assimilate information during retrieval and rescue missions, creating their personal mental models and then formulating a plan. Effective team members ensure the plan is clearly communicated and what the priorities are.

Flexibility was regarded as an important attribute by many of the people I asked. The ability to make decisions even when the information, which was ideally required, was incomplete. Although standard operating procedures can be hugely helpful in complex situations, high performers know when to safely deviate from 'set' ways of doing things. Similarly, an ability to stop progressing with a course of action in light of new information or a change in light of a dynamic situation is vital.

What also became clear from all of those who responded was that the highest performing individuals were those who had diligent and conscientious attitudes to maintain their personal knowledge about the core operations of the service. Through continual practice, they develop automatic processing abilities for all of the core tasks and decisions. When cognitive loads are high, it's essential to have the spare capacity to deal with the situation's unique and dynamic challenges, i.e. having the capacity for type two, analytical processing.

Those who take the requirement to maintain knowledge of core and predictable functions of the team seriously perform best in these circumstances. Those who are fully familiar with how equipment operates and the team's written guidelines do not have to squander their limited cognitive capacity for decision-making and task completion in these areas. However, those with less familiarity of core knowledge and skills are more susceptible to developing cognitive overload and frazzle.

A personal desire and ability to objectively review personal performance after complex tasks is crucial. This needs to be combined with being able to take on board constructive feedback from others involved in the job. All stated that an ability to genuinely, personally reflect on performance was a key trait in effective team members. Those who made time for detailed debriefing, including actively listening to colleagues, were highly regarded. Similarly, during demanding situations, the person who was open to having their plans and mental models questioned by other members of the team was seen as more likely to be a high-performing member of the team.

Finally, retrieval and rescue missions are often prolonged, physically hard and sometimes emotionally upsetting. Members of the team enjoyed working most with colleagues who had a keen sense of humour, especially those who manage to maintain this when under pressure. Cracking a joke sends a message to others around you that you are in control and have sufficient spare cognitive capacity to see the funny side of things. Humour sets the rest of the team at ease and helps get people onside.

Branding to Optimise Team Selection

Only a finite number of people have the ability to perform to a high standard under pressure. In order to identify and recruit people with the requisite abilities, it is necessary to have a large pool of applicants to choose from. It is beneficial for organisations to cultivate a reputation for high performance. This is done through a carefully planned branding and marketing strategy. Use of social media, presentations at industry conferences, blogs and professional journal publications are ideal tools to build this reputation.

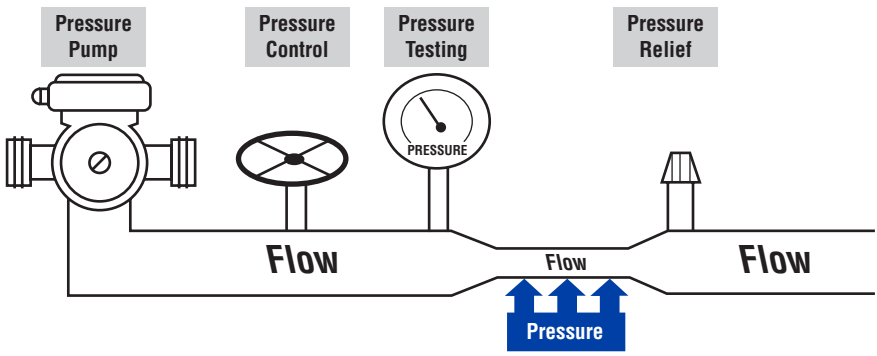
If, through branding and marketing, each position in the organisation is highly oversubscribed, this also engenders a sense of pride and loyalty from existing team members. This improves performance and helps with staff retention.

Organisations which require individuals and teams to perform to a high standard need to consider what personal skills and attitudes are necessary for working in high pressure situations. Only a minority of people have the ability to perform well in these situations. A carefully designed selection process to identify people with the necessary attributes is key to the organisation's pressure pump. This also requires organisational branding and marketing to attract a large enough pool of applicants.

Learning Points

- The ability to select people with the right aptitude and attitudes is essential for developing high-performance teams. It helps to encourage a large pool of applicants in order to aid the selection process.
- The qualities of individuals capable of performing under pressure include:
  - Emotional intelligence.
  - Knowledge of human behaviour.
  - Communication ability, including active listening.
  - Ability to assess and deal with risk.
  - Resilience, self-control and optimism when setbacks occur.
  - Personal methods for information assimilation and decision-making.
  - Flexibility in light of changes in circumstances.
  - Diligence in maintaining personal knowledge and skills.
  - A desire to review and improve personal performance.
  - A sense of humour.

Section 3
Pressure Control



Information recall and decision-making are two of the greatest challenges facing individuals and teams working in high pressure situations. Cognitive overload can easily lead to a state of frazzle and poor performance. The provision of cognitive aids in the form of guidelines, checklists and action cards, in addition to well designed and prepared equipment, helps considerably to avoid excessive pressure and keep us in the zone of high performance flow.

Chapter 7
Guidelines and Accessing Information under Pressure

Cognitive Offloading with Effective Guidelines

Many high-pressure situations require individuals to recollect substantial amounts of information in order to make judgements and decisions. Much of this information is stored in our explicit long-term memories (see Chapter 2, 'Thinking Under Pressure'). This information is needed to make assessments and decisions. Information recall is also necessary when undertaking complex or infrequently carried out physical tasks. In demanding situations, accessing and recalling this information is challenging and can easily lead to avoidable increases in pressure. Access to our explicit memory in order to make use of previously learned information is, unfortunately, compromised by high-pressure.[18] We therefore cannot rely on our ability to recollect vital information when we are experiencing stress. We can address this via the use of cognitive aids, such as clear guidelines. High-performing teams need operationally effective guidelines to help us own the pressure, preventing us from moving to the right side of the arc and heading into a state of frazzle. Well-designed guidelines are a vital tool for cognitive offloading and regaining a state of optimal flow.

Guidelines serve a number of purposes in high-performing teams. They are required for many disciplines because the volume of information is simply too large to commit to memory. With evolving scientific evidence and operational experience, ways of approaching problems are subject to constant refinement. It can be difficult to keep up-to-date with these changes. Guidelines are also an essential part of induction training for new members of the team. Teams working to guidelines are more effective in collaboratively dealing with challenging situations because they help create shared mental models and goals and a standardised approach.

Considerable initial and ongoing effort is, however, required to create and maintain operationally effective guidelines. Guidelines have to be kept up-to-date in light of emerging evidence and organisational experience. Changes need to be communicated to those who are using the guidelines. Guidelines should be written in a style that is suitable for people to use easily in high-pressure situations, i.e. they need to be concise, well-structured and optimally graphically designed. They have to be easily found and readily accessible, ideally in an electronic format such as a bespoke smartphone application.

While providing decision-making support, guidelines shouldn't be overly prescriptive and restrictive. This is particularly important when they are to be used by experts or in complex, nuanced situations. Giving people flexibility to vary their decisions and actions in light of specific circumstances is important. Adhering to narrow, didactic standard operating procedures can, in some circumstances, lead to suboptimal outcomes.

The Emergency Medical Retrieval Service

The EMRS is Scotland's aeromedical critical care retrieval team. Established in 2004 by a group of volunteer doctors, the service is now fully funded by NHS Scotland. The team of 50 doctors, paramedics and nurses operate from a dedicated retrieval base and aircraft hangar at Glasgow Airport. The team have access to a helicopter, a plane and fast response vehicles to respond to incidents.

The main role of EMRS is to support the care of patients in rural locations. People who become seriously unwell or injured in densely populated urban areas can be rapidly transported by ambulance to large hospitals capable of providing all of their care needs. These hospitals have on-site specialist services such as emergency medicine, intensive care and surgery. It is, however, unfeasible to have hospitals with these facilities in rural locations and islands with low population densities. Scotland has 24 small healthcare facilities in remote locations serving isolated populations. Patients with all severities of illness and injury are taken to these centres by the local ambulance. Bypass to larger hospitals is simply impossible. These facilities have the skills and equipment to safely treat the majority of conditions presented to them. However, a minority of patients who are critically unwell require a level of care that is not available outside of large urban hospitals. Patients therefore require on-site stabilisation in the rural facility, followed by safe transfer by helicopter or plane to the definitive care hospital. These retrievals are

referred to as 'secondary missions' as the patient has initially been under the care of another healthcare provider.

The second role of the EMRS team is to provide an advanced level of life-saving medical care at accident scenes. These are termed 'primary' retrieval missions as the team members are the first clinicians to assess and treat the patient. Many seriously injured patients die from potentially reversible injuries, such as bleeding and chest injuries, before they reach hospital. Others who do survive may experience brain damage due to lack of oxygen because their airway was compromised before they reached the hospital. These are complex and time-critical situations. The team has a paramedic in ambulance control 24 hours a day, whose sole job is to identify cases of major trauma as quickly as possible. They then deploy the EMRS team directly to the scene by helicopter or car. This involves landing the helicopter on hillsides, on motorways, and in the middle of housing estates.

When the team respond to these primary missions they can administer an emergency anaesthetic to control the patient's airway and optimise their breathing. They can provide blood transfusions and a number of surgical procedures to treat chest injuries. Patients who are in pain also receive powerful pain-killing drugs such as ketamine. Once stabilised, patients can be taken by air directly to a major trauma centre, bypassing the nearest hospital which may not be capable of providing the care they need. These incidents are often highly pressured in terms of time. The team has to perform complex interventions with the assistance of paramedics they have never met before and who are not trained in critical care procedures. Environmental conditions, especially at night and in the winter, provide additional challenges.

Multiple casualty major incidents unfortunately occur on a relatively frequent basis in the UK. These are usually due to transport incidents, industrial accidents or terrorist atrocities. For incidents in the west of Scotland, the EMRS team deploy alongside the ambulance service, the police and fire fighters. The demands at these scenes can be extremely complex. The team have responded to a number of major incidents including the Clutha Bar helicopter crash, the George Square lorry tragedy, a fairground roller-coaster major incident, large-scale fires and many multiple vehicle road traffic collisions. The cognitive load due to the volume of information and number of patients and personnel at these incidents can be overwhelming. The emotional pressures on the team can also be considerable.

What is expected of these clinicians in dealing with a huge range of medical and traumatic emergencies and a large amount of complex equipment is

considerable. Patients with similar illnesses and injuries in a large hospital would initially be cared for by a group of six or more doctors and nurses. The EMRS team must provide the same level of care with a team of two, with limited equipment and while on the move.

The pressures are increased when working outdoors in challenging environmental conditions and on a number of different transport platforms. Secondary retrieval missions last from 6 to 14 hours. Continuous periods of work exceeding 24 hours are not uncommon. The risks and consequences of poor decision-making or failure to safely undertake medical procedures are high. The ability to perform under intense pressure is paramount. The service has, therefore, invested heavily in developing systems to manage the pressures faced by the team. These include over 120 clinical, operational and safety guidelines.

Hypothermic cardiac arrest

In the winter of 2016, the EMRS team were deployed by helicopter to a remote area of Scotland. A 39-year-old man had been found lying unconscious in a field.[67] He had been last seen the evening before. The temperature overnight had been below zero. The man had been exposed to these conditions all night.

A land ambulance crew had arrived at the patient shortly before the helicopter team. They confirmed that his heart had stopped. He had suffered a cardiac arrest. They commenced resuscitation attempts. The human body's normal temperature is 37 degrees celsius. This man was severely hypothermic with a temperature of only 21 degrees celsius.

When exposed to cold environments, e.g. being immersed in cold water or trapped in an avalanche, it is possible for the functions of people's brains and vital organs to slow down before their heart stops. This slowing of cell metabolism can protect them from the effects of a cardiac arrest, i.e. no blood flowing and no oxygen being received. The body's organs can be preserved by the cold. Hypothermic patients whose hearts have stopped can enter a state akin to 'suspended animation'. If they can be rewarmed and their heart restarted, in some cases it is possible for them to make a full functional recovery.

Encountering a patient in hypothermic cardiac arrest is, however, a rare event for doctors. Most doctors will never be involved in this type of incident. Even for pre-hospital specialists it's a once in a career experience. Recalling the fine details of how to treat the patient in these circumstances and what parameters to use to decide if they have a chance of surviving is simply impossible. In these circumstances, written

guidelines as aids to cognition are essential to ensure that patient care is optimal. The EMRS team responsible for this man's care used the team's severe hypothermia guideline.

This guideline reminded them of the criteria for when it was appropriate to attempt defibrillation and when to give injections of intravenous adrenaline. It supplied parameters with regard to temperature and blood potassium levels, which helped them decide that the patient could, potentially, survive. The guideline also gave details of the nearest appropriate hospital with the facilities to provide definitive care for the patient. Importantly in a pressured situation, it also had the necessary direct dial phone numbers allowing them immediate access to key decision makers. The guideline cognitively offloaded the team and reduced the pressure on them. The team accessed this guideline on the service's smartphone app.

The patient had a tube placed in their airway. This was connected to an electrical ventilator to supply oxygen to the patient's lungs. Manual chest compressions are used during cardiopulmonary resuscitation to compress the heart. This essentially reproduces its blood pumping function. Performing manual chest compressions is tiring, even for just a short period. Maintaining chest compressions for a prolonged period on a patient in hypothermic cardiac arrest while they are rewarmed is very difficult. Effective manual chest compressions during air transfer are almost impossible.

The team placed the patient onto a mechanical chest compression device. This allowed effective chest compressions to be carried out for a prolonged period during air transfer and until the patient was warmed up.

The man was flown by helicopter, in cardiac arrest, to the nearest hospital capable of providing Extracorporeal Life Support (ECLS). This advanced treatment involves using a highly complex machine to take over the work of the patient's heart and lungs. In an operating theatre, a surgeon inserted large plastic tubes into the artery and vein in the patient's groin. Blood flows out of the patient into the machine. The machine places oxygen into the patient's blood and pumps it back into his body. This process keeps blood flowing and supplies oxygen to patient's cells. The function of vital organs is preserved.

While the patient's blood is flowing through the machine it can also be rewarmed. This gradually brings the patient's temperature back up to normal. Attempts are then made to restart the heart. In this man's case, he was rewarmed on the ECLS device to a normal body temperature in

a matter of hours. Once his temperature was back to a normal level, his heart was successfully restarted. He survived, returning to full, normal neurological function by the next morning.

Decision-making by the retrieval team was complex in this situation. There was a considerable amount of information that needed to be accessed to make the correct treatment decisions. It would have been unreasonable to expect the retrieval team to have memorised all of the detailed information required for such a rare event. Even if they had learnt it, their ability to retrieve it from their explicit long-term memory would have been compromised by the pressure of the situation. This patient's survival would have been impossible without the team having a thoroughly researched system and a well-written guideline to refer to.

Advanced trauma life support

A further excellent example of how guidelines have improved performance in high-pressure situations is the Advanced Trauma Life Support (ATLS) system. Major trauma is a complex illness. Many parts of the body can be injured simultaneously, and numerous physiological functions seriously compromised. Patients require multiple interventions with minimal delay or they may die. In most hospitals, however, cases of major trauma are not frequent occurrences. The experience of individual clinicians who don't work in major trauma hospitals is limited. The arrival of a trauma patient understandably generates stress. Chaotic, unstructured approaches to treatment are still not uncommon. These, unfortunately, can result in unnecessary patient deaths. Especially for paramedics, nurses and doctors who don't work in major trauma centres, keeping abreast of all the newly published evidence relating to trauma care is simply not feasible. They need a simplified set of up-to-date, evidence-based guidelines to work to.

In 1976, an orthopaedic surgeon, John Styner, was flying a plane over Nebraska with his family when it crashed into a field. Tragically, his wife died and three of his children were seriously injured. The local hospital was small and not in any way equipped to deal with multiple seriously injured patients. The staff had little experience and no systems for dealing with major injuries. They were cognitively overloaded by the pressures of the situation.[68]

As a result of his family's experience in that small hospital, John Styner made it his life's work to establish an international system for the initial care of major trauma: 'When I can provide better care in the field with

limited resources than what my children and I received at the primary care facility, there is something wrong with the system and the system has to be changed'. Dr Styner developed ATLS guidelines and a trauma management course that is now used internationally. ATLS has saved innumerable lives.

The principles of developing the ATLS course were to form a group of experienced trauma clinicians and have them critically appraise the medical evidence relevant to initial major trauma care. They also provided a consensus opinion on areas where evidence was lacking. Through this process they developed an extensive set of guidelines for managing numerous aspects of serious injuries, including airway management, chest injuries, bleeding and head injuries. They also incorporated aides-memoire and systems to ensure that clinicians focused on the right things at the right times.

The mantra of ATLS is ABC: airway, breathing and then circulation. This ensures that those caring for trauma patients who are rapidly deteriorating concentrate on the problems that are going to kill them first. Working to the guidelines also means that everyone involved has a shared mental model of what's wrong with the patient and how their injuries should be treated.

The ATLS guidelines were incorporated into a three-day trauma life support course that is now delivered all over the world. As a result of the guidelines, the aides-memoire, the evidence-based practice and the course with its skill stations and simulation scenarios, clinicians can develop the knowledge and the systems to respond to rare cases of life-threatening injuries. The full team understand the system and what the priorities are. They have a shared mental model of what's happening. Each person knows their role and what actions they need to take. Clinicians of different specialties and grades communicate in a common language. Potential chaos is replaced by structure. ATLS guidelines control the pressure by creating a shared mental model and reducing the risk of cognitive overload.

What Makes an Effective Guideline?

Effectively researched and carefully structured guidelines can support optimal performance, reducing the risk of overload and inaccurate decision-making. They are particularly helpful for infrequently occurring situations and for use by less experienced personnel. Familiarity with guidelines, what to do and when, allows more automatic cognition when under pressure. This means actions are faster and cognitive capacity

remains free for more complex decision-making. Following guidelines also help make an individual's actions justifiable in the event of an adverse incident occurring. Guidelines promote teamwork and a shared sense of purpose.

Guidelines can be considered in three categories: primary, secondary and tertiary. Primary evidence is the information generated by research into a topic. While being essential in changing practice, this information is not routinely published in a format suitable for operational staff. It also needs to be critically appraised for validity and applicability to a team's particular operational demands. Secondary guidelines are guidelines produced by national, governing organisations. In medicine these include the Royal Colleges or the National Institute for Health and Care Excellence (NICE). These secondary stage guidelines make use of the primary research information and relevant expert opinion to create detailed advice and standards for managing situations. Individual organisations and teams may also create their own team-specific operational guidelines. These can be considered tertiary guidelines. Tertiary guidelines are bespoke to the environment, resources and level of knowledge of an individual team.

These team-specific tertiary guidelines take into account the seniority and experience of the operators using them, the availability of specialised equipment and whether additional skilled assistance is readily available. For example, in medicine two national bodies, SIGN[69] and NICE[70], provide guidance for the management of people who have sustained head injuries. Both sets of guidelines provide criteria to help doctors decide if their patient requires a CT scan of the brain following a head injury. These guidelines are highly effective and relevant for use in a large hospital in a city. However, they need to be adapted for the resources available in small, rural hospitals which have no CT scanner and/or onsite specialists. Similarly the JRCALC guidelines, compiled by the Joint Royal Colleges Ambulance Liaison Committee and the Association of Ambulance Chief Executives, are also used to provide guidance and support for ambulance staff in the UK. Although these guidelines provide guidance for practice on a national level, individual ambulance trusts will also have their own procedures and policies which should be adhered to.[71]

Guidelines aimed at operational users in pressured circumstances should ideally be written by subject matter experts who are operational users themselves. When writing, the authors should consider placing themselves in the situation of the end user, who may be dealing with a high-pressure situation at one o'clock in the morning. They need to have personal experience of the practical decision-making challenges that the relevant situations involve. An appreciation of the nuances and 'exceptions to the

rule' are also needed. This includes an understanding that not all situations readily fit into flow charts and tick boxes.

Short is generally good. Busy operational staff are unlikely to read excessively detailed and long guidelines. Secondary stage guidelines, such as national regulatory body guidelines, need to include information referencing their sources of information in order to demonstrate the guidance is evidence-based. Tertiary, team-specific, operational guidelines don't necessarily require that level of detail as it may detract from the pertinent messages required when operating under pressure. Relevant information needs to be quickly identifiable and readily interpreted in emergency situations.

Careful consideration needs to be paid to each statement and term used in a guideline, especially abbreviated ones. Different words, phrases and acronyms can mean different things to different people, leading to inappropriate actions being taken. For example, in medicine degrees of illness severity can be subjective and ambiguous. If used as discriminators in flow charts, a misinterpretation of an ambiguous term can lead to wrong treatments being administered. Therefore, severity classifications need to be clearly defined. A single, poorly chosen word can transform the decision made and the treatment given to an individual patient.

Designing Guidelines

Standardised formatting is important for guidelines. Investment in high-quality graphic design, layout and fonts means documents are more likely to be read and will be easier to use when working under pressure. The input of human factor specialists in designing the layout of guidelines for high stress situations can be invaluable. Increasing use is now made of infographics to convey information in written documents. These can reduce the volume of text required and represent information in an attractive, user-friendly format. If possible, having the front sheet contain the operationally relevant information as standard means that information is readily accessible and identifiable.

For review purposes and legal reasons, it is essential that guidelines have headers or footers with dates, authors' names and expected revision dates. Describing who the guideline has been written for and explaining any other related documents is useful. It's helpful to group guidelines into categories, e.g. safety, administration, equipment and operational guidelines, making it easier to find them when time is limited. For instance, The JRCALC clinical guidelines' pocket book is separated into sections with coloured tabs for each topic to provide easy access when under pressure.[98] Some guidelines, e.g. those relating to equipment,

benefit from troubleshooting sections. If a malfunction or error message is encountered, the document contains the necessary steps to keep the situation safe and rectify the problem.

When considering length, detail and the language used, the experience of the end user needs to be considered. The less experience and knowledge the intended user has, the more detail is required. For tasks with multiple people completing actions simultaneously, colour coding for each role and guidance related to that task is helpful. Concise, simple statements, short sentences and short paragraphs are more user-friendly in stressful environments, especially if distractions are likely. Use of industry-specific jargon can be useful to reduce ambiguity and keep things concise. It is, however, important to ensure that all end users are familiar with the terminology used.

Forming a small group of individuals to create each guideline is often more effective than assigning a single person to the task. This enables different viewpoints and differing levels of experience in the team to be taken into account. It helps to map out the process with a flow diagram or a mind map before the writing phase starts. The group should consider any previous issues or errors that have occurred relevant to the subject of the guideline. Why did people go wrong on those occasions and how can the guideline reduce the chance of this happening again?

Once written, guidelines should be shared with others for review and feedback. Following this, they can be trialled in simulation. It's most useful to simulate their use with a member of the team who is expected to use the guideline but who has the minimal level of experience and skills in the relevant area.

An effective guideline should be the following:

- Concise.
- Unambiguous.
- Standardised in structure.
- Written with the least experienced member of the team in mind.
- Written by operational users with input from subject matter experts.
- Trialled in simulation prior to operational use.
- Regularly reviewed.

Figure 7.1 shows an example of the front page of the EMRS guideline for the treatment of severe asthma. The guideline is stored on a dedicated smartphone application. The front page of each EMRS guideline contains the operationally relevant information. Subsequent pages contain information about authors, review dates and details of source documents.

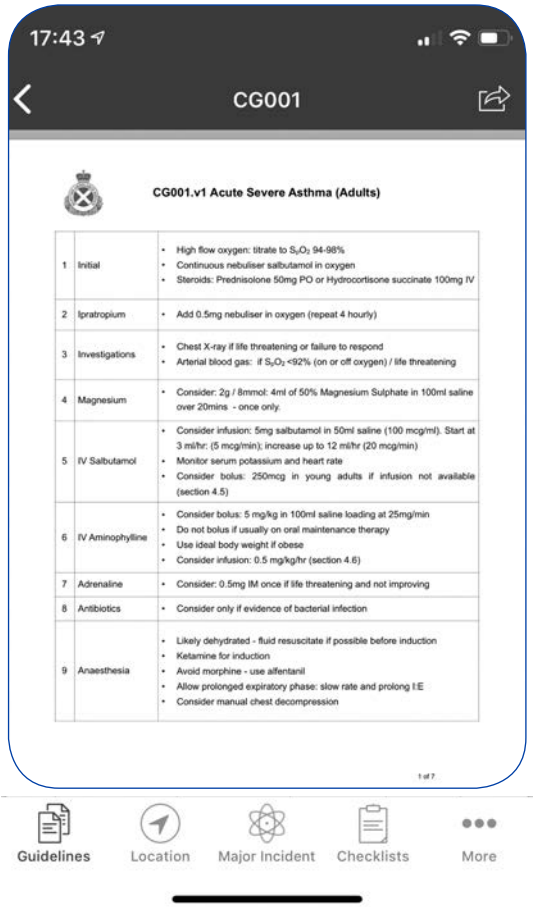


Figure 7.1. EMRS severe asthma guideline.

Guideline Accessibility

There are many methods of making guidelines accessible to operational users. It is important that users are only able to access the most up-to-date versions of the documents. A system to locate the correct guideline in time pressured situations is also essential. Documents can be stored on paper, in bound volumes, on intranet and internet sites and in smartphone and tablet applications.

Paper systems have a number of limitations. Updated guidelines need to be physically replaced in all the places where they are stored. Paper storage carries the risk of out-of-date guidelines inadvertently remaining in use. Individual documents can go missing and the guidelines folder can be left behind when teams are responding to off-site problems. In organisations where guidelines have confidential contents, breaches of security are also

a greater risk. In teams with large numbers of guidelines, paper copies can make locating the relevant document time-consuming.

Online storage is an ideal solution for organisations with reliable internet access. The NHS operates an invaluable toxicology service to advise on the management of patients with poisoning. There are literally hundreds of drugs and household and industrial substances people can be poisoned with. Maintaining a personal knowledge of the effects and treatments for each one is impossible. The National Poisons Information Service (NPIS) maintains an online set of guidelines called 'Toxbase'. When I started working in emergency medicine, before the internet was available, this was actually a teletext-based service! Healthcare professionals can log on to the password-protected Toxbase website, search for a particular substance and receive up-to-date, practical advice on how to deal with their patient.

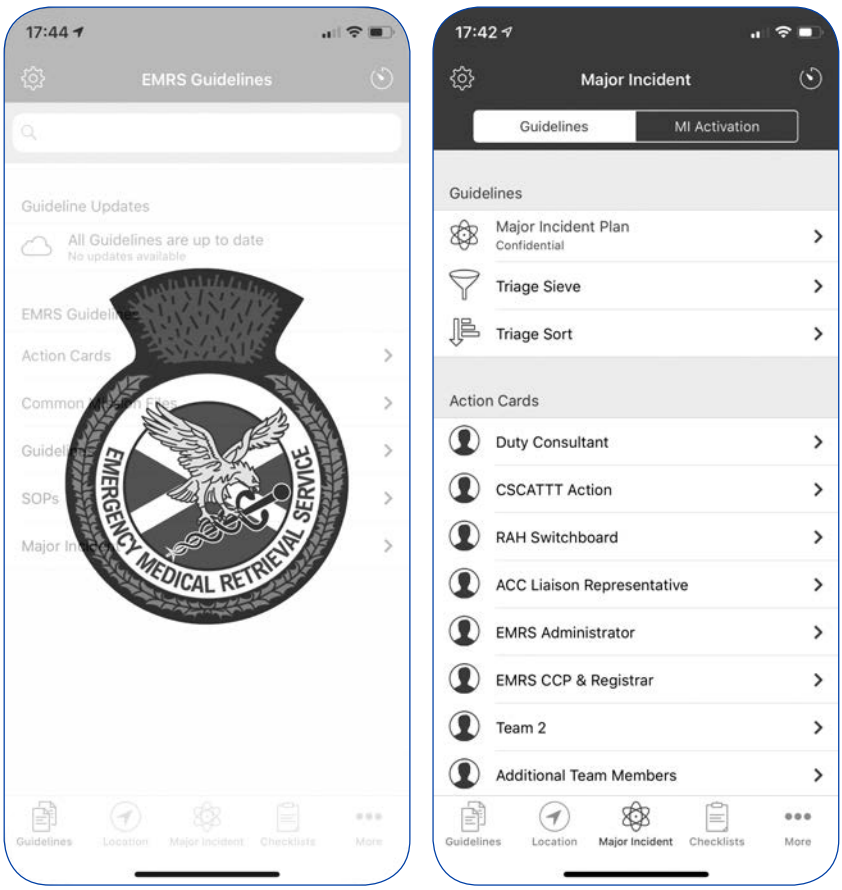


Figure 7.2. EMRS smartphone application guidelines front page and EMRS major incident card action list.

The EMRS team have been using mobile phone and tablet apps for the storage and retrieval of guidelines for many years. The service finds this to be the ideal solution for storing and retrieving our operational guidelines. Team members can be assured that all information is updated automatically. They can even access it in airplane mode while travelling to incidents by helicopter. A backup iPhone is carried on all retrievals. In time pressured emergencies, relevant guidelines can be rapidly found using the search function. Similarly the JRCALC guidelines are also available in an app format for paramedics who are often on the move and cannot take a hefty print publication with them on the job. It also has the benefit of being accessible when offline and has the functionality to filter drug dosages by age, condition and administration route. Paramedics are able to bookmark key guidelines which are

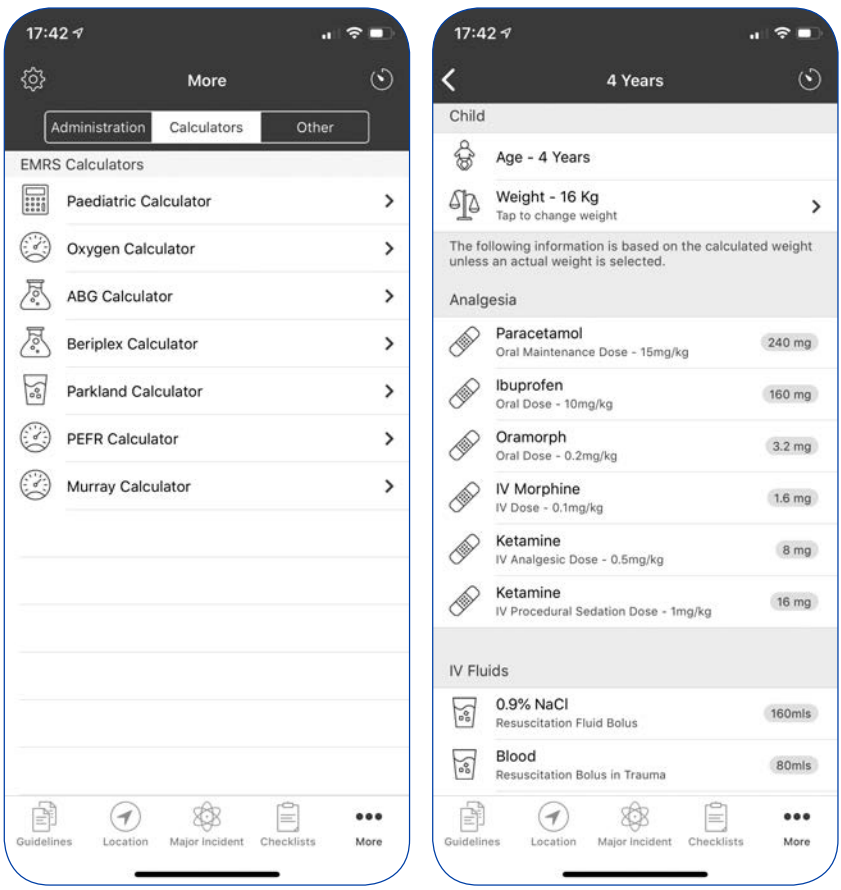


Figure 7.3. EMRS smartphone application clinical calculators and EMRS smartphone application paediatric drug dose guide.

relevant to them. JRCALC also offers bespoke guidelines in app format for individual ambulance trusts (JRCALC Plus). This combines national information with regional guidance and also means that clinical notices can be put out in real time to easily communicate important information to employees.

Standard Operating Procedure or Guideline?

Caution needs to be exercised when labelling documents that provide information guiding practice. Many industries have adopted the term standard operating procedure (SOP). This is a term commonly used in manufacturing industries, engineering and military organisations. The term standard operating procedure may be interpreted as indicating that didactic approaches are mandatory in predictable routine and emergency situations.

Frequently, complex situations don't fit perfectly with standardised approaches. Flexibility is often required in these circumstances. High-performing expert teams should follow pre-planned written guidance when it's appropriate to do so, but also have the latitude to deviate from them as individual situations dictate.

Having rigid, standardised operating procedures may prevent optimal decision-making and task completion in complex and non-standard situations. However, if an adverse outcome occurs when a course of action contrary to an SOP has been taken, it can be difficult to explain and defend the deviation from the SOP.

In many circumstances it's preferable to have guidelines rather than SOPs. This allows individuals to know what the standard approach is, but that situation-specific courses of action are acceptable.

Poorly Written and Maintained Guidelines

I am often asked to provide opinions in cases of alleged medical negligence and professional fitness to practise investigations. In my experience three criteria need to be met when reaching a decision that a person was negligent in their practice. The first question to ask is whether there was a recognised, usual and normal way of performing their duties in the circumstances the individual faced. Secondly, it needs to be demonstrated that the person did not adopt that practice. Finally, it needs to be shown that no other professional person of ordinary skill and acting with ordinary care would have taken the same action.

In proving or defending claims of professional negligence, it is fundamental to establish whether there was an accepted and expected way to do things, what was actually done, and how the two compared. In cases of medical negligence, published guidelines are routinely used to identify the standard of practice that should have been carried out.

Expert witnesses providing opinions in negligence cases receive a letter of instruction from a solicitor. This outlines the case and asks a number of specific questions. The first stage in providing an expert opinion is a written report detailing the circumstances of the case, what the relevant clinical guidelines are and what the actions of the doctor were. Following this, the report discusses how the doctor's actions compared to the standard of care detailed in the guideline. If there was variance from the guideline, was this understandable and justifiable in the circumstances?

Submission of the report is followed by a face-to-face meeting with the solicitor and counsel handling the case. These lawyers can be acting for a patient who is claiming damages (the pursuer or claimant) or for the employer of the healthcare professional (the defender). Medical negligence solicitors place considerable emphasis on the content and standards of practice recommended in the guidelines relating to a case of alleged negligence.

As a result, when assessing whether a case can be considered as negligent, I am regularly required to read and refer to medical guidelines produced by Royal Colleges, NHS guideline agencies (including NICE and SIGN) and hospitals themselves. Most of these are well-researched documents that are up-to-date, concise and well-written. They provide clear guidance for clinicians caring for patients in those conditions. Others guidelines can be, unfortunately, more ambiguous or suboptimally structured. This can easily lead to their contents being misinterpreted, especially in pressured emergency situations. Some are also out-of-date in relation to evolving scientific research. Guidelines of this standard are challenging for doctors in high-stakes situations to interpret and act upon.

It's also not uncommon to have more than one set of guidelines from a number of different organisations on a particular subject that contradict each other. This often results from each group of authors interpreting the primary research differently or having differing personal opinions regarding areas where the evidence is not strong. It can also occur when guidelines have been published at different times.

For many patients with uncomplicated, isolated conditions, well-researched and well-written guidelines greatly aid their safe and effective care. In such cases it can be challenging to justify the actions of a clinician if they have not followed the relevant guideline and the patient has come to harm.

Poorer quality guidelines can, however, be a hindrance to effective decision-making, especially under pressure. Out-of-date guidelines that are no longer based on current evidence can adversely influence patient care. Systems for managing guidelines need to ensure that they are regularly reviewed and updated when necessary. Effective systems for communicating changes also need to be in place.

EMRS Guidelines

The EMRS team started off with around 40 documents at its genesis, which we termed standard operating procedures (SOPs). These related to clinical care, aircraft, safety and administrative policies. Most of these were borrowed from existing high-performing air ambulance services. These SOPs were adapted to fit the team's equipment, transport platforms and their operational environment. These documents have since been updated and expanded over the years. The EMRS now has over 120 guidelines.

These guidelines are the operator's manual for the service. New members of the team use the documents as part of their induction, learning how and why the retrieval service does things. Although already experienced, doctors, nurses and paramedics also refer to the guidelines to inform them of how the team adapts and applies in-hospital practices to the out-of-hospital retrieval environment. The guidelines are used to define how the team approaches certain problems. This means the team have a shared mental model when faced with a particular issue, and everyone knows how to respond. The advice in the guidelines also helps maintain personal safety when working, for example, at road traffic incident sites or when flying in bad weather.

Some of the tasks undertaken by the retrieval service occur frequently and are relatively routine. Some, like the case of the man in hypothermic cardiac arrest, are, however, rare and complex. Guidelines are invaluable; they support our thinking and the team's actions when under pressure in these infrequently encountered situations.

The service aims to review all of their guidelines annually, on a rolling basis. However, changes in practice in light of new evidence or incident reviews also result in guideline reviews. A system of weekly team briefs

that contain guideline updates has been put in place; only changes to the reviewed documents are included in the updates. This means that it's clear to the full team what has been changed in the process, without having to read the full document. Spreading them out over the year also means that the amount of new information is disseminated at an easily digestible rate.

Over time, the EMRS has learned a considerable amount about writing and using guidelines. They've realised that, for their purposes, these documents are more appropriately termed guidelines rather than SOPs. This allows for more flexibility in practice, which is especially important in a service delivered by senior consultants. This means they are less restrictive in complex, nuanced circumstances.

Although the team originally developed a standardised document structure, many of the original guides were more akin to long textbook chapters. They tried to have each clinical guideline start with information advising rural hospital colleagues on the clinical care that can be provided before the retrieval team arrive at their location. Unfortunately, no specific instructions were provided to the authors as to how this should be done, and there was minimal editorial control. As a result, the efficacy of each guideline for their rural colleagues was variable.

The EMRS team in Scotland often work alongside pre-hospital teams from other areas of the country. Despite each team doing much the same job in similar circumstances, they have differing sets of guidelines, some of which are conflicting. This has often led to situations where joint working was compromised due to differing mental models.

In 2017, the EMRS set about reviewing all of their service guidelines. Each guideline was split into two sections. The front page has been made as short as possible, containing only the information that is required when working under pressure with a critically ill patient, i.e. the information needed when carrying out a procedure or using a piece of equipment. The second section is lengthier, with an explanation of how the guidance was developed and what sources of evidence were used in its formulation.

The layout is now clearer and is standardised. Treatments suitable for use by rural general practitioners before the retrieval team arrive at their hospital are distinctively shown in each of the documents.

Operationally effective guidelines are essential to cognitively offload individuals and teams working in high pressure situations. Easy access to well-designed cognitive aids helps maintain operators in a state of high performance flow and reduces the risk of moving in a state of over-pressured frazzle.

Learning Points

- Guidelines are essential in high-performing teams.
- Guidelines need to be carefully structured and worded.
- They have to be regularly updated with emerging evidence and experience.
- A reliable electronic system for accessing guidelines is also key to their effectiveness.
- Minimal length, optimal font size, standardised formatting and good graphic design are important in guideline design.
- A system to locate the correct guideline in time pressured situations is also essential.
- Complex situations often don't fit perfectly with rigid, standardised approaches.

Chapter 8
A Checklist for Checklists

Checklists are invaluable in reducing error and offloading teams working in demanding situations.[72] They help to ensure all steps in a task are completed, reduce pressure prior to high-risk procedures, improve teamwork and help to avoid cognitive overload when unexpected events or equipment failure occurs.

Checklists help us maintain focused attention during the preparatory phase prior to a high-stakes task. If used correctly, they eliminate distractions and interruptions that divide our attention and compromise our cognitive abilities. They also empower all members of the team to share their opinions, knowledge and concerns, thus improving shared understanding and the mental model of the full team.

Prior to a complex, high-risk task, checklists prompt us to go through a cognitive reframing process.

The risks of cognitive biases are also reduced by the use of checklists. Information is considered more thoroughly and objectively, with each member of the team encouraged to share their opinion. They promote analytical processing, even when dealing with routine tasks. This reduces the incidence of errors due to bias traps.

Checklists have been routinely used in the aviation industry for decades. There are numerous instances of how they have helped avert adverse events. Slowly, they are becoming more accepted and utilised in the emergency services, medicine, the military and business settings. Checklists are a key part of high-performance systems to control pressure.

Emergency Medicine Checklists

The pressures placed on emergency department doctors and nurses is continually increasing. Attendance numbers rise year-on-year, largely due to an ageing population. Patients' expectations of healthcare

providers are understandably increasing. The range and complexity of patient investigations and treatments are also rising. In 2018–19, an average of 67,991 people attended accident and emergency departments each day in England – a 4.1 per cent increase compared to the year before.[73] Large UK emergency departments may see between 200 and 300 patients per day. Many of these will be critically unwell and have complex care needs.

Emergency medicine is a very broad speciality, with a huge range of conditions that require accurate assessment and treatment. Frequently, there is time pressure to diagnose and manage patients who are deteriorating. Also, the number of patients requiring care frequently exceeds the capacity of the department. These pressures render it very challenging for emergency physicians and nurses to recall all of the information required regarding the features of each disease and the components of treatment needed for each one.

Emergency physicians are also expected to respond to complex situations with minimal or no warning. Often this involves multiple patients arriving simultaneously, e.g. from car accidents. They are also subject to repeated interruptions and prolonged duty periods, leading to fatigue. Many of the treatments and surgical procedures performed in the emergency department carry significant risk if carried out incorrectly. In some cases, if even a single step is inadvertently omitted from a treatment pathway, this can have devastating consequences.

Checklists are an invaluable tool in emergency medicine to ensure that the department is optimally prepared to deal with the unexpected arrival of critically ill patients. They reduce anxiety about equipment readiness. Completing a checklist can act as a form of cognitive reframing. This is especially valuable in situations where the individual has experienced an initial cognitive appraisal of threat from the situation or the complexity and risk of the practical task they are about to perform. The cognitive reframing process through checklist completion can act to transform their threat appraisal to one of challenge.

They also support more effective teamwork by encouraging a flat hierarchy among the full team. One author describes this in the following terms, ‘One great advantage of a checklist is the ability to democratise knowledge’.[72]

Complex, multi-stage treatments or ‘care bundles’ are more likely to be completed fully and within the necessary timescale if a checklist is used. Pre-procedure checklists reduce error and reduce the feeling of pressure on the operator.

A range of checklist types are used in emergency department settings. These can be categorised into four types:

- Preparedness checklists.
- Pre-procedure checklists.
- Emergency action cards.
- Process guides.

Preparedness checklists

Checklists can be used to ensure that teams have completed the necessary steps to ready themselves for demanding situations. These include equipment checks, vehicle checks, safety checks and team briefings.

Pre-shift checklists are an excellent way for high-performance teams to start the day. Completing checklists in the emergency department resuscitation room at the beginning of the shift ensures that the department has the functioning equipment necessary to deal with any emergencies that may come in during the day. This reduces workload and anxiety in the minutes before a seriously ill patient arrives and reduces the chance of error during patient care. Checklists at this time also allow members of that day's team to identify themselves, informing colleagues of their role during resuscitation. In this way, checklists help create a flat hierarchy in high-performing teams. Experience from the operating theatre has shown that starting the day with a checklist briefing improved communication and teamwork throughout the shift.[56] In high-pressure situations, junior members of the team are consequently more likely to contribute to decision-making and highlight areas of concern.

The process of checklist completion at the start of a shift also symbolises to the team that they are there to do a demanding job and that they personally need to move to a state of readiness. This is a form of psychological 'priming' for high-performance.

As well as completing checks of medical equipment, vehicles and personal protective equipment, the EMRS team completes checklists immediately before it leaves the base on emergency calls. We have a 'leaving scene' checklist which we go through before leaving a rural hospital or an accident site with a critically injured patient. This ensures we have stabilised and packaged the patient as well as possible, any equipment we may need is accessible in the aircraft, we have anticipated how the patient might deteriorate in flight and that we have communicated with the receiving hospital.

Pre-procedure checklists

A culture of using checklists before high-risk tasks, even by experienced experts, reduces omissions and misinterpretation of information due to complacency. Even pilots with thousands of flying hours use pre-flight checklists. These ensure that the aircraft is safe for flight and that the crew have a shared mental model regarding what is going to happen during the take-off part of the flight. The potential to cut corners, omit vital steps or fail to receive information that needs to be processed is considerably reduced.

The process of using a checklist is itself beneficial. In the pre-hospital setting I use procedural checklists before anaesthetising patients, a high-stakes, high-risk procedure. Ostensibly, the checklist ensures that the team has the correct equipment and drugs to intubate the patient and to safely deal with any untoward events. However, the checklist does much more than achieve safety and promote effective teamwork. The period of checking brings an air of calm to the situation; it's clear to everyone present at the scene, including police officers and firefighters, that something critical is about to happen and that a quiet, calm environment is needed. Working through the checklist ensures that everyone involved has the same concept of what's happening and what the plans are – including their own personal role – if something goes wrong.

For me, the pre-hospital anaesthesia checklist signifies a transition from the phase of time pressured scene and patient management, which can be almost frantic, to a phase of calm, high-performance flow for patient intubation. If the initial stages of the situation have placed me into a state of stress and frazzle, the checklist pulls me back into a state of flow.

The EMRS conducted an independent stress study during simulations of emergency anaesthesia. Prior to the study, we expected that heart rates would increase at the point where the anaesthetic drugs were administered to the patient to put them to sleep and stop them breathing. At this point, considerable pressure is on the doctor to accurately place the breathing tube in the patient's trachea before their oxygen level falls. However, what we found was that most of the retrieval consultants' heart rates actually fell during the period when the checklist was being used. The checklist reassured the doctor that everything was as prepared and safe as it could be and that their colleagues had their backs. The checklist helped cognitively reframe the situation. Completion of the checklist also meant that the doctor was as cognitively offloaded as possible. The checklist allowed the team to own the pressure and ensured that

they were situated in the ideal position on the performance arc while performing the procedure.

For others involved in the pre-hospital anaesthetic, especially paramedics who may not have witnessed the procedure before, the checklist makes clear what's going to happen and how they can help. Checklists help achieve accurate, shared mental models. They also create a flat hierarchy that encourages everyone involved to speak up and query things that are causing them concern. After the patient has been safely moved from the scene, the EMRS team have found that the paramedics have a more positive view of the active role they played in the team caring for the patient.

The benefits of pre-procedure checklists in improving medical safety are considerable. A central line is a long, thin plastic catheter that is used to administer drugs, fluids and blood to patients. The majority of patients in intensive care units have central lines inserted. Most commonly, the line is placed into the internal jugular vein in the neck and advanced towards the heart. The first step is to insert a needle into the vein. A long thin metal wire is then passed through the needle into the centre of the blood vessel. The plastic catheter is in turn advanced into place over the wire. The wire is then removed. The removal of the wire is a critical step in the process.

The point of insertion in the neck is anatomical tiger country. Misplacement can lead to the insertion of the wire into the carotid artery supplying the brain. The lung can be punctured and collapse. If the line is inserted too far into the heart, cardiac arrest can occur. During the procedure, it's also possible to administer large boluses of air directly into the heart. There is also a significant risk of the line becoming infected, causing sepsis and organ failure in the patient. When we consider that central lines are usually only inserted in patients who are already critically ill or when they are about to undergo major surgery, the potential for causing significant harm is considerable.

I was taught to insert central lines while working in intensive care in the mid-1990s. The philosophy in medicine to learning practical procedures in those days was 'see one, do one, teach one'. The success of the procedure was initially reliant on who taught you, and then 100 per cent down to your own personal skill and experience. In this era, doctors inserted the lines based on the anatomical landmarks they saw and felt in the patient's neck rather than accurately siting them using ultrasound guidance as is routine practice today. There were no checklists to help the doctor and nurse prepare the 20 sterile items that need to be on the trolley. Without fail, once the doctor was scrubbed with the line half inserted, you'd discover

that a vital piece of kit was missing. Misplacement of the lines occurred. Infection due to less than sterile preparation was also not uncommon.

Many years ago, while working in the emergency department, I saw a patient who had come in with abdominal pain. The patient had undergone an operation six weeks previously. I x-rayed her chest and abdomen. There, on her abdominal x-ray, running from her femoral vein at the top of her leg to her heart, was a metal central line guide wire. It had been inserted when the central line was being put in, but hadn't been removed. Without a checklist, this was a remarkably easy thing to do, especially if the doctor had been interrupted at this point in the procedure.

In 2007, the Scottish Intensive Care Society (SICS) adopted a central line checklist that supported safe central line insertion.[74] This simple measure has significantly reduced line infection rates and the incidence of adverse events occurring during line placement.[75]

Emergency action cards

The examples discussed earlier are types of pre-task checklists, i.e. lists of checks and actions usually undertaken in slow time to reduce the risk of adverse events while completing a planned, anticipated task. Other types of checklists, such as emergency action cards, exist for dealing with unexpected events. These emergency action cards are the epitome of aids to combat cognitive overload in demanding situations that have suddenly deteriorated.

Emergency action cards were pioneered in the aviation industry. Pilots readily become overloaded when a mechanical or electrical malfunction occurs in flight. As well as having to fly the aircraft, they need to investigate and deal with the problem that has developed. The issue may also compromise the functioning of the aircraft and sometimes necessitate an immediate, unplanned landing. Especially with single pilot operations, the cognitive overload incurred can be disastrous.

The aviation industry reduces the risk and effect of overload by creating emergency action cards for specific problems. These problems include engine malfunctions, fires, overheating batteries and gearbox problems. Aircraft manufacturers create bespoke action cards for each aircraft type. These are developed by engineers and test pilots and are trialled in high fidelity simulators. These action cards contain lists of checks and actions that must be taken by the pilot to keep the aircraft and crew as safe as possible. The most urgent actions, to ensure safety, are listed first and are printed in bold font. Each instruction is as brief and unambiguous as possible. Individual pilots are expected to memorise the first actions

to be taken in the event of all emergencies on the aircraft. This allows immediate actions to be taken, even before the action card booklet can be opened and the checklist started.

Despite their obvious benefits, use of these types of checklists is relatively rare in medicine and other high-stakes professions. The most common use of an emergency action card in clinical care is the one used in emergency anaesthesia where the doctor has been unable to place the breathing tube into a patient's airway during anaesthesia. In some cases, this means that the patient's oxygen level will fall within minutes, leading to brain damage or cardiac arrest. The priority in this situation is to get oxygen into the patient. Usually, this means temporarily abandoning the intubation attempt and reverting to placing a mask on the patient's face, around their mouth, and squeezing oxygen into their lungs with a compressible bag.

However, when a failed intubation occurs the instinctive response by many doctors is to persist with trying to place the tube. When you persist trying to place the tube, you are not oxygenating the patient. Doctors can become task fixated at this point, losing situational awareness of the time that is passing and the patient's falling oxygen level. They become so focused on placing the tube that they forget what the patient actually needs to keep them alive. There have been many cases where this task fixation and cognitive overload has led to disastrous consequences for the patient.

In the UK, the most publicised case involving task fixation during a difficult intubation is that of Elaine Bromiley. Mrs Bromiley went into hospital for a routine operation in 2005. At the beginning of the anaesthetic, attempts to secure her airway lasted for approximately 20 minutes. For the majority of the time her blood oxygen levels were extremely low (hypoxia). Sadly, Mrs Bromiley died as a result. The findings of the investigation into this incident indicated that the management of the 'can't intubate, can't ventilate' situation did not follow the accepted Difficult Airway Society guidelines. In particular, too much time was taken in trying to intubate the trachea rather than concentrating on ensuring adequate oxygenation by other means such as direct access to the trachea (a surgical tracheostomy).[76]

While theatre staff ensured that all necessary equipment was available, the clinicians appeared to become oblivious to the passing of time and thus lost opportunities to limit the extent of the damage caused by the prolonged period of hypoxia. Given the skill mix of the clinicians, it would have been very easy to perform a surgical procedure to gain access to the trachea. Theatre staff, when interviewed, all seemed surprised that this was not performed. A suggested action was put forward to ensure an atmosphere of good communication in the operating theatre such that any member of staff feels comfortable to make suggestions on treatment.[76]

It is likely that a pre-operative checklist may have helped all staff present feel empowered to speak up and voice suggestions for alternative actions when they became concerned about the time that was passing and Mrs Bromiley's low oxygen level. It is also very likely that the use of an emergency action checklist for the failed intubation situation would have guided the clinicians to take alternative action at an earlier stage.

Process guides

Checklists can be used to take you step-by-step through an unfamiliar process in slow time. A good example of this type of checklist is a set of instructions for assembling an Ikea flat pack wardrobe. Checklists are particularly helpful in unfamiliar situations when the actions required are not intuitive and when the order of their execution is important.

For many years, I have been involved in developing safe working systems for advanced first aid, to be used by personnel who are not medical professionals. These have included tactical firearms officers, police divers working in remote locations and mountain rescue teams. These teams are supplied with equipment and drugs that can be lifesaving, but which can also potentially cause harm to patients if wrongly or inappropriately used. These groups often operate in environments that are inaccessible to trained healthcare professionals. Therefore they need to be independently competent to use this kit. However, some of the individuals in these teams are unlikely to look after someone who is seriously unwell or injured more than once in their career. Putting on a leg splint or managing a cardiac arrest in an isolated hazardous location for the first time in your life is highly prone to cognitive overload and compromised performance. The development and use of step-by-step process guides have proved invaluable for these groups.

Over 30 medical checklists have been produced for these teams. These guides are used in a two-person check and response fashion. One person reads out one process, one step at a time, while the other completes the action. The teams use these guides for inserting devices to open a patient's airway, to draw up and give morphine injections and to apply neck collars. Prior to having these process guides, the members of the team were simply expected to memorise how to carry out these complex tasks – following training courses they may have completed years before. This was ineffective in ensuring optimal performance under pressure, and was potentially unsafe.

As well as being used as step-by-step guides, checklists can be used as aides-memoire for complex multi-stage processes. In medicine, this type of application is increasingly known as a 'care bundle'. Sepsis is the body's response to severe infection. If sepsis is not effectively treated at an early

stage, patients will develop low blood pressure and their organs can start to fail. These patients need a number of treatments and tests to be carried out within an hour of sepsis being diagnosed. These treatments include the administration of antibiotics, fluids and oxygen. Septic patients need to have their vital signs recorded regularly, their urine output monitored and the level of lactic acid in their blood measured. Despite national guidance instructing doctors as to what was required, the number of patients receiving these treatments in the necessary timescale was low. To improve the care of these patients, a sepsis care bundle was introduced. In my hospital, if the emergency department triage nurse suspects sepsis they attach a checklist sticker to the patient's medical record. This acts as a prompt and an aide-memoire to the doctor treating the patient. They know they need to have all of the checklist boxes completed within an hour, if they agree that sepsis is present. This simple measure has significantly improved compliance with treatment for septic patients.

The Arrochar mountain rescue team also have a number of technical rescue process guides in an infographic format. These are used to help ensure technical rescue rope systems are assembled correctly and safely. Rather than being a list of text checks, an annotated photograph of the correct knots and climbing hardware has been created. These guide the assembly of the rope system and can be used as a 'ready for use' check following assembly.

Introducing Checklists

Surgeon Atul Gawande gives an interesting account of the introduction of checklists in medical practice in his bestselling book, *The Checklist Manifesto*.[56] Learning from industries that routinely use checklists, Gawande discusses their benefits in medicine and the challenges in their implementation. The book focusses on the international introduction of the pre-operative surgical checklist by the World Health Organization (WHO) in 2008. Following initial piloting, the checklists were introduced with a training programme to eight hospitals in different parts of the world. A before and after study of surgical and anaesthetic complications was carried out, as well as staff satisfaction ratings.[56]

The checklists help ensure that the correct patient is in the operating theatre and that they are having the correct operation on the correct side of their body. The plan for anaesthesia and blood loss is discussed and potential problems identified. The process starts with everyone in the operating room introducing themselves.

The results of the surgical checklist were impressive. The incidence of surgical errors, infection rates and anaesthetic complication rates

fell significantly. Fewer patients died. The use of a checklist helped create a flat hierarchy; all staff in theatre felt that they had a voice, that their opinion was valued and that they could speak up. Staff satisfaction improved and staff turnover was markedly reduced. All because of a checklist.

In his book, Gawande discusses the challenges of introducing checklists in medicine. The WHO checklist took years to implement and faced rejection in many quarters. After more than ten years and with extensive evidence of its effectiveness, it is still not universally accepted and used. Some people feel that checklists slow productivity. They feel they suppress individual practice and flexibility. Some experienced earlier versions of a surgical checklist that had not been adequately trialled, refined and validated. This led to negative reactions and a failure to change and adopt.

Gawande said 'We have the means to make some of the most complex and dangerous work we do – in surgery, emergency care, ICU medicine, and beyond – more effective than we ever thought possible. But the prospect pushes against the traditional culture of medicine, with its central belief that in situations of high-risk and complexity what you want is a kind of expert audacity … Checklists and standard operating procedures feel exactly like the opposite, that's what rankles many people'.[56]

Creating a Checklist

So how do we go about writing a checklist? As Gawande emphasises, it's a longer and more complex process than it initially appears. It is essential to carefully plan the content of checklists, ensure all relevant groups are involved in their development and refine them through simulation prior to operational use.[56]

In developing checklists for the EMRS, we normally sit down as a small group of clinicians. We talk through the process and then, using training equipment and a manikin, simulate the task. We look at current guidelines in use by other organisations. We consider the risks of not carrying out the procedure correctly or not performing each step in the right order. Instances when the task has not been optimally completed in the past are examined. To do this we seek input from colleagues and also look at our database of significant event reports.

Following this, we create a 'long-list' checklist. This invariably has too many steps and the wording of each step is too detailed. Getting the balance right with what to include and what not to include in the final

document is often difficult. Every process carried out by an experienced team has steps and checks, which one would imagine would never be forgotten about or missed out. However, reviews of adverse events in many industries have found that these types of omission are, actually, relatively common. However, if we included every possible step, many checklists would be unfeasibly long. An argument also exists that obvious steps that don't end up on the list are more likely to be forgotten once you start using the checklist as people become reliant on it. Trial and error in testing new checklists in simulation is invaluable.

In our experience, checklists should be between four and ten steps long. Any more and peoples' attention begins to wander. Each step should be as brief as possible, ideally using four words or less. It's preferable to use terminology or abbreviations that are in shared parlance among the team. These shorten the length of each point on the checklist and reduce ambiguity. The sequence of execution is especially important for checklists dealing with emergency situations. The main actions to maintain safety come first.

Layout, colours, font and font size are all important considerations. Avoid text in capital letters as these make the text more difficult to read. Fonts should be large enough to be easily read at arm's-length. Prominent, brief and unambiguous titles are important if your organisation has multiple checklists in use.

Once the first draft is finalised we bring other members of the team into the simulation room to try out the checklist in slow time. Following that, we develop real time in situ simulations using the list. Ideally, these should be filmed and the footage reviewed. Finally, the checklist is trialled on a live retrieval mission.

Once this process is completed, the final draft is distributed to the full team for comment. This stage has three aims. It communicates to the team that a new or amended checklist is in the pipeline. It lets them feel ownership of the development process and, finally, it often picks up errors or omissions that haven't been detected by the development team. Most often this is in the form of ambiguous language in the checklist.

Only once all of this process is complete is the checklist formally introduced to the team for operational use. Even then, its content needs to be monitored in light of feedback, changing evidence and relevant significant events.

The UK Civil Aviation Authority (CAA) has put together very useful guidance on how checklists should be structured, worded and graphically designed. This document is entitled CAP 676 and is available on their website.[77]

Immediate anaesthesia checklist

- Does this patient require an immediate anaesthetic? ☐
- Who is giving drugs? ☐
- Who is managing airway equipment? ☐
- Oxygen cylinder full ☐
- Bag valve mask ☐
- Vascular access patent ☐
- Suction in position and working ☐
- Laryngoscope ☐
- Endotracheal tube ☐
- Bougie ☐
- Ketamine – state dose ☐
- Rocuronium – state dose ☐

Figure 8.1. Checklist example.

Using a Checklist

Use of a checklist is not intuitive. If you hand someone a checklist they will often read it silently and mentally check off completion of each step. People need to be shown how to use a checklist. Checklists are most effective when used in a two-person 'check and response' manner. The person with the checklist reads out a step and the other person responds, confirming that the step has been completed or, in some cases, is not necessary. Generally, each step needs to be finished before you move on to the next one. Not doing this, and telling yourself that you will sort that step once you've finished the checklist, is prone to error.

Actively pointing at the relevant piece of equipment, switch or display helps focus concentration on that step in the checklist. It's also important to try to avoid interruptions during a checklist. As we outlined in Chapter 3, 'Back Pressure – Barriers to High Performance', interruptions will detract attention from what is being checked and confusion can occur. It's easy to move on to the next step thinking the preceding step has been completed when it hasn't. For critical checklists it's good practice to return to the beginning and start again if interruptions have occurred.

In summary, checklists are invaluable tools to help high-performance teams own the pressures facing them. They reduce error, create accurate shared mental models and cognitively reframe teams prior to high-stakes procedures. Checklists, however, need to be carefully worded, designed and implemented. The culture within organisations needs to be carefully managed in order to ensure that checklists are universally accepted, respected and utilised effectively.

Learning points

- Checklists can be of benefit in a wide range of situations. They reduce risk and pressure prior to undertaking a procedure. They focus our attention on the immediate actions required in an unexpected, complex and time-critical situation. They promote more effective team working, delegation and shared problem solving.
- For high-stakes procedures checklists can engender an air of calm and shared responsibility, leading to improved performance. They can also act as a form of 'priming' – letting the team know that a high-pressure situation is about to start.
- Checklists reduce incidence of error due to omission of vital steps in a process. Users should start the list from the beginning if interrupted.
- Checklists help create a flat hierarchy, improving communication.
- To be effective and to encourage regular use, checklists need to be thoroughly planned, tested and well graphically designed. New checklists require testing in simulation and in operational environments prior to roll out. Layout, font and wording of checklists requires careful planning.
- There are four types of checklist:
  - **Preparedness checklists** – ensuring teams, environments and equipment are optimally set up before an incident occurs.
  - **Pre-procedure checklists** – before a high-stakes procedure is commenced.
  - **Action cards** – pre-planned responses to unplanned complications.
  - **Process guides** – step-by-step instructions for unfamiliar and high-stakes procedures.

Chapter 9
The High-Performing Team

In high-pressure situations, effective teamwork is paramount. How well groups of individuals work together to process information, innovate, prioritise and complete tasks is key to successful completion of a challenge. In particular, the ability of leaders to make decisions, communicate, delegate and maintain situational awareness is fundamental to effective team performance. Effective communication, delegation and well co-ordinated teamwork are essential for pressure control.

Helicopter Search and Rescue Teamwork

The EMRS uses helicopters and planes to transfer critically ill patients from remote Scottish hospitals. They are also used to deploy the team to remote locations where patients have been seriously injured. These aircraft are operated by commercial aviation companies, which must operate within the regulations laid down by the UK CAA. Unfortunately, adverse weather frequently places these aircraft outside the regulator's permitted flying limits.

In these circumstances, when a patient in a remote location is critically ill and requires the lifesaving interventions of the retrieval team, we need to request assistance from our local search and rescue (SAR) helicopter base. For the first ten years of the retrieval service's operation, the local SAR Sea King helicopters were operated by the Royal Navy. Since 2015, this service has been delivered by a commercial operator on behalf of the UK Coastguard.

Without doubt, some of the most impressive examples of teamwork and effective communication under pressure I have experienced were among the crews of the Royal Navy's SAR squadron. Their ability to safely operate and effectively communicate as a team far surpass anything I have experienced in any other medical, expedition or rescue setting.

A SAR helicopter crew consists of a team of four. Two pilots, a navigator who also operates the winch, and a winch paramedic. These crews work together as a team on 24-hour shifts. They live together on base for these periods, socialise with each other and train together every day. Following an extensive period of initial training in the Royal Navy, each SAR crew member goes through a prolonged and intensive period of selection. This ensures they have the necessary knowledge, skills and attitudes to effectively perform in the most challenging of circumstances as part of a team. Each member of the crew must complete assessments of core competencies on a regular basis. These drills include winching into water, instrument only flying in low visibility and the use of night-vision goggles. Considerable amounts of time and financial investment are put into the maintenance of these core skills. If drills are not completed within the necessary timescale, members of the crew are not allowed to undertake rescue tasks until the assessment is completed.

The crews train for prolonged periods each day. There is a rolling programme of training and drills that need to be completed in daylight, and at night. The crews are also familiar with the principles of military aviation crew resource management. The atmosphere of camaraderie and *esprit de corps* is unsurpassed. When operating with these Royal Navy crews, the principle of a flat hierarchy is clearly apparent. Each member of the crew has a say on decisions and their opinion is respected by their colleagues.

On one of my first retrieval missions in a Royal Navy Sea King helicopter, we were flying to an island off the north west coast of Scotland, about 200 kilometres from our base in Glasgow. The patient had sustained a serious head injury and needed on-site stabilisation with a general anaesthetic, followed by air transfer to a neurosurgical centre. Although the weather was poor and we were flying at night, the chat over the helicopter's communication system was light-hearted and relaxed. Periods of discussion about navigation, endurance (flying time capacity) and fuel levels between the navigator and the pilots were clear, direct and relaxed. This communication was interspersed with good humoured banter and friendly conversation.

As we were heading north, I recall one of the pilots saying to the observer, 'Tobermory golf course on the port side'. Ten minutes later, there was a barely perceptible change in the tone and pace of the communication between the crew. I hardly recognised that something was happening. It was only when I heard the pilot saying, 'Tobermory golf course on the starboard side' that I realised something was wrong and we had turned

around. It transpired that smoke had started coming from the pilot's instrument and control panel. This was clearly a serious emergency that required an urgent landing. We were forced to make a landing on the grass airstrip on the island of Mull. During the approach to the landing, the discussion between the crew was clear, measured and concise. There was an air of confidence, calm and control. The ability of the crew to perform like this under extreme pressure came from years of experience, pre-rehearsed drills, simulation, human factors training and regularly working together as a team. It was an example of a team performing optimally under pressure.

The remote support provided by the RAF's aeronautical rescue control centre in Kinloss was also impressive. By the time we landed, another SAR aircraft from Stornoway was already on its way to collect our team to continue our journey to the patient. The local Coastguard ground team was already at the airstrip to assist our landing and hotel rooms had been identified for the Navy helicopter's crew.

Components of Effective Teamwork

Many of us talk about effective teamwork, but what do we actually mean? What are the characteristics demonstrated by a high-functioning team? Undre et al. have developed a tool to assess the quality of teamwork in surgical teams – 'the observational teamwork assessment for surgery'.[78] The tool can be applied to any high-pressure team and considers five components:

- **Communication** – the quality and quantity of information exchanged among the team.
- **Situational awareness** – team observation and awareness of ongoing processes.
- **Cooperative behaviour** – assistance provided among members of the team, supporting others and correcting errors.
- **Leadership** – the provision of directions, assertiveness and support.
- **Coordination** – the management and timing of activities and tasks.

These five components of teamwork are essential for optimal team performance. They can be used as specific learning objectives during training and simulation. They can also be used as a structure for post-event debriefing. In this chapter we will discuss communication, situational awareness and cooperative behaviour. The next chapter will focus on leadership and coordination of teamwork.

Communication under Pressure

Our ability to transmit and to receive information accurately and comprehensively when working in high-pressure situations is, unfortunately, frequently suboptimal. Following emergency service responses to multiple casualty major incidents, the most common area identified for improvement is communication.

What are the pressures that make communication difficult? How do our physiological and psychological responses to pressure compromise our ability to communicate with the rest of the team? What tools can our teams employ to improve how we share information in these situations?

What are the pressures?

Accurate and comprehensive exchange of information is vital for effective teamwork in the execution of complex, high-stakes tasks. Our ability to send and receive information in circumstances of high pressure is, however, compromised by a number of challenges:

- The cognitive capacity we have to actively listen is reduced when we have a high cognitive load.
- Time pressure limits the duration of information exchanges.
- Time pressure reduces opportunities to question and clarify ambiguous information.
- Multi-agency and flash teams may misunderstand each other's professional jargon and keywords.
- Visual and audible distractions reduce our ability to focus our attention on those communicating with us.
- Poorly managed body language can be perceived as negative and critical.
- States of stress and frazzle can result in defensive or even aggressive communication styles.
- Fatigue compromises our ability to interpret non-verbal communication in others.

When we are operating under pressure there is limited time for communication. People are prone to passing information to their colleagues more quickly than they would normally. They are also less likely to plan and prepare the structure and content of what they are going to say before they start speaking. This results in the passage of unstructured and incomplete information. In normal circumstances with no time pressure, ambiguous information is questioned and clarified by

the person receiving it. In high-pressure situations there often isn't the opportunity for this clarification phase to take place. These factors can lead to misunderstanding, confusion and, ultimately, erroneous decisions and actions.

As mentioned earlier, each of us has a limited cognitive capacity. Unfortunately, only a small percentage of us have the ability to truly multitask.[9] As a result, we can listen, watch, carry out a physical task or make a decision at any one time. We don't have the cognitive ability to do all these things at once. In pressured situations, we frequently develop 'task fixation' with all of our attention focused on a practical procedure or on processing information we have received. In these situations we don't have the ability to simultaneously listen to what others are saying to us. In complex situations involving multiple people, even when we are trying to actively focus on the person speaking to us, our attention can be distracted by the events happening around us.

In particularly challenging situations we may move from a state of pressured flow to one of stress and overloaded frazzle. When this occurs our sympathetic nervous system is stimulated, causing a number of physiological and emotional changes as part of a fight or flight response. Once in this state we tend to perceive the circumstances surrounding us as being potentially harmful and hostile. We focus all of our attention on the potential threat immediately in front of us. We lose our peripheral vision and our ability to hear what is happening around us is compromised.

Fatigue can also significantly compromise our ability to communicate with each other. How accurately we interpret body language in other people has been shown to deteriorate significantly when we are tired. Fatigue also makes us more laissez-faire. We're less likely to make the effort to question or clarify the information passed to us.

Our teams ought to be aware of the various ways pressure affects their ability to communicate accurately. They also need to learn and practise tools to address these challenges.

Tools for Improving Communication under Pressure

Ready to receive?

Finding the right time to communicate is critical. As described above, it's common for people to say something to another member of the team when that person isn't actively listening or is distracted. This might result

in the person passing the information thinking that it has been received and acknowledged by their team mate when, in fact, it hasn't been heard at all.

Before we start speaking we need to ensure we have our team mate's focussed attention and that they are ready to receive the information. Our situational awareness will allow us to know when there is a lull in the tempo of activity, or when the person we need to speak to has become task fixated on a complex task. Focusing the person's attention by using their name, putting your hand on their shoulder and ensuring that they maintain eye contact with you are useful techniques. Clearly asking the person, 'I have something I need to tell you, are you ready to listen to me?' is necessary to ensure that they are free from other tasks and distractions.

Structure and planning

Planning the structure and content of what you are going to say in advance is essential for minimising the time taken to pass on the information. It also reduces the chance of ambiguous information being communicated and misinterpreted.

The order in which we pass on information is important. We are all prone to the 'serial position effect', meaning that we are most likely to receive and process information that comes at the beginning of what someone is saying to us.[34] Information further down the list is less likely to be taken on board.

Using standardised communication structures can be helpful in ensuring that all of the required information is passed on and in improving how well it is understood. A commonly used example of this is SBAR.[79] This is a structure for verbal and written communication in situations like team briefings, emergencies or when handing over responsibility to another team.

- **Situation** – a summary of the situation currently.
- **Background** – how we've arrived at this situation and any useful supporting information.
- **Assessment** – what I believe to be happening.
- **Recommendations** – what I think needs to be done.

Read back and closed-loop communication

If a particularly important piece of information has been passed to a colleague, then we should check that they have received it accurately and ask if they have any questions. A useful technique is having the receiving person read back the information to the sender. If it is read back accurately, this should be confirmed by the sender. This is known as

closed-loop communication and is a technique commonly used in aviation when air traffic controllers are communicating with pilots.

An extension of this is confirmation that a delegated task has been completed. A person delegated a task should report back to the team leader once the task has been successfully undertaken.

Repetition and clarity

Another technique used when passing on critical information is repetition of important words and phrases, e.g. 'I repeat…'. Numerical values can be repeated in two forms. When handing over responsibility for patient care from the helicopter team to the hospital trauma team, it is potentially harmful for the doses of drugs given to the patient in the pre-hospital phase to be misunderstood. In the handover statement, if we have given the patient 16 milligrams of morphine, we will say, 'Sixteen, one six, milligrams of morphine'.

Controlling our speed when speaking is important to ensure clarity. Effective use of tone, with emphasis on key points of information is also vital.

Using abbreviated terms such as 'isn't', 'didn't' or 'won't' can easily be misinterpreted and should be avoided. It is more effective to state clearly 'is' or 'is not'.

Keywords and jargon

All occupations have profession-specific terminology. This jargon is an effective method of communication in time-limited situations. The use of acronyms and concise terms to describe problems, equipment and actions can be used to rapidly and accurately pass on information. When used within teams they are usually unambiguous and hence less likely to cause misunderstanding. Using jargon to communicate with people outside of your team or profession who may not be familiar with the terminology used can however lead to misinterpretation.

Keywords are effective as cues for teams, bringing about changes in mental models and communicating the need for specific, pre-planned actions. For example, among clinicians the term 'the patient has arrested' is universally understood to mean that the patient's heart has stopped and that cardiopulmonary resuscitation attempts should start immediately. Following on from this cue word, everyone in the team will know that the patient's airway will need to be opened, they will require support to breathe, chest compressions will be required, intravenous adrenaline may be needed and it will be necessary to apply a defibrillator to the patient.

Teams can also create and utilise their own keywords for accurate communication in demanding circumstances. Mark Cavendish is one of the world's most successful cycling sprinters. He has won dozens of Tour de France stages. In order to win a stage, Cavendish must be optimally positioned at the front of the large peloton of riders 100 metres from the finish line. This often follows up to 200 kilometres of riding that day. He has a team of riders who work together to protect him during the stage and to preserve his energy for the massive burst of acceleration required during the sprint finish. They take it in turns to ride in front of him throughout the day to reduce the effect of wind resistance on him. A kilometre out from the finish, one rider will cycle behind him to prevent other riders striking his back wheel and knocking him off. Another five or so riders will line up in front of him – his line out. The role of the line out team is to gradually crank up the speed. The rider at the front will ride at full pace for 200 metres and then break off, moving the rider behind him up to the front. The aim is for the second last man to be riding at maximum speed before breaking off 100 metres from the line, effectively catapulting Cavendish into his sprint finish.

The speeds involved can exceed 80 kilometres per hour, on narrow roads with sharp corners. A dozen other cycling teams are trying to do the same thing, in the same space at the same time. The noise is intense and the risks of colliding and crashing are huge. Cavendish's team need to communicate accurately and precisely in this environment. There's a risk that a cyclist in another team might shout a command that Cavendish's team thinks is aimed at them. This could easily result in a crash or the loss of a stage win. Cavendish's team, therefore, have a series of team-specific key words they use during high-intensity sprint finishes. These key words, covering things like move left, move right, easy and breaking off, are unique to their team and are selected for their brevity and precision. They are immediately understood and can't be confused with communication from other teams.

High-performing teams often have their own in-house keywords and jargon to achieve brevity and accuracy in time-critical situations. However, when working in multi-professional situations these terms can cause confusion if everyone present isn't aware of their meaning and relevance.

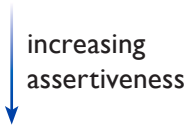
Graded assertiveness

In some professions, command gradients are common. These gradients can inhibit individuals of a lower rank or status from questioning their more senior colleagues. Historically, particularly in the aviation industry, command gradients have led to numerous disasters. Members of the team

have seen dangerous situations developing that have been missed by the team leader. However, they failed to speak up because they thought the person in charge must have observed the hazard as well, or they didn't feel empowered to question them. Often this is because when they've raised concerns in the past, they have been met with negativity.

To avoid these command gradient incidents, a system called 'graded assertiveness' has been developed. This starts with the person gently asking a question that subtly points out the issue they are concerned about. If this doesn't produce a satisfactory response it progresses to use of more assertive language and actions. One acronym we can use for graded assertiveness is 'CUSS':

- **Concern** – 'I'm concerned that…'
- **Unsure** – 'I'm not sure that this is the correct…'
- **Safety** – 'I don't think what we are doing is safe…'
- **Stop** – 'Please stop what you are doing.'



As well as the lower-ranking individual knowing this terminology and structure, it is essential that the person in charge has been trained to know that these are cues to stop what they are doing, listen to the person raising concerns and reconsider the rationale of their decision or actions.

Non-verbal communication

Implicit, non-verbal communication is just as important as how we communicate explicitly by speaking. Facial expressions and body language can convey a considerable amount of information to other members of the team, especially in high-pressure situations.

Managing non-verbal communication is especially important for the team leader. Implicit communication can be used to a positive effect in stressful situations. Maintaining positive body language, such as eye contact and an open stance, helps communicate confidence, competence, progress and optimism. Conversely, in stressful situations that are not progressing well, negative body language, including poor eye contact and folded or tensed arms, demonstrating anxiety or frustration can have a detrimental effect on the confidence and coherence of the group. This is an even greater risk when working with people unfamiliar to you in ad hoc, flash teams.

Teams should also be aware of 'mirroring' of implicit communication. We have a natural tendency to subconsciously imitate the mannerisms of people we are communicating with.[80] Facial expressions and body language revealing that a person is frazzled tend to be replicated by others in the

team. This can lead to a loss of team confidence and can compromise interpersonal communication.

If working with a close colleague as part of a wider team when things are not going to plan, facial expressions can be used to subtly communicate how you are feeling and your assessment of the situation, without the need to let the wider team know. Practising and maintaining awareness of how we are portraying ourselves through posture and facial expressions is vital to maintain effective teamwork.

Exchanging information among the team in challenging circumstances requires communication techniques that differ from those used in normal situations. Our teams benefit from being aware of the reasons why our ability to communicate when pressured is difficult. They need to be conscious of the effects of poor communication due to psychological and physiological responses to pressure or fatigue.

We can provide our teams with the tools to reduce the risks of miscommunication. These techniques need to be learned, understood and practised during pressured simulation scenarios. The effectiveness of communication should also form a routine part of post-event debriefs.

Situational Awareness

In order for groups of individuals to work together to achieve a successful outcome, it is essential that they share the same mental model of the situation. Teams work more effectively if they have a common understanding of what the problem is, what needs to be done and how things are progressing. Each member of the team needs to maintain a degree of situational awareness.

Briefings

Shared mental models and situational awareness are founded in well-structured briefings prior to the start of the event. Frequently, however, time pressures limit the amount of information that can be contained in the briefing. To optimise the content of the briefing, an experienced and well-trained team leader is required, as well as a pre-planned briefing structure. The team leader needs to ensure that every member of the team understands what the problem is, what has to be done and what the desired outcome is.

Briefings achieve a number of goals. They ensure that everyone has clarity about the situation and what is expected of them. In ad hoc teams, they allow each person to identify themselves and let others know what

their role is. If well led, the briefing helps create a flat hierarchy that encourages better communication and cooperation throughout the task. Flat hierarchies reduce the risks of communication failure associated with command gradients and the chance of errors developing, unnoticed and unchecked. They allow people to ask questions and make suggestions. Encouraging each member of the team to speak during the briefing period increases their assertiveness at the beginning of the event. It gives them status and 'a voice'. This means they are more likely to speak up as the situation unfolds and, when appropriate, to express concerns.

Angela Lewis was a search and rescue aircraft commander in the Royal Navy. She described to me how some crews she worked with could 'over-brief' before training and rescue sorties.[52] Their briefings became so prolonged that the team's attention was lost, as was the ability to retain all of the information discussed. There could be too much discussion at the start of the briefing about unimportant and low-risk issues, resulting in insufficient time and focus on the bigger challenges and hazards. The result was a potentially compromised team awareness of the major risks of the mission.

Again, the 'serial position effect' comes into play during briefings. We can only concentrate in detail for finite periods of time. We therefore tend to focus on and recall information passed at the start of briefings and at the end. Points discussed in the middle of prolonged briefings are less likely to be remembered.

Rally points

When lulls in the tempo of the situation allow, it is productive to pause for regrouping periods or rally points. Each person should be asked to concisely give a situation report from their perspective, including their view of the task, what progress they have made, what the current challenges are and what their next actions are going to be. This not only allows the team to take a cognitive pause but the sharing of knowledge also acts to refresh the team's joint mental model and directs the next stage of the task. The team leader should summarise the situation and delegate actions following these rally points. Regular rally points are useful in maintaining situational awareness.

Monitoring

The leader must continually observe the progress of task completion by each member of the team. They also have to monitor overall progress towards the end point. Similarly, it is beneficial for each member of the team to maintain an awareness of what their colleagues are doing and

whether the team is making meaningful progress. This maintenance of situational awareness allows them to highlight issues to the leader and to provide support to their colleagues. Expecting everyone to be able to do this continuously is, however, unrealistic and will detract from the ability of the person to complete their own role.

In training and simulation, pilots are encouraged to continually verbalise their thought processes. This allows other members of the team to have awareness of their mental model and how they can help him or her with particular challenges.

Captain Craig Trott, a former military Sea King helicopter pilot, described one strategy used by Royal Navy 'jungly' pilots during landings in arctic and desert terrain.[81] In these circumstances, snow and sand are blown up by the aircraft's downdraft. This seriously impairs the pilot's view of the landing site. Often their vision is completely obscured, resulting in loss of all visual references. These pilots have adopted a system of repeatedly saying 'happy, happy, happy' during these types of landing. If they are becoming stressed or cognitively overloaded they tend to stop talking. When the rest of the crew become aware that the pilot has stopped stating that he is happy, they make the decision that the landing needs to be abandoned and tell the pilot to 'go around'.

Through training and effective briefing, the members of the team need to have an understanding of what the consecutive stages of the task are likely to be and what final outcome is being sought. Their ability to 'project' the progress of the situation and have a clear image of what is expected of them is vital.

Cooperative Behaviour

The ability of individual members of a team to cooperate with each other is essential for efficient, joint task completion. Effective team players keep a supportive eye on their colleagues, especially those who are less experienced. They make themselves available for advice and assistance. When undertaking high-stakes activities, it is beneficial for team members to crosscheck each other's decisions and their completion of practical tasks.

Experienced members of the team anticipate the next stages in managing the situation and progress to the next task without the need for active delegation. When one task is completed they make the leader aware of this. Each person should also be vigilant for signs of cognitive overload and fatigue in their colleagues. In a constructive manner, they can offer to offload some of the cognitive burden affecting those individuals who are experiencing cognitive overload or fatigue.

Different members of a team will respond differently to pressure. The same level of pressure can result in a state of high-performance flow in some but a state of over-pressured frazzle in others. These different responses can occur simultaneously. Each member of the team should ideally be looking out for signs of excessive pressure being experienced by their team mates, even if they themselves are in a zone of flow. This also emphasises the importance of monitoring in order to work co-operatively.

Cooperation in high-performing groups is the result of functional, flat hierarchies, shared mental models, effective communication and trust.

Learning and improving teamwork

How can we improve the function of teams? We need to ensure that members of teams are aware of the components of teamwork and the features displayed by high-functioning teams. These principles can then be repeatedly practiced in simulation. Structured debriefing and coaching following simulation are useful for identifying areas for improvement. Similarly, open and honest debriefing following real-life events is essential. Greater objectivity and insight can also be achieved by filming the team in action.

The first three components of teamwork have been discussed in detail in this chapter (Communication, Situational Awareness and Cooperation). We will now move on to explore aspects of leadership and coordination and how these can impact working effectively as a team.

Learning Points

- Teamwork can be considered to have five components:
  - **Communication** – the quality and quantity of information exchanged among the team.
  - **Situational awareness** – team observation and awareness of ongoing processes.
  - **Cooperative behaviour** – assistance provided among members of the team, supporting others and correcting errors.
  - **Leadership** – the provision of directions, assertiveness and support.
  - **Coordination** – the management and timing of activities and tasks.

- **Communication** is compromised by limited time, limited cognitive capacity, flash teams, distractions, suboptimal body language, stress responses and fatigue. Techniques include:
  - Planning and structure before speaking.
  - Ensuring you have the attention of the person you are speaking to and that they are ready to receive.
  - Closed-loop communication.
  - Repetition and clarity of key information.
  - Keywords and jargon – awareness of benefits and risks.
  - Graded assertiveness – CUSS.
  - Active management of body language.
- **Situational awareness** can be enhanced through briefings and rally points.
- **Cooperative behaviour** between each member of the team is important for effective team performance.

Chapter 10
Frontline Leadership

When leading teams in pressured situations, one of the main objectives is to attain optimal performance from each member of the group. In order to do this, we need to be cognisant of the three states of performance on the performance arc (disengagement, flow and frazzle). Effective leaders aim to position each member of the team in the zone of high-performance flow. They do this through effective delegation, clear direction and task coordination. Motivation and positive feedback are also key to getting the best from the team. Low performance states of disengagement and frazzle result from inappropriate task allocation and cognitively overloading individuals. The tempo and demands of prolonged challenges vary. This results in undulating pressures on members of the team. Good leaders monitor and balance the demands placed on each person, preventing both overload and under-stimulation.

As described in Chapter 9, 'The High-Performing Team', Undre and his colleagues researched teamwork in operating theatres.[78] They describe the role of the team leader as the provider of directions, assertiveness and support. At the same time, leaders should strive to create an atmosphere where other members of the team are encouraged to speak up in order to share knowledge or express concerns. Coordination of simultaneous team activity is also imperative. The team leader needs to have a robust understanding of the situation faced by the team, what the desired end point is and what needs to be done to achieve that end point.

Ensuring that there is clarity and mutual understanding of the challenges facing the team is key to achieving a successful outcome. Clear and concise briefings and rally points ensure that the team share the same understanding of what the problems are and what needs to be done. Research has shown that team members who share mental models perform more effectively in the execution of complex tasks.[82] Through listening to their teams, leaders should use these opportunities to ensure that they themselves have the correct mental model of what is happening.

Task allocation

Task allocation is a key responsibility of leaders in high-pressure situations. Planning what needs to be done and deciding on the priority of each individual task are important for achieving the desired outcome in the shortest timescale. This comes from awareness of the duration of tasks, how urgent each one is and how multiple tasks are interdependent. 'Directing the team' should be considered in its literal sense, i.e. giving them direction and orientating them with regard to the direction of travel and actions. Good team leaders project how they expect things to develop.

Effective task allocation is only possible if the leader has a thorough understanding of what each member of their team is capable of doing and an awareness of how well they will be able to perform the task in the environment and pressure of the situation. Over-delegation of multiple tasks to more experienced members of the team is a common pitfall. This leads to divided attention, cognitive overload and delayed completion of actions.

When the retrieval team is working at road traffic scenes, it's common to hear medical team leaders say, 'Can someone do x or get y?' More often than not, this results in nothing being done. Leaders must delegate tasks to specific, named individuals. Asking them if they have the time capacity and ability to complete the action is good practice. Ensuring you have the focussed attention of the person being delegated a task is important to ensure that they have received and understood the instruction. It is also good practice for the person undertaking the task to report back to the team leader once it has been completed.

Many techniques for effective leadership can be learned through training. Being an effective leader, especially in high-pressure situations, is, however, dependent on having extensive practical experience, emotional intelligence and communication ability.

Emotional Intelligence

High-performing leaders should have high levels of emotional intelligence. Having the ability to perceive and understand how each member of the team is feeling emotionally and physically is paramount in deciding how much pressure you can safely place upon them. Similarly, knowing when to give someone a break or offload a task from them is necessary to keep them in a state of flow and maintain their resilience.

Emotional intelligence is required to gauge what level of assertiveness is required in different circumstances and with different people. Normally, skilled and well-trained teams don't require high levels of assertiveness from

the team leader. The team already understands and respects the leader's skills, knowledge and experience. They also appreciate that the bulk of responsibility rests on the shoulders of the leader. Well-judged assertiveness is, however, sometimes appropriate in times of indecision, conflict and when the performance of members of the team needs to be improved.

Good leaders have effective linguistic skills. Knowing how to gain information from a colleague or how to allocate to them a large or complex task requires carefully worded communication. When under pressure, a poorly phrased request can rapidly lead to disharmony.

When events are not progressing as well as expected, negative perceptions of the situation can be infectious within a team. The leader has the responsibility for maintaining confidence and positivity in the team. This can be difficult to achieve. Continually giving encouragement and positive feedback is important. Early detection of negative comments or body language is key to stopping pessimistic thinking from escalating. Listening to the thoughts and concerns of the team as a whole and as individuals is necessary to understand other people's perceptions of what is happening. A rally point can be used to allow honest and open discussion about the situation and what challenges the team is facing. This can be followed by letting the team know that a positive outcome is still possible and that this can be achieved with the agreed plan of action.

Leadership Vulnerability

Leaders who are overly confident in their decision-making abilities or who progress with a course of action in a rigid, fixed manner are prone to making errors. They will also lose the respect of their colleagues. Leadership of complex, dynamic situations requires flexibility and adaptiveness. Hand-in-hand with flexibility is having the humility to openly change one's mind in light of advice from the team, or accepting that the original course of action was not working.

In many situations no single course of action is fully correct and risk free. Each member of the team may have differing views on what needs to be done. The leader has to take these views on board and decide on the course of action the team will take. In very high-pressure situations there may not be time to debate or explain this decision. The leader, however, needs to be prepared to justify their judgement after the event, as part of the debrief process.

In *The Culture Code*,[80] Daniel Coyle examined a number of high-performance teams. These included commercial organisations, sports

teams and Special Forces units. He explored the features of these organisations which enabled them to perform to the highest standards. One of the key things he found in each of these organisations was that vulnerability was regarded as a positive attribute, especially in leaders.

The benefits of strategic leaders demonstrating humility, openness and vulnerability has been acknowledged for a number of years. Leaders who demonstrate these traits create cultures of authenticity and trust among the team. Organisations with cultures of openness and psychological safety are more able to identify areas where improvements can be made in terms of systems, equipment, knowledge and skills.

Although acknowledged as a desirable trait in strategic leadership situations, can it be beneficial for leaders to demonstrate vulnerability at an operational and tactical level? If we are striving for high performance in a high-pressure situation, could revealing vulnerability be perceived as weakness or even incompetence?

How leaders process information, make decisions and delegate to the team needs to vary according to the complexity and pressures of the situation. Intuitively, in high-pressure situations we might think that it is necessary for an effective leader to maintain the appearance of complete confidence and competence. In many situations an autocratic leadership style is indeed the most effective way to manage the team. The initial stage of a medical cardiac arrest is a good example of a situation that has been repeatedly drilled, follows a well-recognised algorithm and has minimal need for analytical mental processing. The leader can allocate roles and make relatively straightforward decisions without the need to obtain the opinion of the team. Situations with extreme time pressure, with no free capacity for debate or shared decision-making, render this type of autocratic leadership essential.

This style of fully confident, autocratic leadership is appropriate in many situations to maintain the followership and performance of the team. It is well-recognised that followers ‘mirror’ the behaviour and emotions of their leaders. Leaders displaying signs of confidence, competence and optimism engender these emotions in the rest of the team. This shared, positive, emotional state will help optimise team performance.

In more complex and dynamic high-pressure situations, however, no individual can have 100 per cent knowledge and the situational awareness to make all of the necessary decisions. Often, no single person has the competence or capacity to complete all tasks successfully. This is particularly the case in prolonged and changing situations when progress is not following the originally projected path. In these circumstances,

leaders need the support of the team to make the right decisions. Leaders need to demonstrate vulnerability and ask for assistance.

In the context of strategic leadership, showing vulnerability is a desirable trait that enhances team cohesion and performance. It can be argued that leadership vulnerability is also essential for high-pressure team performance at an operational level. High-performing leaders have awareness of their own limitations and have the humility and confidence to share these with the team.

Leaders show humility and vulnerability during high-pressure situations by letting the team know that they are cognitively overloaded and asking for verification of their mental model. They request assistance in making decisions and in carrying out practical tasks. These actions can be effective in cognitively offloading the leader. Also, they commonly lead to cognitive reframing of the situation from the leader's perspective, achieving a more accurate perception of the challenges of the situation. When they do receive assistance, strong leaders acknowledge other people's suggestions and actions. They give team members credit for their input.

Vulnerability and humility are also important traits when reviewing team performance. Effective leaders are open and honest during debriefs, admitting when they were wrong. They take responsibility for their actions and the overall outcome. When appropriate, they say sorry. Following situations that have been emotionally challenging, they don't hide their own emotions. They show their humanity to the team.

Some leaders believe that it is difficult to lead the team from a position that may be perceived as being weak. They are wary of appearing as lacking in knowledge or competence. They fear losing authority and respect. They wish to create an image and reputation of infallibility. In truth, revealing your uncertainty or exposing your emotions doesn't weaken your status as a leader or make you appear submissive. In fact, the opposite is more likely to be the case. Demonstrations of fallibility and vulnerability help remove command gradients and create flat hierarchies. Leaders who allow themselves to be challenged help create a culture where the team feels empowered to provide suggestions and achieve an optimal, shared solution to challenges.

However, when considering demonstrating vulnerability and uncertainty, caution needs to be exercised in certain situations. One example is when working with flash teams. Individuals you haven't met before, who are not aware of your experience and abilities, may perceive a demonstration of vulnerability as a lack of competence. This carries two risks. Humans have an instinctive tendency to perceive how those around them are feeling and

to 'mirror' their emotions and behaviour. In normal social situations this allows people to communicate more effectively and to empathise with each other. In high-pressure situations, the leader demonstrating vulnerability to a follower who doesn't know them may appear as lacking in confidence. This may induce anxiety in that person. There is also a risk that more assertive characters in these teams may feel the need to take over leadership of the situation in order to compensate for your perceived lack of ability.

Coyle discusses the concept of the 'vulnerability loop' and its beneficial effects on organisational culture. By witnessing their leader asking for help or admitting to making a mistake, members of the team are more likely to act in the same way: 'If the boss can make a mistake and share it with us, then so can I'. Many workplaces are perceived as being competitive. Leaders demonstrating vulnerability and humility dispel this by creating a culture of openness, safety and supportiveness.[80]

Coordination

It is important for leaders to actively coordinate the actions of the team, constantly working towards the desired end point and optimally utilising the abilities of each member of the team. Monitoring multiple team members and multiple tasks is, however, challenging. Especially with unforeseen emergencies involving large and ad hoc teams, it is not uncommon for teamwork to rapidly become chaotic. Teamwork without effective coordination results in a significant compromise in performance.

Butchibabu describes two forms of coordination during teamwork. These are implicit and explicit coordination.[83] In their study, implicit coordination was defined as 'relying on anticipation of the information and resource needs of the other team members'. This means that when a team is undertaking a shared task, they have an awareness of what each other is doing currently and are able to anticipate what they are going to do next, without the need for the details to be verbally stated in advance. This has also been described as 'the ability of team members to act in concert without the need for overt communication'.[83] Implicit team coordination skills can be gained through simulation and training as a team and are developed over time through teamwork on operational tasks. A lack of implicit coordination is one of the reasons flash teams made up of individuals who are unfamiliar with each other perform less effectively.

In contrast, explicit coordination was defined by Butchibabu as 'the transfer of information and resources in response to requests'. Teams

relying on explicit communication have to state to the rest of the team what they are currently doing, what they are going to do next and when they require assistance. These teams use up more time speaking to each other during the completion of tasks. The researchers found that teams who made use of implicit coordination were able to complete tasks more effectively than those who relied on explicit techniques.[83]

From a leadership perspective, coordination of the team in high-pressure situations is similar to managing any project. The leader needs to understand what the challenges are, what the desired end point is, what needs to be done to get there and what resources they have available. Longer duration tasks need to be started first, as do time-critical interventions. Leaders need to monitor the progress and completion of each individual task they delegate to their colleagues. Coordination is based on maintaining situational awareness, using the information gained at regular rally points and observation of the actions of each member of the team.

Coordination of teamwork can be broken down into:

- Task prioritisation.
- Awareness of which tasks are interdependent.
- Awareness of the duration of individual tasks.
- Awareness of competencies of each member of the team.
- Maintaining a sustainable tempo of activity.
- Monitoring the demands on each member of the team.

Tasks and decision-making are prioritised on the basis of how time critical they are, their duration and the availability of someone competent to perform them. Some tasks and decisions will be completed in short timescales; others are more prolonged. In order to successfully manage the situation in the minimal amount of time it's essential that longer tasks are commenced as soon as possible. Linked to this is knowledge of which tasks are dependent on others. Some decisions won't be possible until information is obtained by completion of a preceding action and some practical procedures can't be started until others are finished.

Through simulation and operational experience, the leader will have an awareness of how long each individual task is likely to take. This will help them monitor the progress of task completion and evenly share actions among the team. Knowledge of the abilities of each member of the team is also critical to coordination. Allocating work to individuals based on their own personal skills will result in each person staying in their own state of flow. This also achieves successful task completion in the shortest duration of time.

Resilience

When faced with prolonged complex challenges it is important to be aware of the resilience of each member of the team. This is heightened if team performance is already compromised by fatigue. Some tasks will be more cognitively and physically demanding than others. Skilled leaders strive to alternate the delegation of tasks in order to ensure that members of the team are not given one highly challenging role after another. It's important to avoid over-pressuring people on to the right side of the performance arc into a state of frazzle. Similarly, managing the tempo of the situation is helpful in maintaining capacity and reducing the risk of cognitive overload. Effective leaders know when the pace of activity needs to be high in time-critical situations. They also know when the tempo can be slowed to give people a break.

A risk, particularly when small close-knit teams are working among a wider group of individuals, is that task delegation will be excessive on some and too light on others. Individuals known to the leader are more likely to have actions requested of them. Encouraging feedback from colleagues is important in ensuring that the spread of workload is balanced, and that people are not overloaded. This issue regularly occurs during patient resuscitation in the emergency department. Continually asking a limited number of nursing staff and trainee doctors to complete practical tasks before they have finished existing ones results in unnecessary pressure and some actions being forgotten.

Flash Teams

Communication, coordination and leadership of close-knit teams who know each other and who regularly train and work together is usually relatively straightforward. Achieving effective joint working in ad hoc flash teams is much more challenging. Members of flash teams do not know each other. They are not aware of each other's perceptions of the situation, or their priorities. Coordination of actions and decision-making are challenging as the skillsets of each individual are not known to others in the team. Communication can be difficult as each group has its own professional jargon and set of keywords, and people's names are not known. Establishing command structures and clear lines of responsibility is often never achieved in flash teams working under pressure.

Flash teams are common in the emergency department resuscitation room when multiple specialists, including surgeons, anaesthetists and radiologists, work alongside emergency medicine specialists. Each group of clinicians has their own areas of expertise and their own priorities.

Without effective leadership and clear lines of communication these resuscitations can rapidly become uncoordinated and chaotic.

Flash teams with differing roles also form at incidents requiring police, fire and rescue and the ambulance service. At major road traffic incidents, the police are concerned about the flow of traffic, the identity of those involved and the need for a crash investigation. The fire service is focused on scene safety and the extrication of trapped casualties. The ambulance service's priority is to assess the patients involved, start treatment at the scene and move them to hospital. If a critical care retrieval team is involved, its attention is on patients who are critically injured and who need advanced, lifesaving interventions at the scene.

Sharing and reconciling these differing priorities in a large team of individuals who have never previously met each other is challenging. This is especially the case as there is no over-arching leader. These difficulties are even greater in prolonged multi-agency responses to multiple casualty major incidents. In these circumstances, differing priorities, skillsets and objectives result in varied mental models. Communication using industry-specific terminology can lead to confusion. The absence of an overarching leader can result in failure of coordination and optimal progress. Delegation of tasks is challenging as individual competencies are not understood.

Clear identification of the leaders of each of the sub-teams present is important. Identifying oneself by name and gently asserting your position as a leader of one of the teams is key. Communication between leaders at this level achieves shared situational awareness and can help create a shared overall mental model. Regular rally points are essential to ensure coordination and cooperation.

Leaders of flash teams need to exercise caution in delegating decision-making and practical tasks to individuals who are not previously known to them. Some may not have the ability to undertake the task, but may be too embarrassed to admit it. Others may be overconfident of their abilities due to the Dunning-Kruger effect we discussed in Chapter 3, 'Back Pressure – Barriers to High Performance'. Some may not share the same mental model of what the problem is and what needs to be done; therefore, they may not value the need to undertake the tasks asked of them.

Interruptions

In managing high-pressure situations leaders need input and feedback from their team. However, they need to be aware of the risks of interruptions. As described earlier, interruptions during cognitive processing or when

completing practical tasks can result in a high incidence of errors. Information passed when leaders are task fixated is also unlikely to be effectively received. Leaders need to be receptive to others passing information and of suggestions made to them. However, they need to have methods of delaying the passage of information at inopportune times. If they do this in a manner that is perceived as confrontational, 'not just now, I'm busy' or by raising a hand, this will inhibit the person from speaking up again. More positive language is required to let people know that what they are saying is valued: 'Thanks for that, could I ask you to come back and let me know that again in two minutes'.

High-Pressure Leadership Qualities

During my research for this book, I asked a number of trusted NHS, search and rescue and military colleagues about the characteristics of effective leaders in high-performing teams. The feedback on what makes an effective leader is summarised below.

All said that the leader needed to be highly competent at their own technical discipline, and for this competence to be widely recognised and respected among the full team. Technical competency brings with it credibility and legitimacy when making leadership decisions and giving instructions. This ability is especially important for team leaders in high-pressure situations who need to carry out their own technical tasks, as well as leading the team. They need to have the spare cognitive capacity to make decisions, innovate, prioritise and communicate. Self-control is important. Everyone said that an ability to appear calm when under pressure was an essential attribute. Loss of control and displays of negative emotions result in loss of respect. Many had experienced this in pressured circumstances, causing a significant deterioration in team performance. Displaying resilience when operating in difficult circumstances is similarly important. Charisma and 'presence', without needing to be domineering and loud, were cited as was an ability to communicate clearly and concisely.

Good leaders actively seek and respect the opinions of the team before making decisions. If their ultimate course of action differs from the opinions expressed by the team they take the time to explain how they reached that conclusion. Once a decision is made, however, they remain open to constructive criticism and are flexible enough to change if circumstances or evidence change. They also have the humility to acknowledge if it later emerges they have made an incorrect decision. An ability to change tempo as required was a characteristic observed in good leaders. Placing pressure on your team to perform to a higher standard and at a faster rate is often

necessary. However, trying to do this constantly will be ineffective and will result in a loss of respect. When circumstances dictate, allowing the team to relax, removing pressure from them, is an effective strategy. Similarly, it is important to know when the team has reached its limits in terms of capacity and fatigue and when to stop pushing.

Good leaders use effective motivational techniques, particularly positive feedback and positive body language when communicating with each member of the team while they are undertaking or have completed tasks allocated to them. They know what specific tactics will be productive in motivating each individual member of the team. This is most effective when they know each individual well enough to understand how they are feeling and which techniques to use to get the best from them. Knowledge of each person's personality and the subtle behaviours they exhibit when stressed or fatigued was cited as being important.

Teams need to know what their goals are, where they are heading and how they are going to get there. Good leaders have direction and vision. They manage to communicate that vision to the team in order to create the sense of a shared challenge and forward direction. One person I spoke to compared this aspect of leadership to an expedition group moving through a jungle. The leader isn't the person at the front with the machete cutting a path through the trees. The leader is the person who climbs trees to obtain a clear view of where the group is going and what stands between where they are now and the destination.

Leaders with experience and knowledge of the skills and abilities of all members of the team are most effective when working under pressure. The ability to delegate tasks and decision-making to people who have the appropriate skills, knowledge and capacity to complete them is essential. Humility and flexibility are important to get the job done and a willingness to muck in when and where it is necessary, even with mundane tasks, is vital.

Many commented on the importance of having the respect of the rest of the team. For core members of the team, this respect is gained by conduct around the base and on previous tasks. In the retrieval service, when we are working with rescuers, paramedics, nurses and doctors we've never met before, it's essential for the leader to gain respect as early as possible through effective communication, confident command of the situation and by maintaining a friendly, approachable demeanour.

Maintaining an air of calm was regarded as critical. All had seen demanding aeromedical retrieval missions where members of the team had overtly displayed signs of frazzle and loss of control. They described the effect on team performance as being 'infectious'. Achieving the balance between calm confidence and appearing too laid back was described as an art form.

Trust was described as an important trait in leaders of high-performing teams. Trust to let others get on with what they are competent to do. Many noted that, despite being in situations where the tasks and information processing were overwhelming, some leaders were reluctant to fully delegate and trust their colleagues to undertake roles. This led to work duplication, confusion and prolonged task completion. Confidence to handoff responsibility was seen as a very positive trait in leaders. One person said, 'Personally I find those who are happy to delegate and take "one step" back are those who are most comfortable in their role'.

Leaders of teams operating in demanding situations strive to maintain states of high-performance flow in each member of the team. They achieve this through judicious delegation, clear direction, optimal communication, emotional intelligence and effective coordination of task management. Careful regulation of the pressure on each member of the team is vital. Leadership of flash teams is a particular challenge.

Learning Points

- **Leadership:** The leader must understand the problem, know what the end point is and how it can be achieved. Other aspects of good leadership include:
  - Delegation to a clearly identified recipient who has competence to complete the task.
  - Planning, projection and direction.
  - Emotional intelligence. It is vital to recognise, empathise and react to how other members of the team are feeling. This is also important in order to judge the appropriate level of assertiveness to adopt.
  - Maintenance of positivity and optimism through verbal and non-verbal communication. Be aware of 'mirroring' of negativity.
  - Demonstration of vulnerability, openness and humility.
- **Coordination** is essential to optimise efficiency, task completion and utilisation of the resources available. We should ask ourselves:
  - How time critical is each task?
  - Which tasks are interdependent?
  - How long does each task take?
  - Who is competent to do what?

  - Can we maintain a sustainable tempo?
  - How can we optimise the load on each member of the team so that it is not too much and not too little?
- **Flash teams** may introduce additional challenges to frontline leadership including:
  - Lack of awareness of each other's skillsets and perception of the situation.
  - Differing priorities for action.
  - Jargon and keywords may not be understood.
  - Command structures are often unclear and confusing.

Chapter 11
Tools of the Trade

Equipment and how we interact with it plays a key role in how we are able to perform in pressured situations. Equipment that is fit for purpose, reliable and intuitive to use can greatly assist us when working under pressure. Conversely, if we experience issues relating to equipment, this can quickly push us into a state of frazzle. Not being fully familiar with how to operate a piece of kit, a malfunction, a power loss or being unable to locate something can make the completion of tasks considerably more challenging, or even impossible.

High-performing teams have well-designed systems to select, prepare and check equipment. Competencies in dealing with each piece of kit are clearly defined. Teams are trained to troubleshoot common problems, assisted by emergency action cards. Redundancy also exists for mission-critical items.

In stressful circumstances, it's easy for people to use a piece of equipment incorrectly. Well-designed equipment should prompt operators on how to use it correctly, even in pressured situations. Design should make incorrect use of the equipment difficult or, ideally, impossible. The ergonomics of human and equipment interfaces is a rapidly expanding area of psychology and engineering. Carefully designed equipment can significantly reduce the incidence of human error in high-pressure environments.

Standardisation to Enhance Performance

Wayne Auton was a Royal Marine sniper. He was trained to carry out reconnaissance and marksman tasks for prolonged periods while remaining concealed from the enemy. As well as his rifle, photography equipment and a sighting kit, he carried personal equipment in his webbing. The equipment was to allow him to survive for the first 24 hours if he came under attack and was separated from his rucksack. In his webbing there were limb tourniquets, a medical kit, ammunition and food and water.

Wayne had a standard way he always packed his webbing. Everything was always in the same location. Ammunition magazines were stored in the left chest pocket. The right chest pocket contained his weapon cleaning kit and a speed loader. His rear pouches contained a 24-hour ration pack and a water bottle. The upper front pocket contained his field dressings and limb tourniquets. Even in the dark and when under fire, every marine could instinctively locate what they needed in an emergency. The other marines in his team packed their webbing in an identical manner. This meant that if one member of the team was incapacitated, his mates could easily locate the vital equipment he was carrying.[49]

Mike Henson is a search and rescue helicopter paramedic. He is regularly called upon to rescue and treat seriously injured climbers and sailors. As the only trained medical professional on the aircraft, he is responsible for single-handedly assessing and treating their injuries on the mountain side, on the deck of boats and in the back of the helicopter. Being able to immediately locate vital equipment is essential for him to provide medical care while working under extreme pressure in hazardous environments. Over the years, Mike has developed his own personal, standardised method of storing kit in his medical pack and of laying it out on the surface he is working on. This method allows him to put his hand on any piece of equipment without having to think about where it is. He can also direct anyone who may be assisting him to where the kit he needs is located.[84]

SCRAM Bags and Prefilled Syringes

Anaesthetising patients at the scenes of an accident carries considerable risks. Multiple pieces of equipment and drugs are required to carry out the procedure. Additional kit also needs to be immediately available to hand in the event of an emergency occurring.

For the first ten years of their operation the EMRS used an off-the-shelf airway equipment pack. This pack was crammed with 20 pieces of equipment. An additional ten bits of kit which we needed when anaesthetising patients were spread out in various other parts of the two rucksacks we carried. Assembling and checking the kit in preparation for pre-hospital anaesthesia was a prolonged and cognitively demanding task for one member of the team. Using this system, two members of our team, Paul Swinton and Neil Sinclair, undertook a study to time how long it took to prepare our equipment and to draw up the necessary drugs into syringes. During simulation, it took an average of 21 minutes to assemble and prepare the equipment and medication. When one considers that we want to arrive at the scene, assess the patient, anaesthetise them, package them and start moving to a hospital in under 30 minutes this is a significant amount of time.

The airway packs had other disadvantages. When open, they didn't have a large enough surface area to lay out all the equipment in an organised manner, some of it ended up on the ground, or on the floor of the helicopter. Kit wasn't laid out in a logical order. This made it more difficult to use the pre-anaesthesia checklist and to find things in an emergency. The equipment also wasn't protected from blowing away in the wind. Despite this, other pre-hospital teams around the world used the same system.

Realising how inefficient and cognitively demanding the current system was, Neil and Paul developed a new, bespoke pre-hospital airway pack – the SCRAM (structured critical airway management) bag. This was designed around the needs of our service and others who perform pre-hospital anaesthesia. The bag is large enough to carry everything we needed for the procedure and for dealing with complications that might occur, all in the one location.

When our team open a sealed SCRAM pack we have 100 per cent confidence that everything we need is immediately to hand. Once opened out, all of the kit is laid out in a user-friendly manner. The printing on the lining of the pack creates a 'shadow board' just like people have for their tools on the wall of their workshop. There are outlines for laryngoscopes, syringes and forceps. The bag can also be hung up vertically in cramped spaces such as the back of an ambulance. The SCRAM bag has improved the safety of the care we deliver. The time and mental processing required have been significantly reduced.

To perform an emergency anaesthetic, we also need to access a range of drugs. This includes drugs to put the person off to sleep, to stop their muscles from working, emergency drugs in case their blood pressure falls or their heart rate slows, and drugs to keep the person asleep while we transport them to hospital. This medication is stored in small glass vials. Preparing syringes for the anaesthetic involves checking the labels on the vials, breaking them open, opening syringes and needles, drawing up the drug into the syringe and diluting it with water from yet more vials. Following this, drug labels are added to each of the syringes. This is a prolonged process and can't be undertaken by someone who is not a trained member of the team. Even then, there is risk of mixing the drugs up, getting the dilution wrong, adding the wrong label, injuring yourself with a needle or cutting yourself with broken glass. In the past, some of us tried to draw them up in flight in the helicopter on the way to the scene. This wasn't the safest practice.

When Paul and Neil timed the equipment setup process they also realised how long it took to draw the drugs up. This took the full attention of one member of the two-person retrieval team. Drug preparation was a time-consuming and high-risk task. The solution was to prepare drug

syringes before we were tasked to cases of major trauma. Working with our pharmacy colleagues we introduced pre-filled syringes for emergency anaesthesia. The drugs are carefully prepared in a controlled environment by a trained pharmacist. These syringes offload a considerable amount of pressure from our team. They also significantly reduce the chance of us making a medication error.

As stated, with our old airway equipment bags and having to draw up drugs on scene, preparing for an anaesthetic took an average of 21 minutes. With the SCRAM bags and pre-filled syringes this has been reduced to under 12 minutes. Risks are lower, and the cognitive load is a lot less.

Every time we anaesthetise a patient the procedure is filmed. This allows us to have a more detailed and objective debrief of how the team performed. These videos show the clinician who is preparing the drugs and kit discussing plans with the doctor. With the SCRAM bags and pre-filled syringes prepared, the person preparing the equipment now has sufficient cognitive capacity to contribute to decision-making regarding patient assessment and treatment.

Equipment Preparation

There is a set structure to each day on the EMRS base. This structure ensures that our equipment is prepared and checked, ready for the day. The equipment for the fast response car, plane and helicopter is packed at 6.45 a.m. ready for our duty period starting at 7 a.m. All electrical equipment is tested and we make sure it's fully charged. We check the lifejackets, underwater breathing systems and the satellite locator beacons we are going to wear that day while flying in the helicopter. Radios and phones are also checked to ensure that they are functioning and have full batteries. We use a two-person check and response system for each of these checks. The morning checks promote familiarity with the service's equipment and give us confidence that we don't have to be concerned about equipment when we go out on a retrieval mission later in the day.

We have an aviation briefing with the helicopter pilot at 8 a.m. to discuss weather, aircraft issues and any problems with hospital landing sites. This is followed by a medical briefing with the paramedics who are on duty. We discuss what role each person will have if we are tasked to different types of patient.

Anyone who has ever left their mobile phone at home and spent the day without it, or who has had their laptop battery run out of power while giving a presentation, will know the feeling of frustration of being without vital equipment. The emotional effect on performance when finding out

that a key piece of rescue or medical equipment has been left behind at base or has just run out of power is even greater.

In large hospitals, oxygen is piped into the resuscitation room and intensive care unit from huge storage tanks, it's virtually impossible for it to run out. We can plug electrical equipment into the mains and, if that fails, we have backup electricity generators. In the hospital, we can't run out of power. We have storage areas full of consumable equipment. We have ward cupboards packed full of drugs, with 24-hour restocking from pharmacy stores a phone call away. Things are very different in the retrieval environment. If we're providing care to patients in small, remote hospitals or at the roadside we can't rely on equipment, power, medical gases and drugs being there when we arrive. Experience has also shown us that we can't rely on other services we work with to be able to supply equipment that is charged, checked and working. We have to be self-sufficient in taking the resuscitation room with us in our equipment packs.

We deliberately factor in redundancy for equipment failure or for instances when an aircraft issue leaves us stranded in a remote location for prolonged periods. If our ventilator fails, we can change to manually squeezing oxygen into a patient's lungs using a hand ventilation bag. Our patient monitoring devices measure blood pressure, heart rate, oxygen levels, breathing rates, carbon dioxide in expired breath and the temperature in the patient's oesophagus. We carry small backup oxygen and carbon dioxide meters. We can count a patient's heart rate and breathing rate manually. We also carry hand-operated suction devices in the event that our electrical suction device fails.

All of the helicopter emergency medical services I have worked with use two people to check their packs. Their packs are restocked and checked by two people after each mission. In addition to these post-mission checks, once a month all the packs are emptied, expiry dates are checked and the packs are then restocked. A system with one person checking bags is prone to error. Two people using a check and response system with a checklist ensures that everything that needs to be there is present.

When you're already under pressure, a poorly organised equipment pack that you're not familiar with can compromise your performance. All members of the team contribute to the bag checks. This means that all members of the service have their personal knowledge of where equipment is kept refreshed on a regular basis.

We try to create a sterile environment for kit checks in order to avoid distractions and interruptions. When we check and restock bags we complete and sign an equipment check form. This creates an audit trail for each individual

numbered pack. If a piece of kit is subsequently found to be missing from a pack, it's easy to identify when the bag was last checked and who carried out the check. If we check a bag and find that a piece of equipment is missing, or additional kit is present, then this is reported as a significant event.

Many helicopter medical teams seal their packs with plastic cable ties. The zips on each pocket are sealed. This serves two purposes. It allows a quick visual check on leaving base to ensure that the pack's interior has been checked and is complete. Also, on returning from a retrieval mission we only need to check the compartments with broken seals. Each compartment's zip has a keyring attached with a printed label describing the contents. The labels are colour coded: red for circulation, blue for airway, etc. This helps us to rapidly locate vital equipment in emergency situations.

The same kit sealing and checking systems have been introduced by the police dive units and mountain rescue teams I provide training and advice to. Arguably, this system is even more important for these teams as they are able to provide a high level of medical care, but are not full-time healthcare professionals. Being able to immediately put your hand on what you need in an emergency is vital for these casualty carers to avoid frazzle. My mountain rescue team has also introduced a medical equipment pack infographic. This has images of each piece of equipment, their names and where they are stored in the bag. This helps locate equipment in emergencies and makes it easier for casualty carers to communicate what they need from the person with the medical pack.

The Arrochar Mountain Rescue Team operates a colour coding system for technical rescue equipment. The team carries four identical bags of climbing hardware to set up belays, stretcher lowers and for rock climbing: these include karabiners, figures of 8, prussic loops, slings and belay plates. Each pack has its own colour. Each piece of equipment has a coloured label showing which pack it came from. This colour coding system greatly aids restocking after a rescue or training exercise.

High-performing teams need effective equipment management systems. The benefits of reducing pressure by using a simple two-person check and response system and well-labelled, sealed packs are considerable.

Choosing Equipment

Deciding on whether to obtain new equipment in the hospital emergency department, mountain rescue team and helicopter retrieval service is always a challenge. Evidence often emerges suggesting how indispensable a new piece of equipment is in rescuing or caring for patients. Members of the team attend conferences and training courses

sponsored by kit suppliers and become persuaded of the necessity to carry a new device or upgrade the equipment the service already has. Our need to procure new kit or update what we already have should, however, be driven by any deficiencies we have identified in our ability to assess or treat patients with current equipment. Too often though, expensive solutions are developed for small and sometimes relatively insignificant problems.

In the EMRS, Phil Munro, the consultant who is in charge of equipment, has a very measured approach to equipment acquisition. There are many factors to be considered when obtaining a new device. With multiple teams deploying simultaneously it's never the case that a single unit will be enough. As a minimum, we need one unit for each team. We also need an additional unit to allow servicing and repair. Costs rapidly mount up. The training burden of new kit and the time and financial costs of initial training and refresher courses also need to be considered.[85]

For equipment to be used in the helicopter and plane, we need to ensure that the aircraft manufacturer has approved the device for flight and that it's compatible with the aircraft's avionics systems. Unsecured equipment can cause damage in a helicopter in turbulence or in a heavy landing. Retainers are, therefore, required to secure kit. Sometimes these need to be specially designed and made. The retainers are often more expensive than the piece of equipment itself. Also, every kilogram of equipment means a kilogram less fuel and, therefore, less flying endurance.

The robustness of the kit for pre-hospital use also needs to be thoroughly considered. How long do the batteries last? Can the device be dropped without damaging it? Is it water resistant? Can the equipment function at extremes of temperature? Can the display be seen outside in bright sunlight?

When planning what equipment and drugs to take on critical care retrieval missions, we need to consider what types of medical conditions we might be called upon to treat and how long we might need to be with the patient before we reach a major hospital. Using our database of 15 years of retrieval missions, we can assess exactly what drugs and equipment we've used, and how often. We can calculate the duration of retrieval missions and hence how many batteries and what quantities of drugs and oxygen are required. We can review our significant event reporting system to identify occasions when we ran out of consumables or had battery failures. All of this information allows us to continually review the contents of our equipment packs. This is an ongoing process –

at the time of writing this book we're now on version 38 of our medical equipment pack checklist!

Introducing New Equipment

Teams should adopt structured methods of safely introducing new equipment, especially if it has a vital role and needs to be used in pressured situations. The first stage is to develop a service-specific guideline for the equipment. Simply giving people access to a large operator's manual is unlikely to result in them reading it. The guideline should contain information about how to use the equipment, how to check it and a troubleshooting guide for error messages and malfunctions.

For pieces of equipment that are not intuitive to use, for example those with controls that have multiple functions, the retrieval service develops brief aides-memoire to describe how to carry out common functions. Examples of this are our airwave radios and our portable ultrasound machines. For some devices and procedures, we produce an infographic as these can be a more effective method of showing what's required to operate the equipment and the function of each separate control.

Some devices and procedures benefit from their own checklist. A few years ago, the EMRS started to carry three units of blood to allow us to transfuse bleeding patients at the site of accidents. The blood is stored in a refrigerated box and needs to be warmed before going into the patient. Assembling the blood warming device and giving a blood transfusion has to be done meticulously as the risks of giving the wrong type of blood to a patient can be fatal. We need to carry out this procedure quickly as these patients are usually bleeding severely. To help us give blood transfusions safely, we developed a 10-point checklist for our doctors and paramedics. This system speeds up the blood administration process and has reduced the potential for error.

New equipment guidelines and aides-memoire are distributed to the team and added to our iPhone app. Staff are expected to use the guidelines when training on the new piece of equipment and during clinical simulation. This beta testing phase is used to identify errors and ambiguities in the documents before the kit starts live, operational use. Once training is complete, each member of staff is assessed and signed off as being competent to use the new device.

After the equipment starts to be used operationally, a feedback system is put in place to communicate any issues and learning points for the team.

Equipment Design to Reduce Pressure and Error

Chemotherapy is a mainstay of cancer treatment. Drugs that destroy cancer cells are given by injection to the patient. These drugs carry significant side effects and risks for patients. As a newly qualified doctor in 1993, in the evenings and at weekends my colleagues and I covered a haematology ward. This ward had patients with leukaemia and lymphoma who were receiving chemotherapy injections. In those days, the nursing staff on the ward, even though they specialised in haematology nursing, weren't allowed to administer chemotherapy drugs. The junior doctors had to do it – without any specialist training. I regularly administered potentially toxic drugs I knew nothing about to patients I had never met before. I had no induction, no checklists and no written guidance. The first I knew about it was when I was paged at nine o'clock one evening during my first week in the job.

Usually the injection is given through a cannula into the patient's vein. In some types of cancer chemotherapy however, the drug is administered directly into the patient's spinal canal. This is called an intrathecal injection. A thin plastic tube is inserted into the spinal canal at the base of the patient's back. At the end of the tube, protruding from the skin, is a connector that allows a syringe to be attached. This allows the drug to be injected into the spine.

Many patients receive multiple chemotherapy drugs at the same time. A small number receive both intravenous and intrathecal chemotherapy. Unfortunately, drugs designed only for intravenous use can have devastating effects if given into the spinal canal by mistake. In 2001 an 18-year-old boy, Wayne Jowett, undergoing treatment for leukaemia, died in Nottingham after he was mistakenly given chemotherapy into his spine rather than into a vein.[86] One of the doctors involved was later prosecuted for unlawful killing. A number of other similar fatal incidents have occurred.

The standard device to connect a syringe to a cannula in a patient is a threaded screw type system called a luer lock. Until recently, the connection device on intravenous cannulae was identical to those on intrathecal cannulae. This meant that any syringe could be attached to either a vein or a cannula into the spinal canal. As a result, if a drug meant for intravenous use was mistakenly administered into the spinal canal there was nothing in place to physically stop this from happening.

Recently, health equipment manufacturers have developed a new syringe connection system for use only in spinal canal catheters. These require specific spinal syringes to be used with them. Normal luer lock syringes cannot be connected. This means that it is now impossible to administer chemotherapy drugs meant only for intravenous use; an intravenous syringe cannot be connected to a spinal catheter. Through engineering, the risk of human error has been hugely reduced.

Equipment manufacturers are becoming increasingly aware of errors that have occurred due to incorrect use of their products. These errors often happen during times of high-pressure and cognitive overload. With input from human factors experts, equipment can be designed to reduce the incidence of errors. These measures include ensuring that equipment controls are logical and intuitive to use. Devices with barriers and warning systems to prevent operators using them incorrectly in certain situations are also vital.

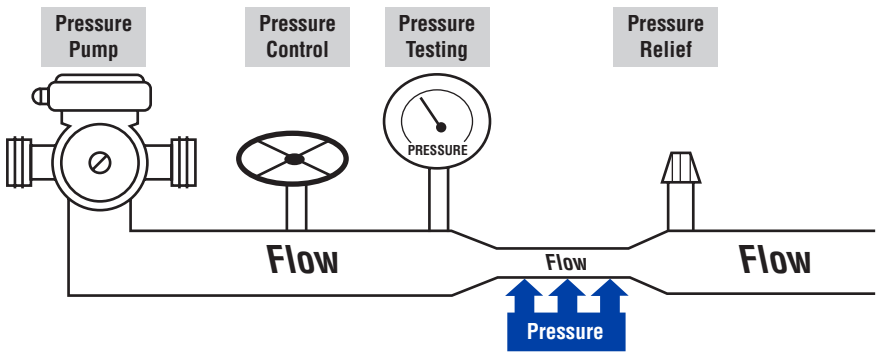
Equipment can be designed to actively assist people in operating them correctly. A simple but effective example of this is the design of aeroplane control levers. Two levers are located near to each other in fixed-wing aircraft. One controls the flaps and one lowers the landing gear. In the past, use of the wrong lever has caused a number of serious accidents. Nowadays, the landing gear lever is shaped like a round wheel and the flap lever is shaped like a wing. This means that the pilot is much less likely to use the wrong control. It also means that the controls can be identified by touch alone in the event that cockpit lighting is lost. This design is now part of aviation law in the United States.

Poorly selected, designed and checked equipment can significantly increase our chance of making an error in high-pressure circumstances. It also adds to the cognitive load on our teams. High-performing organisations invest time and resources into optimal kit selection, training and cognitive aids.

Learning Points

- **What goes wrong when using equipment under pressure?**
  - Malfunction.
  - Power loss.
  - Forgetting to take a vital piece of equipment.
  - Lack of knowledge concerning operation and function.
  - Being unable to locate vital pieces of equipment in an emergency.
- **Checking and storage of equipment is of vital importance. Consider the following:**
  - Two-person check and response systems are necessary to check equipment optimally.
  - The ability to mark or seal equipment packs to confirm that they are complete is useful.
  - Colour coded equipment labels help reduce time and pressure.
  - Readiness state checklists help manage team pressure and confidence at the start of shifts.
  - Standardisation of equipment type and storage layouts reduces pressure on teams.
- **How can potential equipment problems be dealt with?**
  - Ergonomic design helps the use of equipment when working under pressure, and reduces the risk of error.
  - Troubleshooting emergency action cards help with managing equipment malfunction.
  - Systems for charging electrical equipment are required.
  - Backup kit for mission-critical equipment is needed.
  - Operation of complex equipment that is rarely used can be supported by step-by-step equipment guidelines.
- **In choosing and introducing new equipment the following should be considered:**
  - Careful matching of equipment to the skills of the team and the operational environment is important.
  - Careful planning and regular review of equipment pack contents are essential.
  - Introduction of new equipment requires team-specific guidelines to be written and carefully planned training and simulation.

Section 4
Pressure Testing



It is important that we and our teams are appropriately prepared to deal with high pressure. How we train in terms of simulation and drilling are of vital importance. We can train people to recognise the early signs of frazzle in themselves and in their colleagues. We can also prepare ourselves mentally and physically for performance under pressure.

Chapter 12
Training for High Performance

Mike Henson is a winch paramedic. He currently works for the company contracted by the coastguard to provide the UK's helicopter search and rescue service. Mike originally trained and worked with a Royal Navy search and rescue squadron for many years. He was based at the country's busiest search and rescue unit at Royal Navy Gannet on the west coast of Scotland. While based at Gannet, Mike undertook hundreds of mountain and maritime rescue missions. He was also involved in many critical care retrieval transfers of patients from Scottish islands when the weather was too severe for the ambulance service's aircraft to fly. I regularly work with Mike when the EMRS team undertake critical care retrievals from remote areas in bad weather. I also work alongside him during mountain rescue callouts. His experience of decision-making and completion of complex physical tasks under conditions of extreme risk is extensive.[84]

Mike works as part of a four-person search and rescue team on an Augusta Westland 189 helicopter. The aircraft has two pilots who are highly experienced aviators, each with thousands of hours of flying. Most of the pilots have military flying backgrounds. The third member of the crew is the winch operator. The winch operator has the demanding task of controlling the winch when Mike is lowered down onto a boat or to the side of a mountain. He or she also has the role of navigating the aircraft. Frequently, this has to be done in zero visibility in storms and at night. Once a patient is on board the helicopter, the winch operator assists the paramedic in providing medical treatment.

Winch paramedics have three main roles: winch rescuer, paramedic and aircraft crew member. They have to be lowered on a 70-metre metal cable to the casualty's location. This can be onto a boat, in the sea or on a mountainside. Mountain and maritime accidents usually occur at times of bad weather and poor visibility. These conditions make the job technically and physically even more demanding and hazardous. Once with the casualty, Mike must make decisions about how to secure himself and the

casualty to the terrain they are on in order to keep them both safe. The nature of the job means that they are often in precarious locations. Each mission has unique challenges in this regard. A high level of physical fitness and ability to innovate under pressure is required.

Prior to moving the patient to safety, Mike uses his paramedic skills. He assesses and starts treatment before the patient is initially moved. How much treatment to administer and how long to stay on scene prior to winching takes precise judgement. Moving an unstable casualty before they have been treated could result in them deteriorating during the extrication process. Unlike most paramedics and doctors who work as part of a larger team, Mike is usually the only medical professional looking after a patient. There is usually no other qualified clinician to help with examination, treatment, decision-making and movement.

Often, when at the accident site, Mike works alongside volunteer mountain rescue and lifeboat teams. Operating under time and safety pressure with flash teams of individuals you have never met before is cognitively demanding and requires excellent communication skills – both talking and listening.

Following on-scene medical assessment and treatment, the next challenge is to get the patient safely into a stretcher or a harness at the end of the winch before being lifted on to the aircraft. It is usual for people who are being rescued to be frightened and distressed, especially if they are about to be winched into a helicopter for the first time. They can be on the end of a wire hundreds of metres above the ground. It is essential that Mike maintains a calm and confident manner in order to gain the person's trust and keep them secure.

Once the patient is safely inside the helicopter, Mike's paramedic role continues. He must examine the casualty and provide drugs and treatments while the aircraft is in flight. Noise, movement and vibration make this much more difficult than when working at the roadside or in hospital. He also has to decide, along with the aircraft captain, what the most appropriate hospital to take the patient to is. Ideally, patients should be taken to hospitals with on-site landing pads that can provide all the care the patient needs. Direct transfer from the scene to definitive medical care is ideal. Sometimes, however, the patient is too unstable to survive the journey to a definitive care centre, the aircraft may be low in fuel or the weather may prevent the transfer. In these circumstances Mike has to make the decision to make a run to the nearest hospital.

Mike's third role is to be an active member of the aircraft crew. Using his extensive aviation experience, he assists with mission planning,

decision-making during the task and with navigation. During landings in poor visibility, Mike connects himself to a waist harness that is fixed to the roof of the aircraft cabin. He opens the side door and lies on his stomach with his head out of the door. As the pilots can't see below or behind the aircraft, Mike becomes their eyes. Using a number of predetermined commands, he guides the pilot into the exact landing position, 'Move right three metres. Forward one metre'. This role is similar to the one he has when he is on the winch. He must continually describe his position, his height, the terrain and the position of the casualty to the winch operator and the pilots to ensure that he is placed on precisely the right spot to initiate the rescue. Clear, well-drilled, unambiguous keywords are essential for this high-stakes communication process.

Mike described to me a number of challenging rescues during which he has had to operate under pressure. He described to me a complex rescue he was involved with in April 2012. Mike's heroic role in this high-profile rescue was widely publicised in the media and gained him a number of bravery awards. The success of this mission is testament to the quality of training he received in the Royal Navy.[87]

A cargo ship, the MV Carrier, with a Polish crew, had lost power and was being repeatedly struck against the sea wall in Colwyn Bay.[88] A ferocious Force 9 gale was blowing. The sea was in turmoil. The ship was rising and falling three metres with every incoming wave. It was also shifting violently from side-to-side as it struck the sea defences.

Further out to sea, there is usually a predictable, uniformly recurring period when the sea is calmer between the waves. This allows a window of opportunity for the winch paramedic to get on to the boat deck. However, as this boat was in the surf there were no lull periods. The ship was continually violently moving up and down and from side-to-side.

The eight crew members on board were uninjured, but had to be rescued by winching them into the aircraft. Landing on the deck safely was an immense challenge for Mike, the pilots and the winch operator. The gale meant that hovering the aircraft was very difficult and the constantly moving boat rendered the positioning of the winch extremely hazardous.

Once on the ship, Mike could smell leaking fuel. There was also talk of a fire below deck. He managed to winch five of the crew to safety. When he was placing the sixth sailor into the winch strop, the winch became snagged on the deck of the boat. The movement immediately damaged

the metal cable. It was impossible for Mike and the remaining crew to be lifted to safety. The winch operator had to jettison the cable from the helicopter. Mike and the remaining crew were stranded on the out-of-control ship as it smashed against the sea wall.

After a period of time on the deck of the ship a second search and rescue helicopter, from the Royal Air Force, reached the scene. This winched Mike and the remaining crew to safety.

Search and Rescue Training

One might expect that Mike's ability to perform to this level under such extreme pressure and personal risk was due to years of search and rescue experience. Incredibly, however, this was Mike's first ever rescue, on his first day in the role. His ability to undertake this rescue was not due to years of operational experience, but to the intense and highly effective training he had received from the Royal Navy. This training allowed him to perform to the highest standards under pressure, from day one on the job.

His knowledge of the Royal Navy's search and rescue standard operating procedures, time invested in drilling of core procedures and repeated deliberate practice enabled him to save the lives of the boat's crew in the most testing of circumstances. Mike says that often during a rescue the circumstances are so complex and dynamic it is simply not possible to receive and process all of the incoming information in an analytical fashion. Cognition during these demanding rescues requires intuitive, automatic processing. Mike describes this as 'hard wired' cognition. The training he had received gave him the ability to carry out each core skill of the rescue mission with automaticity, using minimal cognitive load.

Mike describes how the Navy have clearly defined written competencies for winch paramedics. The core knowledge and skills expected of him were understood by him and his trainers. The performance standards expected of him were clear from the outset of his training. Each individual skill Mike used on the day of his first rescue had been deliberately and repeatedly practised. His trainers described and demonstrated what he needed to do to perform an individual task. They then witnessed him undertaking that task. They debriefed him, letting him know what was good and what could be improved upon. Then he did it again. And again. These core skills became automatic, intuitive actions that require almost no conscious thought. His mental processing for these skills changed from analytical to automatic cognition.

During his training, Mike started off by acquiring a set of core winching, rescue, medical and aviation skills and knowledge. Once these had been perfected, he then started to simulate rescues and caring for seriously ill and injured casualties. Initially these simulated rescue missions involved straightforward daytime scenarios in good weather. As he became more proficient and competent, the scenarios gradually became more challenging and increasingly pressured. Simulation sessions started to take place in bad weather and at night.

At each stage Mike was continually assessed and debriefed. This was realistic, immersive simulation for the job he was expected to do under high-pressure and high-risk rescue situations. This performance coaching honed and perfected his ability to perform each and every skill. Gradually, he started to combine these skills, gaining the ability to conduct a full rescue mission from start to finish.

Mike's competencies were also understood by other members of the helicopter's crew. They knew what he was capable of. They knew how he would behave when circumstances changed. He knew their competencies and how they, in turn, would react to different situations during the rescue. They shared the same mental model through effective training and simulation as a team.

Stages of Training for High Performance

The first stage in designing a high-performance training programme is to define the roles each individual is expected to perform and to what standard. Clear and detailed competencies are essential in any high-pressure organisation. This is followed by the acquisition of factual knowledge through written guidelines and SOPs. Core tasks that require proficiency are identified for each member of the team. These are repeatedly drilled, under supervision, until they become automatic processes. Following this, new team members start to take part in increasingly complex, immersive simulation. These simulation scenarios have clear objectives such as improving communication and team work, or developing strategies for regaining composure and situational control. Each simulation is debriefed and coached by an existing member of the team who has attained expertise in the skill. Through this deliberate, purposeful practice, mastery of the subject develops.

In addition to these training stages, each person should receive training in human factors, communication and cognitive biases. They also need to become competent in the use of cognitive aids and metacognition techniques.

Define the competencies

If we are working to develop high performance in an individual or our team, before we start to plan induction programmes, training sessions or simulation scenarios we need to know what we are aiming to achieve. This means accurately and comprehensively detailing what competencies are required of each individual.

The learner and the trainer need to know what the specific aims of each training session are, through an understanding of the expected competencies. Once operationally active, knowledge of each member of the team's competencies allows effective and safe delegation, thus optimising the performance of the team under pressure.

When defining competencies, it is important to detail what level of knowledge or skill is required from someone in their particular role. Does this member of the team only need to have an awareness of this piece of information? Do they need to be able to carry out this procedure under supervision? Should they be able to operate this piece of equipment autonomously or should they be at the level where they can train other people how to undertake the task?

Knowledge acquisition

Prior to developing practical skills, it is essential for new members of the team to attain the relevant factual knowledge. Induction training of new EMRS clinicians starts with acquisition of the necessary information about service operations, equipment and aircraft. New colleagues are expected to fully familiarise themselves with all of the team's written guidelines. There are 120 of these. These documents provide practical guidance on how to undertake tasks, treat medical emergencies and use the service's kit. Access to the guidelines is provided on the team's iPhone and iPad app. The app also allows the new team member to gain familiarity with the various checklists, aides-memoire and resources we have available to support operations.

Some information needs to be used in extremely time-critical situations. In some instances, it is necessary to commence managing sudden problems before there is time to start using a checklist or action card. Knowledge for these types of emergency needs to be thoroughly memorised and mentally rehearsed by the members of the team.

Drilling and overlearning

Our long-term memory has two parts.[26] We have explicit memory, which is used for the recollection of factual knowledge and for experiences we

have had. Using explicit memory is a conscious action. Implicit memory, on the other hand, is accessed subconsciously. One type of implicit memory is our procedural memory. This is memory laid down when repeatedly practicing a practical task.

Sandi's review of the effects of pressure on cognition concluded that our ability to use explicit memory was adversely affected by high levels of pressure, i.e. our ability to consciously recall memorised facts is worse when we are frazzled.[18] However, similar levels of pressure actually improve our ability to access our implicit memory. If we repeatedly drill practical skills this allows them to be successfully completed, even in situations involving high levels of pressure. Our ability to perform these tasks may even be more proficient when we are experiencing pressure.

Repeated practice is key to mastering core skills for performance in any team. This is also known as overlearning. The benefits of drilling to develop intuitive, automatic practical skills, especially in demanding situations, are described in Eysenck and Keane's *Cognitive Psychology*: 'A key finding … is the dramatic improvement practice has on performance. This improvement has been explained by assuming that some processing activities become automatic through prolonged practice'.[9]

The book describes how well-practised, drilled activities require less cognitive capacity and less attention. They are also harder to perform incorrectly once learned. Multiple automatic processes can be rapidly conducted in serial order. Knowledge that has been stored through repetitive practice is easily accessed with little or no conscious thought. A review of research studies relating to overlearning of skills also showed that overlearning significantly improved retention of information and skills.[89]

In the EMRS, supported by service specific guidelines, new staff are fully briefed in the use of all of the service's equipment and equipment packs. Setup, operation and troubleshooting are drilled and re-drilled until they become automatic actions. Similarly, preparing for and carrying out clinical procedures are practised and drilled. Team members are expected to be able to perform dozens of tasks with this level of competence and confidence. These include preparing for emergency anaesthesia, applying splints to fractured limbs, packaging patients for transfer, giving blood transfusions and using our mechanical resuscitation device on people who are in cardiac arrest. Our team is also trained to instinctively react and deal with unforeseen emergencies such as a failed intubation during anaesthesia or a ventilator failure.

During the training period, a strong emphasis is placed on personal and team safety. New staff are issued with, and trained in the use of, personal protective equipment, including immersion suits, helicopter helmets, life jackets, emergency satellite locator beacons and underwater breathing cylinders. All staff must complete a helicopter underwater escape training course and familiarisation training for each of our aircraft types. All emergency equipment and all drills for emergency landings and escape must be practised until they are automatic. Each person must be able to complete these tasks intuitively under extreme pressure.

Through factual knowledge acquisition and drilling, the new team member gradually starts to perfect the predictable components of a retrieval mission. All retrievals are unpredictable. They are, however, made of predictable parts. Skills that have become automatic can be compared to jigsaw pieces. The new team member gains their own collection of retrieval jigsaw pieces. When they get to the patient they can fit the pieces together according to the unique circumstances they are faced with. As a result of repeated drilling they can undertake a number of practical procedures quickly and with minimal cognitive load. This frees up the remaining cognitive capacity to analyse and deal with the nuances of the case they are dealing with.

Once a new team member has been signed off as being competent to undertake a set number of tasks, they become a reliable 'known quantity' among the team. There is clarity for those leading a retrieval mission as to what the person can be safely asked to do with and without supervision.

Purposeful practice

In his book *Bounce*,[31] Matthew Syed describes the quantity and the quality of practice that is required to attain a state of expertise in a specialist area. He discusses the concept of 10,000 hours of practice as being necessary to develop competence and proficiency in any discipline, be it sport, surgery or playing a musical instrument.

Syed's key message is that the practice needs to continually challenge the individual. Most middle-aged people have spent 10,000 hours driving cars. They're competent, but they haven't become experts. This is because each time they get behind the wheel they are repeating the basic functions again and again. They are not striving to improve their use of the controls or their knowledge of the rules of the road. They are not challenging themselves. If we want to become experts who can perform

under pressure, we need to put the time into practice, but we also need to ensure we are constantly pushing ourselves during that time. This concept of purposeful practice requires planning and lots of personal motivation.

No one has researched the subject of purposeful, deliberate practice more than the Swedish psychologist, K Anders Ericsson.[90] Professor Ericsson is interested in how individuals become experts in areas such as medicine, sport and music. His research shows that it is most effective to divide a discipline up into small chunks of knowledge or skills. Each of these small segments can be concentrated on and mastered with sessions of deliberate or purposeful practice. Repeating the skill again and again with real-time feedback from an expert coach is the route to achieving mastery. Weaknesses in performance have to be identified and actively worked upon until they are eliminated.

Coaching by expert colleagues is an essential part of deliberate practice. Learners need to be open to scrutiny and constructive criticism during training and on operational tasks. Only by taking on board advice and applying it during the next session can they improve their expertise.

In many professions, people equate time served to competence. If, during this time, the individual has operated at the same level, has had minimal opportunity for personal development, has not been subject to regular peer review, and has not undergone regular assessment, then it's likely they will be no more expert at their job than the day they started. In fact, due to complacency and the progress of professional knowledge, there's a reasonable chance they will be worse.

When planning training sessions, we need to be aware of what competencies we are trying to achieve. We need to identify a specific learning objective for each individual session, one that will improve our performance and bring us nearer to achieving competence. With each drill and simulation, we need to ask the following questions: What am I trying to achieve? What do I know currently? What do I want to know or do better? What am I specifically going to try to improve during this session?

Human Factors Training

Technical knowledge and technical skills alone are not sufficient to allow people to work optimally when under pressure, especially as part of a wider team. A thorough understanding of how and why we behave and make decisions under stressful situations is extremely important.

It is mandatory for all members of the retrieval team to undertake a full day of team resource management and human factors training each year. This training is delivered by former military aviators. These courses are specifically applied to our team and our working environment. Case examples of issues caused by poor communication and decision-making are discussed. The team gains greater insight into factors affecting personal and team performance. They also learn techniques to reduce the chance of unsafe practice due to cognitive bias, fatigue and ineffective communication.

Motivation and Inspiration

In any high-performing team, motivation for learning and attainment of expertise is essential, both in the individual and in the organisation's culture. Individuals are inspired by colleagues who are respected for their abilities. They are motivated by other members of the team who regard learning and development as positive and essential.

Ex-Royal Marine sniper Wayne Auton describes the pride marines have in their fighting skills and fitness, particularly in their ability to perform in austere environments. The desire to gain the skills and knowledge and to be part of that 'family' of marines was a huge driver during his training. He also describes the need to not let his mates down in training and on operations. Each individual required a minimum level of skill and fitness. The failure of an individual to perform to that standard could put their colleague's lives at risk. Similarly, each member of the team had individual, specialist competencies. Not being able to work to that level under pressure would jeopardise the objectives of the operation.[49]

The ability to perform at a minimally proficient level in a low-stress environment is readily achieved through simple practice. Attaining the ability to perform complex tasks as part of a team under pressure requires significantly more intensive and structured training. Expertise results from attaining well-defined competencies and repeatedly drilling the execution of core tasks to a level of perfection. The development of skills should be based on deliberate, purposeful practice with debriefing and coaching. Training of new team members should involve incrementally complex simulation scenarios within realistic environments. Performance under pressure can only come from training under pressure.

Learning Points

Training for high performance should include:

- **Clearly defined competencies:** knowledge and skills are essential for every member of the team. Members of the team need to know what is expected of them and what the objectives of training are. Planning training without competencies as learning objectives is impossible.
- **Factual knowledge:** the provision of organisation-specific guidelines is important for the induction of new staff and continuing personal development.
- **Human factors training:** teams expected to perform under pressure need to be able to recognise when the pressure is becoming excessive and to have the ability to regain personal composure and situational control.
- **Drilling:** plan, practice and perfect. Identify the core skills repeatedly used by your team. Plan how you undertake them, then practise them again and again. This drilling process will transform them from requiring analytical cognitive processing to automatic processing. This improves speed, reduces error and minimises the cognitive load.
- **Deliberate practice:** train with the aim of improving one or two parts of your technique. Do this with expert review and coaching. This deliberate, purposeful practice leads to mastery of the skill.

Chapter 13
Simulation and Competency Assessment

Following attainment of the necessary factual knowledge and completion of core equipment and procedural drills, individuals being trained for high-performance roles may then progress to simulation training. Drills training develops automatic cognition for discrete, core procedures. Simulation, however, develops more complex cognitive abilities, e.g. the ability to analyse problems, innovate and make decisions based on unique circumstances. Simulation also differs from drilling in that it concentrates on the development of communication skills and working as a team. Human behaviour under pressure can also be explored during the scenarios.

During simulation training, numerous tasks and decisions have to be processed and completed, often in rapid succession. The skills of how and when to apply knowledge, interpret data and carry out procedures are developed. The cognitive load can be continually increased as the simulation training progresses. The learner gains the ability to deal with ever-increasingly pressured and complex scenarios. Placing varying challenges on individuals through simulation is based on Ericsson's principle of deliberate and purposeful practice to achieve effective learning.[90] Simulation can also be used to place teams under pressure as part of a stress inoculation process.

As well as developing individual skills and performance, simulation is also beneficial for a number of additional purposes. When new equipment and procedures are introduced they can be trialled and improved in a realistic but safe environment. New and revised checklists and guidelines can be validated before being used in a live, operational setting. Joint working between different teams and organisations is more effective if they have simulated training together. This training improves awareness of each other's capabilities and working practices. Well-planned simulations can also be used to assess competence and performance in individuals and teams. Video recorded simulations, both positive and negative, are useful classroom teaching tools.

Realistic Simulation

It is important to make a simulation look and feel as close to real life as possible. If training sessions appear unrealistic, it is difficult to engage the minds and enthusiasm of learners. They need to be able to suspend their disbelief and engage with the session. Only once this is achieved will people start thinking, acting and communicating the way they would in real life. This is essential for effective learning. The more realistic the scenario, the equipment and the environment, the easier it is to challenge the team and place them under gradually increasing amounts of pressure.

The Arrochar Mountain Rescue team makes use of a high fidelity manikin for simulation. This manikin can have intravenous drips inserted. Its pupils constrict when light is shone in them. It can answer questions. It has pulses that can be felt. The team also use simulated physiological signs monitors that are tablet based. These can be remotely adjusted by the person running the simulation to show patient deterioration or an improvement in response to the treatment. For simulation training, they use the same medical equipment that they would use on real mountain rescue missions. All of this adds to the feeling of reality and credibility.

At the EMRS base in Glasgow, in order to train our teams to work in small, rural community hospitals we use a dedicated simulation room. This recreates the cramped environment we often have to work in during rural retrieval missions. There is limited space to lay out equipment, people get in each other's way and the temperature rises during the scenario. We also regularly train outdoors for pre-hospital care. This brings in a range of environmental challenges including low temperatures, traffic noise and kneeling on hard surfaces. Realistically, equipment becomes wet in the rain and blows away in the wind.

Some helicopter retrieval services, such as the one in New South Wales, have developed aircraft simulators where they can simulate in-flight clinical emergencies. This involves assessing and treating the patient in the cramped, noisy and moving environment of the helicopter cabin. These simulators can be made to vibrate and tilt. They can have video screens fitted as windows to recreate landing and take-off.

Rather than using dedicated simulation rooms, many hospital emergency departments, operating theatres and intensive care units now perform clinical simulation in real patient areas. This in-situ simulation adds greatly to the credibility and effectiveness of training as it occurs in the actual environment the learners will be required to perform in. Each member

of the team takes part in their own role. My emergency department runs in-situ simulations every Friday morning in our resuscitation room.

The Scottish Fire and Rescue Service have recently opened an extensive simulation training facility in Glasgow. On a single site they have a motorway, a train track running through a tunnel and a large number of mock-up commercial and residential buildings. This allows the service to simulate train crashes, multiple vehicle road traffic collisions, plane crashes, major fires and building collapses. The retrieval team members regularly take part in full-day multi-agency major incident simulation training at this facility. This joint training has proven to be invaluable for improving responses to real-life incidents.

During simulation we can bring in additional people to play roles in each scenario, making the situation more demanding and lifelike. These might include an overly helpful passing doctor, a disengaged paramedic or a distressed relative. Each of these adds to the pressure of the simulation, consuming time and the cognitive capacity of the team. Developing strategies to communicate with and manage these individuals is essential for effective pre-hospital care.

All of these components help create what is termed 'immersive' simulation, making the experience, environment, stimuli and decision-making as real as possible for the team. This improves the learning potential for the individual, allowing them to develop skills for operating in more challenging environments and spaces and in dealing with individuals who are not part of their core team. Skills of communication and human behaviour can be practised and improved in a safe environment.

Simulation scenarios are also effective learning tools for those who are facilitating the session rather than taking part. Even highly experienced simulation facilitators can learn by observing the way their colleagues behave under pressure, communicate and deal with the problems they are presented with.

Stress Exposure and Inoculation

Over consecutive simulation scenarios, environmental, team and clinical pressures can be increased. This places increasing cognitive and stress loads on the individual and the team. This can be used as part of a stress 'inoculation' process. US Airforce pararescue jumper (PJ) Michael Lauria describes the use of this technique in Special Forces training.[91]

Stress inoculation was originally developed as a cognitive behavioural therapy technique to treat patients suffering from stress. By placing

individuals under pressure, they can experience the physical and emotional effects of adrenaline and cortisol release.[91,92] They find out how these alter their perception of the situation, how they communicate and how they perform. Over time, they come to recognise when excessive pressure is developing. They discover their own personal warning signs and can implement coping mechanisms to reduce the negative effects on their performance. Coping strategies used in these simulations might include controlled breathing, taking a brief time out to allow cognitive reframing or making better use of the team to cognitively offload.

Stress inoculation is achieved in three stages. First, participants learn about pressure and its effects on how we think, feel and behave. Second, they then find out about and practice coping mechanisms to mitigate the effects of excessive pressure. Third, in simulation under pressure, they practise the techniques in a controlled environment. This is all done under the supervision of an experienced simulation coach. With repeated simulation scenarios, the pressure and cognitive load are gradually increased. Over time, learners come to recognise and react to the early stages of stress and cognitive overload in both themselves and their colleagues.

A meta-analysis of 37 studies, which examined the use of stress inoculation, concluded that, 'stress inoculation training was an effective means for reducing performance anxiety, reducing state anxiety and enhancing performance under stress'.[92]

Planning Simulation

In order to optimise the learning potential of a simulation session, careful planning is important. It is necessary to consider the existing skills and experience of those taking part and what they specifically need to learn and improve during the scenario. The standard of difficulty should be just above what the participant is currently capable of. Repeatedly pushing them to achieve these gradual increases in complexity will lead to improvement in performance. Ericsson's concept of deliberate, purposeful practice should be employed.[90]

If it is accepted that performance will inevitably deteriorate with excessive pressure, then it is logical to simulate with a level of expected performance that exceeds the normal level of an operational activity, i.e. 'train hard, fight easy'. As Michael Lauria describes, one of the principles of his Special Forces training as a PJ was to work at '130 per cent' during training. This allowed him to perform at 100 per cent during actual operations, when pressure and fatigue caused deterioration in ability.

However, although recognising the benefits of stress, when planning simulation we must also be wary of intimidating the learners and creating overly complex situations where poor performance is likely. How much information, complexity and time pressure to use must be carefully considered. Familiarity with the competencies and behavioural characteristics of the individuals involved is essential. Creating simulation scenarios that challenge and pressurise individuals is necessary in order to improve their performance. Pushing things too far, however, will damage their confidence, especially if this happens in front of their peers. Reluctance to become involved in future sessions can also result. Simulation needs to be seen as difficult, but achievable. It should be perceived as a positive experience. Our ability to lay down memories also deteriorates under excessive levels of pressure. If we make simulation too stressful, the educational benefits will be compromised.

One also needs to consider the status and seniority of those taking part in the simulation. It's important to calibrate the level of difficulty according to the level of competence of the learner. Failing to do so will lead to a lack of challenge and appropriate pressure and, hence, a wasted opportunity to improve performance. Setting the standard too high runs the risk of embarrassing senior members of the team in front of their peers and, potentially, the loss of credibility and respect.

When we are creating a simulation, we have to carefully consider what we are trying to improve in the person or team taking part. Being overly ambitious is likely to result in a confusing scenario and a debrief with poorly identifiable and memorable learning points. During simulation planning, it is usual to aim for a maximum of three specific learning points. The content and flow of the simulation should be designed to emphasise and develop these three points. The simulation shouldn't be too prolonged. Simulations that are too long are less likely to focus on and achieve the learning objectives. It is a normal practice not to reveal in advance what the learning points are, but to use the session and the debriefing process to allow the learners to identify the points themselves. In this way, they are more likely to remember the points and to improve the way they approach the same problems in the future.

Organisations that wish to benefit from their teams simulating should strive to make simulation easily achievable. The provision of training equipment, which is separate from operational equipment, is kept in a dedicated simulation area, which reduces the time in moving equipment and restocking after training. Establishing a permanent simulation area enhances the reality of the planned scenarios and eliminates the disincentive of prolonged setup times.

Many services have a bank of pre-planned and tested simulation scenarios. Again, this helps minimise any reticence to simulate as part of the daily or weekly routine. It also helps avoid those running the simulation from concentrating on their personal areas of interest.

Debriefing

How we debrief following simulation is critical to the learning and development of the participants. In advance, the simulation facilitator should identify a finite number of 'take home' learning points. A well-planned and well-executed simulation loses its educational value if the debrief is unstructured, poorly led or fails to focus on these learning points.

A number of structures can be used for reviewing performance during simulation and following real-life events. Many discuss elements of the simulation in a chronological order. Some will divide the event into categories of activity. For a retrieval mission, these might be clinical care, communication, equipment and transport. Others may start with positive things that have been done well, followed by a discussion on those areas that could be improved. What is vital is a positive end to the debrief. A summary of what the learning points are, which emphasises examples of good practice and clarity, is essential.

Similar to a coaching session, it is very tempting for the simulation facilitator to do the majority of the talking and tell the participants what went well, what didn't go well and what they should have done. This is straightforward for them as they knew what the scenario was in advance and how it was going to develop. The experience from the viewpoint of the participants will, however, be somewhat different. This approach is likely to result in a negative experience for the participants. Telling someone what they need to do is less effective than the person coming to that realisation themselves.

Syed discusses the value and necessity of feedback during practice, and when undertaking a skill for real.[31] Feedback and personal insight are essential for continual improvement and the development of expertise. An effective post-simulation debrief should aim to facilitate a situation where the participants describe what happened from their own perspective, and the reasons why they did what they did. This discussion should lead on to participants deciding for themselves what they should have done and then identifying their own learning points. Open and non-judgemental questions are most effective in achieving these aims.

Facilitators should beware of the risk of more confident members of the team dominating the debrief discussion. They should ensure that

everyone gets the opportunity to express their opinion. Dwelling for prolonged periods on single issues results in less emphasis and time for the remaining learning points.

Video recording of simulation can help the facilitator demonstrate areas for improvement. This tool is especially effective in highlighting examples of non-verbal communication and behaviour when working under pressure. Watching video recordings also helps eliminate the effects of recollection bias. Oakley used video recording to examine errors in paediatric resuscitation.[93] He found that only 20 per cent of the errors that had occurred were subsequently recorded in the patients' clinical records. Review of the recordings was highly effective in identifying errors that had happened, especially those that were subtle.

Emergency physicians in Edinburgh have been using video to record the resuscitation of patients in the emergency department and in pre-hospital settings.[51] The team found the technique valuable for reviewing both technical skills and team behaviour. Learning points from the videos were used to create and adapt guidelines and checklists to be used by the teams. It was also beneficial in identifying objectives for future training and simulation sessions.

For the past few years, the EMRS team have used video filming during simulation scenarios and on real retrieval missions when we perform emergency anaesthesia. As well as learning for the team involved, key learning points are recorded and collated. These are shared with the full team and any necessary changes to practice implemented.

Simulation for Competency Assessment

As well as a being a vital tool for learning and skills development, simulation is an effective and realistic method of assessing competencies. Simulation can be used to assess an individual's operational capabilities and as part of formal examinations.

When preparing for performance under pressure, we need confidence that members of our teams have the requisite core practical skills. For those leading teams, delegation of decision-making and practical procedures is essential for pressure regulation through cognitive offloading. Team leaders need to know that those being delegated these tasks have the competency to perform them independently, or with minimal supervision.

In many disciplines, particularly military and aviation, following initial training it is mandatory to have core knowledge, skills and competencies repeatedly assessed on a regular basis. Pilots refer to these regular competency assessments as line checks. At regular intervals, pilots

are placed in a flight simulator and a range of in-flight emergencies are practised. The pilot's actions in response to these scenarios are recorded, assessed and debriefed. Pilot line checks also include flying with a training pilot to assess how well they fly the aircraft, communicate and respond to a number of simulated scenarios.

Regular assessments, even for pilots with thousands of flying hours, maintain motivation to continually refresh their knowledge and skills. They also place them under a degree of pressure. Even experienced pilots can be removed from flying duties if they fail to make the grade during these assessments.

Historically, academic, oral and practical examinations were prone to bias. There was considerable potential for variation in marking between individual examiners. In medical school examinations for example, a patient used in the exam may describe different symptoms to different candidates, meaning that some individuals were disadvantaged. Nowadays, practical medical examinations have become significantly more objective and reproducible through the use of simulation. Objective structured practical examinations are routinely used by universities and medical Royal Colleges.

Simulation is the assessment tool we use when we run the diploma in retrieval medicine at the RCS in Edinburgh. Around 20 practical skills testing stations are set up for the exam. Each station has a single examiner and most have a professional actor. The actors can play the role of a patient or another retrieval team member. The candidates spend exactly seven minutes at each station before moving on to the next. Each simulation scenario has been meticulously planned and repeatedly rehearsed in advance. They are precisely timed and carefully scripted. Each candidate should have exactly the same experience in each station as every other person sitting the examination. The examiner also has a well-defined marking system which reduces the potential for subjectivity and marking bias. We are able to recreate a wide range of real-life situations during the exam, such as in-flight emergencies, giving advice to a rural doctor via telemedicine, breaking bad news to a patient and their family and debriefing a colleague after an adverse event has occurred.

Simulation is an invaluable tool for improving performance in teams who work under pressure. Detailed planning is needed if we are to use the technique to its full potential in developing knowledge, technical skills and non-technical behavioural skills. Effective and structured debriefing is key to ensuring that the participants leave the session with enhanced abilities. Simulation is also an objective method for assessing competency in team members.

Learning Points

The aims of simulation:

- Develop analytical processing ability.
- Practise and develop skills of innovative problem solving.
- Provide novel circumstances for decision-making.
- Improve communication skills – verbal and non-verbal.
- Improve leadership skills – delegation, coordination, situational.
- Test new equipment, procedures and guidelines.
- Provide competency assessment.
- Improve joint working between teams.

Realistic simulation aims to create immersive simulation scenarios:

- Environment and equipment realism are important.
- Should be real time.
- Role-playing needs to be credible.

When planning simulations one should consider the following:

- The level of difficulty – put under pressure, but not excessively.
- A maximum of three learning objectives.
- It should not be excessively prolonged.

Stress inoculation simulations should follow a standard pattern:

- Three stage process.
- Debrief to discuss how they felt and give strategies for pressure relief.
- Repeat simulations to practise use of techniques.

Simulation debriefing:

- Should promote reflective practice through open questioning rather than telling the learners what they need to improve on.
- Learners should identify the learning points themselves during the debrief.
- Structure: chronological or good points followed by points for improvement.
- A positive end to the debrief is essential.
- Video recordings can be very powerful in allowing learners to gain insight.

Chapter 14
Personal Preparation for High Performance

Each individual member of a high-pressure team has to take personal responsibility for their own performance. How each person gains the appropriate competencies, how they approach each working shift when there is a risk of high pressure and how they mentally prepare themselves before a high-intensity task are all essential for optimal performance. Setting oneself up for cognitively and physically demanding situations goes a long way to owning the pressure and reducing the risk of overload and frazzle. Personal preparation techniques include mental rehearsal, 'sterilising' the shift, memorising core information for use in emergencies, controlling the environment and maintaining physical fitness.

Mental Rehearsal

Sports psychologists and military personnel advocate mental rehearsal and task visualisation for pressured and cognitively demanding tasks. This involves mentally rehearsing the stages and motor actions of core, predictable tasks. The imagery should be of us performing the task with excellence and confidence, in a state of flow. The belief is that visualisation makes us more efficient in completing the task when it actually arises. Through repeated rehearsal, the task becomes increasingly automatic, requiring less cognitive processing. Users of the technique also report that mental rehearsal makes them experience pleasant and positive emotions when confronted with the task.

Sports professionals use visualisation to reduce performance anxiety. Being excessively stressed about competing leads to compromised ability. The time preceding competition can be an anxious period for athletes. Many experience thoughts of doubt, leading to reduced confidence. Mentally rehearsing the lead up to the event start time, as well as what is going to happen during the event, has been found to increase confidence and reduce anxiety.

This technique is also used by military personnel and tactical firearms police. Mental rehearsal is particularly useful for planned, predictable tasks that are demanding and carry risk. A good example of this is a planned forced entry into a building. Personnel visualise the period of donning personal protective equipment, preparing and checking weapons, approaching the building and the entry process. This builds confidence in the individual officer or soldier. Repeated mental rehearsal means that only minimal cognition is required for the task. This leaves adequate residual cognitive capacity to process and react to sudden and unpredicted events.

In medicine, visualisation can be used to improve the execution of complex, multi-stage tasks. Surgeons mentally rehearse the stages of operations. They can visualise adverse events such as inadvertently damaging a blood vessel leading to sudden bleeding, and how they will react to these events.

One study compared the teamwork performance of two groups of doctors during a simulated trauma resuscitation.[94] Prior to the assessment, one group had engaged in 20 minutes of mental rehearsal; the control group received 20 minutes of training in trauma resuscitation. Teamwork behaviour was found to be superior in the mental rehearsal group.

Individuals are encouraged to fully immerse themselves in the rehearsal. Closing your eyes and concentrating on what you anticipate seeing, hearing, touching and even smelling are all part of the process. Anticipating what others are likely to say and what you are going to verbalise are just as important as what you are going to do with your hands, feet and body. It's also effective to think about non-verbal communication during visualisation. How is my body language likely to come across to others who are present? Am I going to appear confident and in control or am I going to appear anxious and out of my depth? Rehearsing how we are going to interact with, and be perceived by, others is arguably as important as rehearsing our physical actions.

One visualisation technique is to imagine yourself in the air above the situation, essentially watching yourself and your team in action. This is termed dissociative visualisation. Dissociation is particularly helpful for us to gain insight into how we appear to others when performing a physical task or leading a team.

Another valuable use of visualisation is to help when reflecting on how we have performed under pressure. If we were happy with the performance, we can mentally recreate, in real time, what we remember happening, what we said, how we looked, how we felt, and what we did and why. This will help reinforce this behaviour and condition our brains to behave the same way in the future. Similarly, when our performance hasn't been as

good as we expected, it is beneficial to visualise how we reacted and try to identify the stimuli which made us feel that way. This can prepare us for similar situations in the future and help us avoid reacting in the same way.

Sterilise the Shift

As we already know, our cognitive capacity is limited. It stands to reason that avoiding unnecessary, additional information that requires analytical cognitive processing will reduce the risk of cognitive overload in high-intensity situations. Similarly, avoiding having to receive non-essential information that may lead to negative emotions will help maintain confidence and optimism.

In aviation, the periods around take-off and landing are the times with the greatest need for information processing and decision-making. These are the riskiest periods of the flight. Pilots create what they term 'a sterile cockpit'. They minimise unnecessary information input and processing demand by requesting that other members of the crew only speak when it's absolutely necessary to do so. All superfluous discussion stops. The only reason why someone might need to speak is because they have seen a hazard or detected something abnormal that the pilot urgently needs to know about. The same 'sterile cockpit' principles can be applied to periods when the risk of excessive pressure and cognitive overload is high. We can take measures to 'sterilise the shift'.

With modern technology, working patterns and lifestyles, it is routine for information to be continually pushed at us. Information from emails, texts, phone calls and social media arrive at us throughout our working day and evening. It's hard to resist frequently checking our phones and tablets for new messages and information. Some of us even have audible alarms to signal the arrival of a new email or tweet.

Each text, email or social media message contains information that needs to be processed. These often affect our emotional state. These messages add to our cognitive load. Many will require a decision and a response. Some carry information that causes negative emotions. These negative emotional responses are likely to be greater if the person is already under a degree of emotional or decision-making pressure.

Objectively, however, emails and social media information are rarely urgent. It's uncommon to need to know this type of information or to respond in an urgent time frame. Usually it's best to receive and respond to this type of information flow when no other demands are placed upon us and we're in an appropriate frame of mind.

Like many high-pressure roles, retrieval medicine puts us at risk of overload due to receiving and processing unnecessary information at inopportune times. Work comes in peaks and troughs, and at unplanned times. Effective time management means you want to make the best use of the 'downtime' between retrieval missions. This means we set devices to accept the information that is being pushed to us. We also make plans to complete administrative tasks and phone calls while we are on shift.

However, at a moment's notice, we can be tasked to attend a critically injured patient and put in a situation where we are leading a team trying to save the patient's life. Going into the retrieval with part of your brain still processing information which you received just before leaving the base, adds to your cognitive load before you've even started caring for the patient. This is especially the case if the information requires further consideration and a decision, or has caused negative emotions. In addition, it's not uncommon to see members of the team embarking on retrieval missions with a degree of resentment that they have not been able to complete the administrative tasks they had planned for that day. These plans were based on optimism biased thinking, i.e. the hope they would have a retrieval free day. Starting the mission with this resentment and negativity primes us for suboptimal performance.

In order to optimise our ability to deal with highly demanding, time-critical situations, it is possible to 'sterilise' our shifts. This can be achieved by stopping information being continually 'pushed' at us. Instead we can 'pull' information when the time is right, i.e. during periods when there is no risk of sudden increases in cognitive load occurring. Planning tasks, meetings and phone calls for times when we are on standby for emergencies should be avoided.

Control the Environment

Environment-specific preparation is also important. Anyone who has tried to undertake a complex task when cold or exposed to wind, rain or snow will know how motor skills and concentration are compromised. Verbal communication is also difficult in these conditions. Ensuring that we have clothing to keep us dry and warm in adverse weather is essential for our own safety and for the successful completion of the task. In mountain rescue, the ability to tie a series of knots to create a safe anchoring system is relatively straightforward on a warm July afternoon training session. Carrying out an identical task in January, in the dark, in a blizzard is a lot more complicated, prolonged and prone to error. Inadequate personal protective equipment to ensure comfort and safety would render the task impossible.

During air ambulance transfers it is common to encounter turbulence on both rotary and fixed-wing flights. Motion sickness is extremely debilitating. It's difficult to concentrate on anything other than nausea and the longing for the flight to end. From experience, it's very difficult to pay any attention to the patient or whatever else is happening around us. The ready availability of anti-emetics is important to maintain our ability to make decisions and receive information.

Anticipating and preparing for the pressures associated with challenging environmental conditions is an important component of owning the pressure and minimising the risk of avoidable frazzle.

Knowledge Acquisition for Emergencies

This book emphasises the value of referring to cognitive aids, guidelines and checklists in improving safety and performance when we are under pressure. The volume of information that is required for many professions is simply too vast to be retained by the human brain.

However, some decisions and tasks need to be completed immediately. Sometimes there is no time to refer to supporting documents. We can't rely on reference documents for immediate time-critical actions. For certain decisions and tasks, we need to commit information to memory. We need to memorise a degree of core knowledge for these actions.

In the EMRS, we have dozens of service-specific clinical, transport and equipment guidelines. Together these run to over 300 pages. It's impossible for us to be fully familiar with every piece of information contained in these guidelines. It is, however, essential for us to know certain core guidelines thoroughly.

An example of this is our surgical airway guideline. If a patient has an obstructed airway due to burns or trauma to their face, they will rapidly die due to lack of oxygen. If we have anaesthetised them and then are unable to insert a breathing tube into their airway via their mouth, the person's oxygen level will rapidly fall. In seconds to minutes this may lead to brain damage or cardiac arrest. In these time-critical circumstances, it is necessary to proceed to cutting open the front of their neck with a scalpel and inserting a breathing tube into their trachea through the opening.

It is thankfully very rare to have to do this. No emergency physicians or anaesthetists in our service have experience of routinely performing this procedure. Most of these doctors will go through their whole careers without having to perform a surgical airway. We must, however, be

mentally prepared and drilled to know immediately when and how to carry out the procedure to save the patient's life. There may be no time to refer to a written cognitive aid.

The decision to perform a surgical airway must be made in seconds, before the patient's oxygen level falls to a critically low level. Both members of the retrieval team need to know that a surgical airway is indicated, and jointly make the decision to proceed. Both require a full knowledge of the indications for the technique without having to look them up. The retrieval practitioner needs to assemble all of the necessary equipment in under 30 seconds. The doctor needs to complete the procedure in under a minute. Our team need to memorise each stage of the procedure in order that we react and respond correctly as a team within the necessary timeframe.

The clinical guideline needs to be memorised, the equipment needs to be well prepared in our packs and we need to drill and mentally rehearse the procedure. Emergency surgical airways require intuitive, automatic actions.

For immediately time-critical actions with the potential for a huge surge in pressure we need to personally prepare by memorising, mentally rehearsing and drilling.

Physical Fitness is Mental Fitness

Psychological preparation for the shift helps reduce the chances of excessive pressure and cognitive overload. It is also important to prepare ourselves physically for periods of high mental demand. Adequate sleep and hydration prior to the duty period carry obvious benefits, as does avoiding alcohol the night before the shift. Eating healthy food before and during the shift improves the overall sense of well-being and aids cognitive processing. Low blood sugar levels, especially during prolonged and physically demanding tasks, contributes to a reduced ability to process information during decision-making.

A research team studied a group of Norwegian police officers, looking at how their personal physical fitness affected their stress responses and ability to recover from a stressful situation.[95] The group took part in a simulated active shooter training exercise. Each participant also had their physical fitness measured by a VO^2 max test. Those who had higher levels of physical fitness demonstrated a better ability to 'recuperate and rest after a stressful incident'. Physical fitness helps us cope with high pressure situations.

Many tasks with high mental demands also involve physical activity. A lack of cardiovascular fitness predisposes you to poor task performance in these situations. For example, during a mountain rescue arriving at the casualty out of breath and with a high heart rate results in us starting the job from a different baseline. Our ability to communicate and take on board information is limited until the effects of the physical exertion have settled. Maintaining an appropriate level of fitness and strength is essential to help us perform to the best of our ability in time-critical, demanding situations.

Appearing exhausted and breathing rapidly does not inspire confidence in other members of the team. This can induce a sense of unnecessary urgency in the rest of the group. It also compromises leadership credibility. When working with the London Air Ambulance service we would be transported to incidents by helicopter. In densely populated areas it was often difficult for the helicopter to land adjacent to where the accident has occurred. It was common for the helicopter to have to land up to 500 metres away from the incident.

The paramedic and I would have to run to the scene from the landing site, carrying two heavy rucksacks. When we arrived at the incident our first task would be to take over scene leadership and patient treatment. If we arrived breathless and sweating, we would have exacerbated an already stressful situation. We would also have been far from being able to function mentally and physically at an optimal level. We would, therefore, stop running at the last corner from the scene. Walking along the road to the incident allowed us to regain our composure and catch our breath. It also sent a message to those already with the patient that we were calm and in control of what was happening.

If we're not feeling fully able, due to illness or fatigue, or we're experiencing challenges in our personal life, it's important that the rest of the team are aware that we may require extra support when under pressure. Starting the day with a team briefing that includes specific questions relating to these issues is invaluable for allowing people to speak up, creating awareness in the full group.

Mindfulness

There is increasing recognition that the practice of mindfulness can have a positive effect on our ability to maintain performance under pressure and during high cognitive loads. In pressured environments, distractions can lead to incomplete and inaccurate decision-making and task execution. This is due to divided attention. Our minds can also start to deviate

towards negative emotions and the possible adverse consequences of the situation we are in. An inability to stay focused on the task in hand can lead to excessive pressure and suboptimal performance.

The practice of mindfulness improves our ability to stay focused on the situation and the tasks in hand. If our attention wanders, those skilled in mindfulness techniques have the ability to quickly recognise that this is happening and refocus. Mindfulness stops us dwelling on events leading up to the challenging situation and wasting precious cognitive resources thinking about potentially negative outcomes.

Emotional Response and Cognitive Appraisal

When describing the causes of frazzle, cognitive overload and stress, we previously discussed the concept of inaccurate cognitive appraisal due to our instinctive emotional responses. The emotional parts of our brain receive information from the world around us before it is passed to our rational brain. If our emotional brain perceives a potential threat it can instantly trigger a cascade of events leading to a physiological stress response that prepares us for a fight or flight response. Sometimes these responses are appropriate and essential for maintaining our well-being. Often, however, they are due to exaggerated misperceptions of the situation. This can lead to harmful changes in our ability to function physically and mentally, and to emotional distortions.

Professor Steve Peters refers to the emotional part of our brain as our 'chimp'.[17] We can't control how our chimp responds, but we can develop strategies for managing how we react to it. Chimp response management is an important aspect of owning the pressure and avoiding moving to the right side of the performance arc.

Peters describes exercises that allow us to examine our in-built beliefs and automatic responses to certain situations. With practice, we can alter some of these to reduce the effect of automatic negative emotions and responses.

Strategies for responding to high-pressure situations are described. Peters suggests attempting to consciously recognise the situation as pressured and to be actively aware of how our chimp is dealing with it. At the same time, we should try to be aware of how our rational mind is perceiving things. We should endeavour to patiently allow our chimp to react and then allow our rational mind to assess the situation. We can then consciously consider what the true, if any, threats are, and appraise the options for action.

We can also have an internal conversation between our rational mind and our chimp. The negative output from our chimp can be suppressed with facts, reason and logic. We should expect temporary outbursts of negative thoughts from our chimp and we should run with these until the outburst is finished. Peters says that, unfortunately, we can't stop our chimp from reacting, but we can stop the chimp from acting on its emotions.

Peters recommends trying to put stressful situations into perspective. He talks about hovering in a helicopter above yourself and the situation. How important is this situation really? What impact is this going to have on me? Will this affect me tomorrow, or in ten years' time?

Preparing ourselves for demanding situations takes more than training in the technical skills required. Ensuring that we are in good condition physically is important. Avoiding unnecessary emotional and cognitive burdens by controlling how we receive information and the effects of the environment is vital. An understanding of our emotional response to situations and how to maintain focus and concentration under stress helps keep us in a state of flow. Techniques such as mental rehearsal and mindfulness can also aid performance. Cognitive distortion can lead to falsely negative perceptions of the situation. Having the skills to manage our chimp helps control the pressure.

Learning Points

Mental rehearsal and task visualisation can be used when taking on challenging tasks. This can improve confidence and reduce performance anxiety. It can also improve the automaticity of cognition and execution.

Consider the following techniques:

- Mentally rehearse stages of core, predictable tasks and situations.
- Imagine execution with confidence and excellence.
- Imagine what you will see, hear, touch and smell.
- Imagine what emotions you will experience.
- What will you say and what will others say to you?
- What will my hands be doing?
- What will my body language be communicating?

- Use dissociative visualisation – from above the scene.
- Also use mental rehearsal for reflection following a high-pressure event.

Sterilise the shift and try to minimise unnecessary information

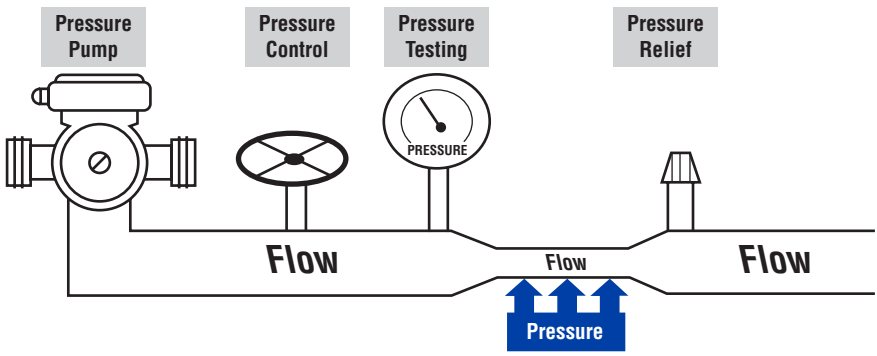
- Preserve your cognitive capacity.
- Avoid unnecessary emotional pressures.
- Prevent information being 'pushed' at you.
- 'Pull' information when it's convenient to do so.

Emotional response and cognitive appraisal

- An instinctive, emotional response occurs before the rational, analytical judgement of situation.
- An emotional response can wrongly judge the situation to be a threat rather than a challenge.
- We can't stop the emotional response, but we can try to suppress our reaction to it, i.e. prevent ourselves experiencing a stress response.

Control the environment, ensure you have the correct equipment and wear optimal clothing.
Core knowledge: some situations will deteriorate without warning and with no time to consult cognitive aids. For these situations, a knowledge of what immediate actions to take is essential.
Physical fitness reduces fatigue and pressure.
Mindfulness improves our ability to focus attention on the task in hand and reduces the negative effect of distractions.

Section 5
Pressure Relief Valves



If we do find ourselves in a state of over pressurised frazzle we need to have tools at our disposal to regain personal composure and situational control. In this section we will discuss some depressurising techniques we can employ to regain a state of high performance.

Chapter 15
Reducing the Pressure from Frazzle to Flow

We've discussed a number of strategies and techniques for controlling pressure to keep us in the zone of high-performance flow. But what if these strategies fail? How can we regain control if we find ourselves on the right side of the performance arc, in a state of frazzle?

There are two stages to regaining flow and ownership of the pressure: regaining self-composure and regaining control of the situation.

Regaining Self-Composure

We can employ a range of different tools to pull ourselves back from a state of stress and negative emotional responses. We can start by slowing our breathing to reduce the effects of the stress response we are experiencing. It is also important to make sure that our perception of the situation is accurate and objective. This is done through cognitive reframing and verifying our personal mental model. Confidence can be increased by having an inner dialogue with ourselves and with the use of visualisation techniques.

Controlled breathing

Cognitive overload and the development of a stress response aren't simply psychological phenomena. They lead to a physical state of being. Our brain and our sympathetic nervous system respond as if we are at physical risk, that we are experiencing a threat to our personal well-being, and they react. This evolved fight or flight response can be lifesaving when we are truly under physical threat and the only solution is to fight back or run away. However, it is not so desirable when we're in a situation where it is essential to maintain control, think analytically and perform tasks requiring dexterity.

Our brains process risk assessments very rapidly. Physiological changes can be triggered before we are consciously aware of the potential danger.

This means we are often too late to prevent a response to an unnecessary and exaggerated perception of risk. Upon sensing danger, a part of the brain called the amygdala passes a message to the main hormone producing centre of the brain, the pituitary gland, telling it to react by releasing a hormone called ACTH (adrenocorticotrophic hormone). This sudden increase in ACTH in the bloodstream triggers the release of a number of different hormones from the adrenal glands adjacent to our kidneys. These include adrenaline and cortisol. This process takes a fraction of a second to occur.

The physical consequences of this hormone release serve to prepare the body for intense muscular action, in order to fight or to run. The changes include increased heart rate, increased breathing rate, increased blood glucose levels, inhibition of hearing, tunnel vision and increased muscle tension.

The release of adrenaline and cortisol also have emotional effects. These include anxiety and aggression. Cognitive distortion occurs. There is a tendency to think pessimistically, create negative mental models and recall similar situations that had poor outcomes. Subjects who are experiencing a stress reaction are more likely to use negative and hostile words. They can perceive that they have lost control of the situation. In some instances, this results in an acceptance of failure and a belief that attempts to rectify what's happening are futile.

Most of these responses compromise our ability to receive information, process it analytically, communicate, lead the team with confidence and carry out intricate physical tasks. When these hormones are released in response to a stressful situation it is imperative that we rapidly take steps to mitigate their physiological and psychological effects.

An effective method of counteracting this stress reaction is controlled breathing.[96] Slowing your breathing rate acts to counteract some of the effects of the fight or flight response. Controlled breathing is widely used as a relaxation technique in yoga and as a treatment for panic attacks. It is also used by Special Forces soldiers and snipers prior to engaging the enemy.

The aim is to reduce your breathing rate to about eight breaths a minute, i.e. eight seconds per breath. Breathing can be divided into four stages: inhalation, breath holding, exhalation and holding the breath out. If we consciously control our breathing, i.e. inhaling for two seconds, holding it in for two seconds, exhaling for two and holding the breath out for two we can feel our heart rate and anxiety levels falling.

One advantage of controlled breathing to reduce pressure is that it can be done without the rest of the team knowing. This is useful when a

period of transient stress is occurring and you wish to maintain an air of calmness and control.

Verify your mental model

Sometimes our perception of the situation facing us is worse than it truly is. It is useful to regularly seek the views of the team to ensure that we are interpreting the challenges as accurately as possible. We need to repeatedly recalibrate and verify our own perception of what is happening.

When a team is dealing with a complex and evolving situation, members of the team develop differing concepts of what is happening, what the problems are and what the priorities for action are. These differing mental models can be due to individuals being distracted at certain times and not receiving all of the relevant information. People with different levels of knowledge and experience will perceive situations differently. Individuals can also focus their attention on separate aspects of the problem.

These differences are especially likely if the quality of communication in the team has deteriorated due to cognitive overload or task fixation. If we were able to press a pause button during a high-pressure situation and interview each person individually we would likely receive very different descriptions of what was happening. A useful analogy of this is the police taking statements from multiple witnesses who have observed the same crime being committed. The account of the events and the descriptions of the perpetrators can vary considerably.

In challenging situations it's important to make sure that your perception of what is happening is the same as the other members of the team. When you're becoming overloaded it's key to make sure that you have the correct mental model of the situation and that your colleagues share that model. This should be done during regular rally points, i.e. when there is an opportune moment, pausing activity and discussing the situation with the rest of the team.

One would instinctively think that the best way for the team leader to verify the accuracy of their mental model and bring the team together would be for them to start describing what they think is happening and asking the team what tasks need to be completed. This can be effective. However, it runs the risk of less experienced members of the team, who may be overloaded themselves, assuming that the team leader's account is correct. If they have a different take on things they might disregard their own mental model and go along with the person in charge, even though they themselves are, in fact, correct. It can be the case that a number of individuals in the team have a different opinion on what is happening

compared to the leader but none of them speak up. This is an example of groupthink. People might not agree with the leader's perception of what is happening and what needs to be done, but don't speak up due to a wish to preserve team harmony and cohesiveness.

Arguably, a more effective way for the team leader to gain an objective assessment of the situation is for them to ask another team member, 'What is your take on what's happening here?' This empowers each member of the team to express their personal opinion and their own mental model. The leader and the rest of the team are more likely to gain useful information in this way. Accurate parts of the leader's mental model will be confirmed by their peers. Aspects of the situation that the leader has misinterpreted or misjudged can then be corrected.

This is an example of creating a flat hierarchy. A flat hierarchy exists when, although there is a clear leader, everyone feels empowered to speak up and contribute to decision-making. Experienced leaders manage to create the correct atmosphere for a flat hierarchy. It is, however, difficult when teams are under pressure or when a team hasn't worked together before. Using people's first names, gaining eye contact and actively listening to them when they speak make people feel that their opinions are valued. They are, therefore, more likely to express them. Checklists and briefings should include stages where opinions from the team are actively sought. However, in high-pressure situations rally points with flat hierarchies need to be carefully managed to prevent excessive and unnecessary discussion.

Ensuring a shared mental model exists should be a dynamic, continuous process. When the tempo of the situation allows, the team should regroup and ensure that each person's perception of what's happening and what needs to happen remains the same.

The opposite of a flat hierarchy is a command gradient. This occurs when the team leader is in a more senior position than the rest of the team and carries ultimate responsibility for the team's decisions and actions. This can make people disinclined to speak up. Reasons for this include fear of saying the wrong thing, or more junior people believing the leader is fully aware of everything that is going on. It is more likely to occur if some of the people present are not members of your core team. In my experience, this sometimes happens at car accident scenes, with paramedics who rarely work alongside the EMRS team. Even though they might have spotted something important that the doctor leading the team has missed, they discount it because they think the doctor must have seen it too.

At the end of a rally point, once team members have voiced their opinions, the team leader should summarise what's been said and confirm that the

team have arrived at a shared and accurate mental model. This process of information and opinion gathering acts to improve the accuracy of the situational perception of each member of the team. Often, they will discover that the situation facing them is not as much of a threat as they thought. This greatly helps reduce pressure.

Reframing

In some cases, handing over control of the situation to a teammate and physically removing yourself from the area, even for a brief period, is beneficial. This removes us from the multiple high-pressure stimuli we are experiencing in the midst of the situation. It also helps put the situation into perspective, stops fixation on less important issues and allows you to identify priorities for action. Having a timeout period to allow cognitive reframing also helps us regain control over the sympathetic nervous system responses we may be experiencing. The time can be used for a period of controlled breathing and for positive self-talk to help us tackle the next stage of the challenge.

One of the most demanding of tasks carried out by pre-hospital critical care teams is a thoracotomy. If someone has been stabbed in the chest, the knife can penetrate the wall of the heart. Blood escapes, under pressure from the chambers of the heart. As well as leading to a major reduction in circulating blood volume, the blood may start to accumulate within the sac that surrounds the heart. This thin sac is called the pericardium. The blood leaking from the heart starts to build up inside the pericardium. It also clots. As the trapped blood increases in volume it starts to fill the limited space inside the pericardium and then compresses the heart from the outside. The compressed heart isn't able to fill or to pump properly. This is called cardiac tamponade. The patient's blood pressure falls, and they lose consciousness. Shortly after this, they are likely to suffer a cardiac arrest. Once cardiac arrest has occurred there is a brief window of around ten minutes to remove the clot of blood and restart the heart. Attempting resuscitation after that ten-minute window is usually futile.

Some patients are fortunate enough to make it to a trauma centre before their heart stops. If the condition is recognised in the emergency department and a surgeon is available, they can have an urgent operation in a controlled operating theatre environment. Unfortunately, however, many patients suffer their cardiac arrest before they get to hospital and don't survive. All emergency physicians and pre-hospital medical teams need to be able to perform a thoracotomy at the time it's needed, wherever that happens to be. Even though they are not

surgical specialists and they are not in an operating theatre, opening the patient's chest and removing the clot is the only intervention that gives these patients a chance of survival.

The procedure involves using a scalpel and scissors to cut open the front of the patient's chest from one side to the other. The front of the rib cage is lifted up revealing the heart and the lungs. The pericardium is then opened, and the blood clot removed with the doctor's hands. The doctor then tries to restart the heart with internal cardiac massage – literally putting their hands around the patient's heart and gently squeezing. The remaining members of the team must insert a tube into the patient's airway and start breathing for them. They also have to place lines into the patient's veins and start a blood transfusion.

Performing this procedure at the roadside or in someone's living room is potentially overwhelming for the team. I've personally had to carry out the procedure four times – twice in the street in London and twice in the emergency department. Each time I found it to be technically difficult and emotionally demanding.

It's hard to believe that this procedure is possible outside a hospital. The operation was pioneered by London's Air Ambulance service. Over the past 25 years they have carried out hundreds of these procedures. Dozens of people who would otherwise have died have survived. The reason this service can carry out the procedure so successfully is because of excellent supporting systems and effective teamwork. The procedure is described in a step-by-step clinical guideline. The indications when to perform the operation are clear and evidence based. All of the instruments required to carry out the task are carried by the team. The procedure is drilled on specially built simulation manikins. Everyone working for the service knows they will have to carry out the procedure at some point. They have the same mental model, they know their role and they know how to do it, step-by-step. Communication among the team is almost unnecessary once the procedure starts.

I recall a consultant colleague, Dr John Ferris, talking about his experience of pre-hospital thoracotomy. Prior to starting the procedure and despite the time pressure, John recommended briefly handing over control to a colleague and walking away for 30 seconds. He described doing this on the pretence that he needed to make a phone call or speak to a police officer.[97]

What he was really doing was initiating a process of cognitive reframing. By extricating himself he was able to temporarily stop the visual and auditory stimuli he was receiving and reset his perspective of the situation. This

allowed him to move on to the next stage of the patient's care, i.e. carrying out the operation. During the 30-second reframing period he controlled his breathing and mentally rehearsed the steps of the procedure he was about to undertake.

By taking a brief 'time out' John gained a more objective perception of the situation; he confirmed with himself that he was taking the correct course of action, he calmed himself down and he mentally prepared himself for the task in hand. His cognitive appraisal changed from one of threat to one of high-performance challenge.

Visualisation and mental rehearsal

Visualisation techniques can be used in two ways during high-pressure situations. One method is to take a 'helicopter view' of the situation to gain a more tactical perspective. The other is to mentally rehearse the next stage in dealing with the challenge.

When we're standing among a team of people dealing with a pressured and high-stakes problem we tend to have a narrow, limited view of what is happening, what people are doing and what still needs to be done. This limited view can create the impression that progress is slow and that the current challenges facing the team are insurmountable. Trying to mentally step back from the situation to gain an overall view of what is happening can be extremely helpful in assessing what is actually occurring. It is helpful in reassuring oneself that progress is being made and what the priorities are. In particular, leaders need to have a wide situational awareness of what is going on.

A useful technique for this is to gain a 'helicopter view'. This involves trying to picture the situation from above, from the sky above an outdoor situation or from the ceiling of the room. What would someone looking down from a helicopter see? What would their view of the problems be? What would they see each person doing?

Another extremely useful visualisation technique in stressful situations is mental rehearsal. This can be done in advance of a situation occurring, immediately prior to a practical procedure, or as a depressurising technique to build confidence during a challenging set of circumstances.

Thinking about what we are going to see, hear and feel when we are carrying out a task or when faced with a stressful problem helps us cope with it. The element of surprise is minimised and the release of stress hormones is reduced. If we have thought through the stages of a procedure in advance, when we are going to do it, what we are going

to say and what our hands will have to do, this builds confidence and increases the chance of successful completion.

In the midst of a high-pressure situation that we have prepared for in advance, recalling how we previously visualised the situation, how we would feel and what we would do is effective in reassuring us that we have the skills and experience to deal with it: 'I knew this situation would happen. I've prepared for this eventuality and I've thought through how I will react'. Visualising a successful outcome helps maintain optimism and determination.

Inner monologue

The development of negative emotions and nihilistic thinking is common when we are excessively pressured. It is essential to deal with these emotions as early as possible. Allowing these emotions to lead to negative actions will result in a degradation of performance and a loss of confidence within the rest of the team. When negative feelings are developing in the midst of a stressful situation, we can use 'self-talk' techniques to help manage these emotions.[96] Psychologists refer to self-talk and inner monologue techniques as being key to controlling our emotions.

I routinely use motivational self-talk during high-pressure situations. I tell myself, 'I can do this … I've got this … I've handled worse situations before'. Inner monologue can be used to assert to yourself that you're capable of dealing with the situation: 'I've trained for ten years for this situation. I can do this as well as anyone else'.

Another use of inner monologue is to recite key pieces of information about the task in hand. An athlete undertaking intensive interval training might say, 'Just hold for 30 seconds and this will be over'.

Many people also have a 'cue word' they can use when situations are becoming overwhelming. This can be used to focus their attention on the task in hand. These are particularly useful to maintain attention for brief periods when fatigued. A simple example might be intermittently telling yourself to 'switch on' to improve attentional focus when tired and having to complete a complex task.

Nutrition and hydration

Maintaining the tempo of decision-making and task completion for prolonged periods is difficult. This is even more challenging when we are tired, hungry or dehydrated. Ensuring we have adequate carbohydrates, protein and fluids on board is necessary for prolonged periods of intensive activity. Judicious use of caffeine for stimulation can also be helpful.

Once we have managed to regain our personal composure through reframing, mental model verification, controlled breathing, visualisation and self-talk we can move on to regaining control of the situation.

Regaining Situational Control

Getting an intense, complex situation that has lost direction and coordination back on track is challenging. Letting the team know that you are becoming overloaded can be beneficial, if done in a measured manner. Identifying and listing problems makes the situation more manageable. Prioritising actions gives direction to the team and helps ensure that time-critical decisions and interventions are carried out first. Delegating actions and decisions offloads the leader and helps ensure efficient team working. In some situations, outsourcing tasks to someone remote from the situation can also be beneficial.

Rally points

The initial step in managing a team that has become excessively pressured in a challenging situation is to pause for a team discussion. As described earlier in this chapter, comparing your own mental model to that of other members of the team ensures that all of those involved have a full and accurate understanding of the task in hand. Rally points can also be used to create prioritised task lists.

Articulate how you feel

As with many problems, early recognition and early intervention are key to maintaining safety, rectifying the situation and preventing further compromise in our abilities. If you recognise overload in yourself, this needs to be shared with the rest of the team. The team should have a key phrase that is easily recognised, and its implications understood. Clearly, the simplest thing to say is, 'I'm overloaded at the moment'. However, if individuals involved with the task are not core members of the team, this carries a risk of misunderstanding. In these circumstances, being clearer in your communication is necessary, e.g. 'This situation is becoming more complicated. I could do with help in managing things'.

Once the overload is appreciated by each member of the team, other individuals should be expected to increase vigilance, take stock of the situation and offer assistance. In experienced teams, colleagues may be able to take on some of your decision-making or physical tasks. They may

also suggest that they take charge for a period to allow you to take time out to reframe and regain composure.

List the problems and prioritise actions

Clarifying and quantifying the extent of the problem and the tasks required to deal with it are essential to relieve pressure and cognitive overload. Defining the problems helps immensely in making the challenge seem manageable. It reduces the perception of loss of control and negativity. It also focusses the actions of the team.

In my experience, treating a patient with multiple medical issues (heart, lungs, brain and metabolic problems) can be more complicated than dealing with a major trauma situation. Evolving, acute disease processes may affect the function of a number of organs and other pre-existing conditions can complicate the ease of diagnosis and treatment. Multiple drug treatments that are required may cause problems themselves through side effects and interactions. Trying to rationalise what's going wrong, why and how to fix it, can be complex.

When treating critically ill patients with co-morbidities, it can help to pause and make lists. I usually list how the problems are manifesting themselves, e.g. respiratory failure or low blood pressure. Then I list what existing long-term diseases we know are playing a part and which new illnesses have occurred acutely. Next, I identify what investigations are required to confirm or refute the diagnoses. Finally, I list what treatments are needed, and in what order, to treat the patient in the next few hours.

Making a list often acts to calm people down in situations of pressure. It stops the brain ineffectively jumping from problem to problem without actually resolving anything. A written list also helps communicate problems to those who are assisting, especially those who join the situation after it has started. A prioritised list of actions facilitates delegation and helps ensure that individual tasks are completed without distraction from other issues. Being able to make a list gives followers the perception that the leader is competent, confident and in control. Completion of each stage also gives the team a sense of momentum and progress.

Mantras

When situations are extremely overwhelming, it's useful to fall back on engrained mnemonics or 'mantras' focusing on the top priorities. In medicine this is ABC: airway, breathing and circulation. In the short term,

if we focus on these we'll keep the patient alive. Similarly, aviators use ANC: aviate, navigate, communicate.

Delegation

It's obvious that an effective method of reducing the cognitive burden and pressure on yourself is to offload as much of that burden as is possible on to others. It's possible to allocate practical tasks to others around you. It's also possible to delegate problem solving to appropriately experienced colleagues.

When delegating, leaders need to give well-defined instructions about what is required. They need to make sure that it is clear which individual has been given each responsibility and that the person has the time and competence to complete the task. Asking someone to read back to you what you have asked them to do and asking them whether they are happy to do it may appear time consuming, but it saves time in the long run. Asking the person to let you know when they have finished the task helps ensure effective coordination of the overall situation.

In the emergency department resuscitation room, there are frequently episodes when the team leader identifies a task to be carried out and verbalises it to no one in particular. In their head, the job has been delegated. Each member of the team assumes that the leader was speaking to someone else. The result is that it doesn't get done. Putting your hand on someone's shoulder, using their first name and gaining eye contact are useful in establishing and passing on responsibility.

Leaders need to be conscious of the possibility of overloading other members of the team. These individuals may also have a series of tasks they need to complete that the leader isn't conscious of. When asked to undertake another job, the person may agree to it with the best of intentions. They may, however, be unable to prioritise that task among the other things they are doing. This means that it doesn't get done or is done at the wrong time. Usually the best thing to do is to politely refuse to take on the role. It's rare, however, even for people who are overloaded, to refuse an additional task because they want to help or don't wish to appear incompetent.

With an effective team of experienced colleagues who are known to you, delegation is an effective strategy. It is less effective when working with people who are less skilled or aren't previously known to you. In pressured situations, these individuals may often experience emotional stress. They may be eager to please the team leader and to help with the situation.

This often leads to them agreeing to undertake tasks they don't actually have the skills for. This can result in them being done poorly or not at all. Team leaders need to have confidence that those being delegated tasks have the competence to complete them.

Keeping track of what tasks have been delegated and what stage they are at can be challenging. When I'm leading a team during a complex incident, once I've delegated a task I mentally score it out from the list in my head and move on. Finding out ten minutes later that the task has been misunderstood, inadequately completed or not even started causes angst. It may even compromise ongoing clinical care or safety.

In some cases, the team leader must temporarily delegate overall leadership to another member of the team. This should happen when the team leader is the only person skilled enough to undertake a practical procedure, which will take all of their concentration. In doing so they need to go 'heads in' and will lose overall situational awareness.

Outsourcing

Making use of a colleague who is remote from the situation can often be beneficial. They are less emotionally involved in the situation, have no situational stimuli affecting them and may be able to view things less subjectively. They may have specialist knowledge of a particular problem that no one else in the team has. They may also have access to reference material. Remote support can be useful for cross-checking of decision-making or coordinating the next stages of the task.

Cognitive aids

Most pressured, complex situations have predictable components in terms of practical tasks and decision-making. Well-organised teams will have developed guidelines, checklists and action cards to direct the actions of the team in these situations. Use of these cognitive aids is invaluable for reducing pressure.

When the pressure becomes excessive and we move into states of frazzle, there are many strategies open to us to regain our personal composure and to retake control of the situation. Using the skills of the whole team and referring to cognitive aids is essential. Having an awareness of the various depressurising techniques described earlier in this chapter is invaluable.

Learning Points

- **Controlled breathing** can help counteract the effects of our sympathetic nervous system during a stress response. Aim for eight breaths per minute.
- **Consider rally points** to verify your mental model.
- **Cognitive reframing:** remove yourself from the situation and the stimuli associated with it. Recalibrate your appraisal of the situation. This puts things into a more accurate perspective.
- **Mental rehearsal and visualisation:** use a 'helicopter view' to gain a more tactical perspective. Visualise the next stage of the challenge and how you are going to handle it.
- **Positive self-talk with an inner monologue:** boost your confidence by telling yourself that you have the knowledge and skills to overcome the challenge facing you. Include your own 'cue words'.
- Maintain adequate nutrition and hydration.
- **Delegate** responsibilities and tasks and outsource decision-making if possible.
- **Articulate** to the team how you are feeling.
- Make use of cognitive aids.

Section 6

Owning the Pressure – the EMRS Experience

Chapter 16
Pressure Management Case Studies

Flying by the Seat of my Pants: An EMRS Case Study

Tuesday, 4 p.m., 1998, Glasgow. The consultant in charge of the emergency department approached me. A general practitioner working in a small island hospital on the west coast of Scotland had been on the phone. The rural doctor had a critically ill patient who he wished to transfer to the emergency department by helicopter.

The patient was a young man who had been started on antibiotics for pneumonia a few days earlier. Over the previous 24 hours he had deteriorated significantly. His lungs were no longer working properly and, despite receiving oxygen by facemask, his blood oxygen level was only 86 per cent. He was breathing at twice his normal rate to try to keep these levels up. The infection that was causing the pneumonia had begun to spread and his other organs were beginning to stop functioning. His blood pressure was low and his kidneys were starting to fail. The GP reported that he was no longer fully conscious and that his airway was compromised. The patient had multiple organ failure from severe sepsis.

The role of a GP in remote and rural parts of Scotland is very different to that of a GP working in an urban health centre. As well as providing a normal general practice service, they also run small, remote community hospitals. In metropolitan areas, seriously ill and injured patients are taken by ambulance from their homes or accident locations directly to large hospitals where they have access to specialist consultants and nurses, CT scanners, laboratories, operating theatres and intensive care units. In rural areas, especially on islands, travel times mean that taking patients directly to these large hospitals is simply impossible. They are taken to the GP's practice or to the small community hospitals. There is much that the rural GPs and nurses can do to improve the condition of

seriously ill and injured patients, but without onsite emergency physicians, intensive care doctors and surgeons it's not possible to provide the full range of treatments these patients require. These patients need to be safely transferred to hospitals capable of providing definitive care.

In many parts of the world these rural patients are transferred to urban hospitals by ambulance helicopter or plane. In Scotland in 1998, the air ambulances were crewed by paramedics and ambulance technicians. There was no system or funding for specialist aeromedical retrieval doctors to safely transfer critically ill patients. Without the skills and equipment to stabilise these patients before they were transferred, a significant number deteriorated during the flight. Unfortunately, many died before they reached a hospital with the facilities to provide lifesaving emergency and intensive care.

At the time of the initial phone call, the plan for the young man with multiple organ failure was for him to receive treatment by the GP and to be put on a helicopter, crewed by a paramedic and an ambulance technician. The aircraft would shortly depart from Glasgow to collect him. The emergency department consultant, however, had a different idea. From experience of receiving these patients by helicopter, he realised that the patient was too ill to be safely moved without having his airway, breathing and circulation stabilised in the rural hospital before he was transferred. Without this stabilisation prior to transfer there was a high chance he would die during the flight to Glasgow. The treatments he needed would involve administering an emergency general anaesthetic, placing a breathing tube into his airway and connecting him to a mechanical ventilator to take over his breathing. He would also need a line inserted into an artery in his wrist to measure his blood pressure and a tube inserted into one of the large veins in his neck running into his heart. Using this tube, an infusion of a drug called noradrenaline could be given to improve his blood pressure.

The patient required intensive care level treatment in the small rural hospital and the helicopter needed to be used as a mobile intensive care unit. The consultant wanted me to fly to the island to stabilise the patient. I was a junior doctor with only five years of post-graduate training. I'd recently finished a year of anaesthetics and intensive care medicine, but I'd never looked after a patient as ill as this by myself, and I'd certainly not transferred anyone in a helicopter. Naively, I said yes. The bottom line was that any care I could provide before transfer was better than nothing.

The consultant arranged for the ambulance helicopter to pick me up from the hospital on the way to the island. In those days, the helicopter carried no equipment or drugs to support a patient with intensive care needs. In

the emergency department, I was given a bag that was used to care for people at car accidents. I grabbed a monitor and a ventilator machine from the resuscitation room. One of the nurses filled an Asda supermarket bag with anaesthetic drugs, intravenous fluids and the various lines I would need to insert.

It was very haphazard as none of us had prepared equipment for this type of transfer before, and there was no written plan.

I recall standing at the edge of the hospital helipad with the plastic bag of drugs in my hand. The traffic on the main road in the hospital had been stopped by the police. The helicopter landed. It didn't shut down but kept its rotors running. A paramedic got off the helicopter and approached me. He was wearing a flame-retardant flight suit, a life jacket and a helmet. I was wearing theatre greens, a white coat and Adidas samba trainers.

He introduced himself and shook my hand. He asked me if I'd been on a helicopter before. I told him I'd been on a Royal Navy search and rescue helicopter a few times during mountain rescues. I had never been on this type of aircraft. Without any further briefing I followed him to the helicopter. When I sat in my seat he helped me put on the four-point seat belt. I was given a set of headphones with a microphone attached. Two minutes later we were airborne.

As I was very much at the level of 'unconscious incompetence' I didn't feel unsafe. I wasn't aware that there are lots of things you need to know before you fly on a helicopter. How to safely approach the aircraft with the rotors running, escape drills, how to open the doors, what to do if the helicopter has a forced landing on water, how to use a life jacket, when to speak and when not to speak.

We landed in a field on the island. The local coastguard had kindly secured the site before we landed on. Once the rotors had stopped turning and the pilot had shut the engines down I was told that it was safe to unbuckle and open the door. We exited the aircraft, taking the equipment I'd brought with me. We entered an ambulance, which was waiting to take us to the hospital.

I didn't think to talk to the helicopter paramedics about the patient we were going to look after and what needed to be done. I didn't take the opportunity to ask the island paramedic about what he knew of the patient.

We entered the hospital's resuscitation room. It was tiny compared to an urban emergency department resuscitation area. Carrying out multiple practical procedures was going to be difficult. I looked at the patient from

the door. He was clearly seriously unwell. The local doctor started to tell me what had happened and what treatment he had administered.

I didn't have the sense to ensure that the paramedics from the helicopter were receiving the same information as me and were developing the same mental model of what was wrong with the patient and what the next few hours held for us.

I was fixated by the patient and couldn't help myself from starting to examine him while the GP was still talking. As a result, I only took on board a fraction of what he was saying.

A brief assessment of the patient, a look at his vital signs on the monitor and his chest x-ray confirmed what the local doctor had told me, and that his diagnosis was correct. It was at this point I realised I had no paper form to document times, examination findings or interventions. I planned to try to remember events and write it all down when I got back to Glasgow.

The gentleman needed to be anaesthetised and a breathing tube inserted into his airway. This wasn't going to be easy for a number of reasons. He was overweight, which carried a risk of difficulty in being able to pass the breathing tube. His blood pressure was already dangerously low. With the drugs I had at the time, his blood pressure would fall further when I gave him the anaesthetic. There was a risk he would suffer a cardiac arrest on induction of anaesthesia. Before I put him off to sleep, I needed to be able to measure his blood pressure accurately by inserting a small catheter into an artery in his wrist. This would allow me to have real time, accurate blood pressures. The standard blood pressure cuff around his arm was inaccurate at low blood pressures and only gave me a snapshot every three minutes. Once I had his blood pressure continuously monitored, I could start to give him an infusion of noradrenaline to bring up his blood pressure. The local team had given him lots of intravenous fluids in an attempt to improve his blood pressure, but this hadn't worked. Once his blood pressure was more stable, the risk of anesthetising him would be much reduced.

In an urban hospital all of this would be a team effort. There would normally be consultants and trainee doctors from intensive care and emergency medicine with the patient. The patient would also be cared for by two emergency department nurses experienced in critical care. Decision-making would be discussed and shared. Practical procedures would be divided up and would happen simultaneously. One of the consultants could stand back, taking a hands-off strategic role, allowing him or her to observe, direct and plan ahead. The nurses would carry out practical

procedures such intravenous cannulation, preparing drugs, inserting urinary catheters and preparing all the kit needed for anaesthesia and line insertion. The sharing of the decisions and tasks by an experienced and skilled team in a large, well-equipped resus room would make caring for the patient demanding, but achievable and not stressful.

I let the rural team and the two helicopter paramedics know what needed to be done. They looked back at me. They had never been involved in the resuscitation of a patient as sick as this before in a hospital. The local doctor and nurses were happy to prepare the drugs and kit – if I could tell them exactly what was needed for each procedure and where it was kept in the bags. I had never used the bags before and they weren't labelled. I became task-fixated on finding the kit and sorting everything out. I lost track of what was happening with the patient. My situational awareness was lost. As I pulled the kit out, I realised that some of it was missing and some of it was out-of-date. I could feel my anxiety levels rising. There were no effective systems in place back in Glasgow to stock and recheck the medical equipment bags. It was inevitable that when they were needed they wouldn't be complete and up-to-date.

The paramedic and ambulance technician who were with me were keen to assist. I asked them to get out the patient monitor, ventilator and the syringe drivers. The syringe drivers allow syringes of drugs to give slow, constant infusions of drugs. I would need them for the noradrenaline and for the anaesthetic drugs to keep the man asleep once I'd put the breathing tube in place. In 1998, however, the helicopter crew had received no training in critical care. It was rare for them to work with a medical team. Their normal practice was to collect patients from an ambulance crew at the helicopter landing site. They didn't normally come into the rural hospital to stabilise patients before transfer. They had no experience of anaesthetising patients or inserting lines. They had never used any of the equipment this patient required.

In addition to assessing the patient, making decisions and carrying out all of the practical procedures, I needed to set up most of the equipment and drugs myself. Time was starting to pass very quickly. I could feel my heart racing and I was beginning to sweat. I could hear myself becoming short with people. I was starting to become stressed and cognitively overloaded.

The surrounding situation was adding to the pressure. I had seen the man's parents, sister and girlfriend in the relatives' room down the corridor when I came in. They were understandably worried and upset. The pilot came into the room to let us know that we'd been there for over an hour. In that period, we hadn't actually done anything to physically treat the patient. The weather was deteriorating. Flying later in the evening would

be impossible. He also mentioned something about rules for his flying hours. I hadn't heard anything about civil aviation pilot regulations before. These further pressures added to my anxiety.

Over the next 30 minutes we managed to get the arterial line into the radial artery in his wrist. This allowed us to measure his blood pressure accurately and in real time. Next, we needed to put the line into his neck. This would allow us to start giving him the noradrenaline infusion. We would normally lie someone flat on the couch and put them head down to insert the central line. Because this patient was so sick he couldn't tolerate this. The line would need to wait until he was anaesthetised. As an interim measure I started another drug, adrenaline, as an infusion through a drip in his arm. This was risky, but I had no alternative.

I then started to think about the process of putting him off to sleep. There was a risk his blood pressure could fall with the anaesthetic drugs. In order to put the tube in place and for the ventilator to take over his breathing I needed to give a drug to paralyse all of his muscles. This would stop him breathing. The patient was currently breathing oxygen at four times its normal concentration, at twice his normal respiration rate to maintain the oxygen levels in his blood. Even at that, his blood oxygen concentration was only 86 per cent. Within a minute of me stopping him breathing his oxygen saturation would plummet. In that space of time I needed to get the tube into his airway and start to take over his breathing for him. If I struggled to get the tube into place, especially due to his size, I would have made a bad situation much worse. There was a high chance that his heart would stop due to lack of oxygen.

In an operating theatre there are specialist anaesthetic nurses and staff called operating department practitioners who are fully trained to assist in anaesthetising patients. They have a thorough, professional knowledge of the appropriate equipment and drugs. They anticipate difficulties and have the skills to decide exactly what you need, even before you realise you need it. I looked around the room. No one else had ever helped with an anaesthetic before. I asked the GP to give the drugs. I tried to be clear about when and how much. I needed someone to press on the patient's neck, cricoid pressure, to try to reduce the risk of his stomach contents coming up his oesophagus and down into his lungs before I got the tube in. I tried to teach one of the nurses how to do this. With the paramedic, I talked through the intubation equipment that I'd put on top of a trolley near the patient's head, what bits of kit I needed to be handed to me and when.

I started to become fixated on what the consequences would be if I gave the wrong dose of anaesthetic or I couldn't pass the breathing tube quickly

enough. My confidence started to be tested. My stress levels increased and the rest of the room knew it. They could see that I was perspiring and that my communication was becoming increasingly terse. I was vocalising all of the things that could go wrong during the anaesthetic.

Normally we would discuss plans for a 'failed intubation'. What the priorities are, i.e. keeping the patient's oxygen level up, what different techniques could be tried and what rescue airway devices could be used. It's even normal to discuss performing a tracheostomy with a scalpel if it's impossible to maintain the patient's airway and breathing after the anaesthetic drugs have been given. Nowadays, this is supported by written and practised failed airway drills. In the rural hospital in 1998 I didn't have the capacity to discuss any of this and the people around me didn't have the skills to help me with a failed intubation anyway. I just hoped for the best.

Nowadays, at this stage the full team would focus on the job in hand using a pre-anaesthetic checklist. We would ensure that everyone had the full picture and knew their role if things went as planned or if an emergency was encountered. We would make sure that we had the necessary 20 pieces of kit to hand, the spare oxygen, the spare suction and the rescue airway devices. This brings an air of calm to the room before the anaesthetic is carried out. I wasn't even aware of the concept of checklists in 1998. We cracked on.

Once the patient was asleep and the breathing tube was in place we connected him to the ventilator. We started an infusion of a drug called propofol to keep him asleep and gave him more muscle relaxant drugs to keep him paralysed. I passed another tube from his mouth into his stomach to remove gas and fluid. The local doctor inserted a catheter into the patient's bladder to monitor how well his kidneys were producing urine. We then laid him back and inserted the central line into his neck. This went into his jugular vein and advanced it to just above his heart. This allowed us to start the noradrenaline. This drug constricted the patient's blood vessels, bringing his blood pressure back up to a normal level.

Three hours after arriving, we were ready to move. At this point I realised I had no idea how to package a patient to safely transfer them in a helicopter. The patient needed to be insulated from the weather and the various lines we had inserted were at risk of being pulled out – including the endotracheal tube – which could kill the patient if it happened during the transfer. Equipment needs to be securely stored and the whole package needs to be straightforward to lift. However, all of the monitoring lines and tubes ended up in a tangled mess.

I went to see the patient's family. I explained what was wrong with him, what we'd done and how I was going to transfer him to Glasgow by helicopter. I tried to appear confident. However, I painted a realistic prognosis.

We moved the patient from the hospital trolley to the ambulance trolley. We then all moved to the ambulance. Once the ambulance was at the aircraft we unloaded the patient and all of the equipment and slid it into the aircraft. It was only then I realised we had no way of securing the 5 kg monitor, the 3kg ventilator or the syringe drivers. In the event of bad turbulence or a forced landing they would become lethal projectiles in the cabin. The aircraft was not equipped with brackets to secure critical care equipment. I also became aware how cramped it was in the helicopter, how carrying out any procedures would be nigh on impossible. It also struck me that I had very little means of assessing the patient. Listening to his chest was impossible. Luckily it was a short flight.

We made it back to Glasgow. After handing over in the resuscitation room the intensive care consultant didn't look very pleased. She was keen to let me know that I had transferred the patient to a hospital with no intensive care beds available. He would now need a secondary transfer by road to another hospital. Through inexperience and the workload in the rural hospital I hadn't even thought to phone to check bed availability before we left the island.

The paramedics left me in the resuscitation room and returned to the helicopter. It didn't cross any of our minds to arrange a time to talk things over, to debrief. I never saw them again.

We managed to do the right thing for this patient, but the lack of a system made it extremely difficult. It wasn't a positive experience for me and it wasn't a positive experience for the helicopter paramedics or the rural hospital team. I found the episode exhausting and extremely stressful. I knew then that what had happened carried risks. Only now, however, with 20 years of aeromedical retrieval experience, can I appreciate how unsafe this was for the patient, and for me.

Reflecting on this event, I can understand how the pressures of the situation seriously compromised my ability to care for this patient. I had the technical skill to carry out the required procedures in a controlled and familiar hospital environment. I had the knowledge and experience to assess the patient, make the right diagnoses and decide upon the right treatment plan. However, I had only ever experienced this type of patient care carried out in a large, urban hospital with a skilled team around me.

Prior to this, I hadn't cared for a patient in a small rural hospital. I hadn't transported a critically ill patient in a helicopter. I had never looked after

as sick a patient with a team who were unfamiliar with what needed to happen. I was working in a challenging environment in the aircraft cabin. I had no training about how to conduct myself safely in the aircraft and had none of the necessary personal protective equipment. I wasn't briefed by the helicopter team before take-off. I wasn't conscious of the risks to my personal safety. When transferring the patient in the air, the noise and vibration made patient assessment almost impossible.

The restrictions on the pilot's hours meant that we had to have the patient assessed and stabilised within a limited time period. This, combined with the lack of skills in the team working with me, put immense strain on me to complete all of the practical interventions. None of the team members had worked with each other before. Their individual skills were unknown to me. Offloading through delegation was impossible.

The equipment I was working with was not fit for purpose and was unfamiliar to me. There were no spares if it failed. The equipment was poorly organised and hadn't been routinely checked. The cognitive load on me in terms of gathering all of the relevant information and recalling necessary information was overwhelming. I had no cognitive aids, guidelines, checklists or emergency action cards to help me cognitively offload.

During this retrieval I was also very much aware of the consequences if I failed to complete each of the treatment procedures required to get the patient back to Glasgow alive. My perception of the challenges of the situation was understandably very negative; this led to me developing an appraisal of threat rather than challenge, which further compromised my abilities.

So, despite having the necessary technical skill, knowledge and experience, the pressures of the situation seriously compromised my ability to perform at the level the patient required. During the episode, I had no insight into what the pressures specifically were and what effects they were having on my decision-making, leadership or practical procedure abilities. I had no tools to own the pressure.

Trauma Call: An EMRS Case Study

Tuesday, 4 p.m., 2017.* The tannoy at the EMRS base sounded: 'HEMS call, HEMS call, HEMS call'. We gathered around the emergency phone. The paramedic on the trauma tasking desk in Glasgow's ambulance control centre had identified a child who had sustained major trauma. Forty miles south of Glasgow, an eight-year-old boy had been struck by a car while

* This case study is not an account of an individual retrieval case but is a combination of information from a number of similar cases.

crossing the road on the way home from school. The paramedic had listened into a number of 999 calls from distressed bystanders. The child wasn't moving and had blood coming from his ear.

The paramedic at the trauma desk is based in ambulance control and monitors every emergency 999 call in Scotland to identify the handful of patients each day who have sustained major trauma. These patients require the skills and experience of a pre-hospital critical care team, in addition to a standard ambulance paramedic response. This provides a higher level of assessment of their injuries and lifesaving interventions to be carried out at the scene, at the earliest possible time. These procedures include blood transfusions, surgical procedures and emergency anaesthesia. The pre-hospital team can also bypass local hospitals and take patients directly by helicopter to the rooftop helipad of the regional major trauma centre. Pre-hospital critical care teams significantly reduce the number of preventable deaths from major trauma.

As we received information about the patient, Craig, the pilot, went outside with Julie, the paramedic, to prepare the helicopter. Once the pre-start checklist was complete, Craig started the engines. He radioed air traffic control (ATC) and, using the call sign 'helimed 5 alpha', requested clearance to lift and head on a bearing of 160 degrees towards Lanarkshire. Simply adding the keyword 'alpha' to the helicopter's standard call sign communicated to the ATC that our mission was a time-critical emergency and that our take-off should take priority over all of the scheduled aircraft that were requesting landing and take-off slots. When planes are on their approach to land on the runway, they can be instructed to abandon their approach and 'go around' in order to clear the airspace for an alpha category HEMS helicopter.

I was on duty with Stuart, an advanced retrieval practitioner. We went through our own medical pre-mission checklist and collected radios, badge cameras, a drug pack and 3 units of blood. The blood is stored in a cool box that was developed for military medics in Afghanistan. The rest of the equipment, which had been checked at the start of the shift, had already been placed on the helicopter. As well as our fire-retardant flight suits and jackets, we put on lifejackets with satellite emergency locator beacons and a small SCUBA cylinder. The latter was to increase our chances of escape if the helicopter ditched in the sea.

By the time we approached the helicopter, the rotors were already turning. We waited outside of the rotor disc area with our helmets on and visors down. Once we had the thumbs up sign from Craig we knew we were safe to walk under the rotors and enter the aircraft. Our first action on opening the door was to plug our headsets in to allow communication

with Julie and Craig. We secured the equipment and strapped ourselves into a four-point harness. The pilot lifted.

When we arrived overhead at the scene the pilot circled to allow us to survey the area. It's extremely valuable to get a bird's eye view of accidents from the air. One can often work out what direction vehicles have come from and how they've collided. Understanding the mechanism helps us identify specific injury patterns in patients. We can assess scene safety from the air – has the traffic stopped and, for railway incidents, have the trains been stopped. We can also find out what other emergency services are already on scene.

Craig and Julie ran through their pre-landing checks. Once Craig had confirmed that the police had stopped the traffic, we landed on a T-junction of a main road. The full team in the helicopter were 'eyes out' surveying the area all-round the helicopter during landing. It's not uncommon for people or animals to run towards the aircraft while its landing or for objects on the ground to be blown upwards by the downwash. If they ended up in the tail rotor it would be disastrous.

Once the rotors had shut down, we exited the aircraft taking our equipment with us. We had checked all of our equipment in the morning. We knew our electrical equipment – suction unit, ultrasound machine, vital signs monitor, defibrillator, CPR device and ventilator – were fully charged and working. Each pocket in our equipment rucksacks was sealed with a plastic cable tie and clearly labelled. This meant it had been checked by two of our team mates using a two-person check and response system. There was no doubt that we had everything we needed and that it was charged and functioning correctly.

At the scene, as is often the case early on, the situation was chaotic. An ambulance and one police vehicle had arrived shortly before us. There were dozens of children and adults gathered around the boy and the emergency vehicles. The boy's mum had also just arrived. Tensions in the crowd were high. There was clearly animosity developing towards the driver of the car. The paramedic and ambulance technician were being pressured to get the child into the ambulance to go to hospital.

Julie, Stuart and I approached the ambulance crew and received a brief handover from them. Stuart went to look at the damage to the vehicle and speak to a police officer to ascertain the mechanism of injury. He reported back that there was a dent in the front of the bonnet and a 'bullseye' break in the windscreen near the A-post at the side. This indicated that the boy's head had sustained a considerable impact force.

While Stuart was doing this, I introduced myself to the boy's mum and did my best to reassure her. It was, however, clear to everyone that he was in a bad way. The boy, Ben, was previously well, other than mild asthma, and had no drug allergies. At the same time, Julie had established a kit dump and was starting to prepare the equipment and drugs we would need to treat Ben.

Ben had sustained a head injury with considerable force. He wasn't moving or talking. There was blood coming from his ear. The standard trauma ABC (airway, breathing, circulation) mantra kept us focused on his most life-threatening treatment priorities. His airway was noisy and full of vomitus. His breathing rate was slow. A probe placed on his ear lobe showed a blood oxygen level of only 74 per cent. I could feel broken ribs on the right side of his chest. The scene was too noisy for me to listen to his lung sounds properly using my stethoscope, as I would normally be able to do inside a hospital. His low oxygen level and broken ribs suggested bruising to his lung, which had probably also collapsed. It was possible that there was also a build-up of pressure inside his chest – a tension pneumothorax. This is a rapidly life-threatening condition. There could also be bleeding into his chest cavity. His hands and feet were cold, showing poor circulation due to severe bleeding – hypovolaemic shock. Ben's abdomen felt soft but there were signs that he had broken his pelvis. That, and his chest injury, would explain his blood loss.

Ben had a number of life-threatening injuries and required multiple complex interventions to stabilise him before we moved him to hospital. Some more vocal members of the crowd were shouting at us to put him into the ambulance and take him to the local general hospital, which was about two miles away. This further added to the pressure on Julie, Stuart, the ambulance crew and me. Ben was unlikely to be able to survive the journey, and the nearest hospital was an adult-only hospital. This facility was unable to provide the specialist paediatric care he needed. He had to be taken directly to the children's hospital, which had all of the specialists on site who would be able to provide him with definitive emergency, surgical and intensive care. We needed to stabilise him for the journey first.

Julie, Stuart and I had worked together for many years. We each were familiar with our service's pre-planned guidelines for the situations we encountered, equipment and processes. There was, however, a lot to be done. We needed to get the ambulance crew, who we had not previously met and who were not familiar with our kit or critical care interventions, 'on side' and working with us as part of a single team. A second paramedic in a response unit had also arrived on scene. I briefed the two paramedics

and the ambulance technician. I explained that our priorities were to anaesthetise Ben to secure his airway and control his breathing, and then to cut a small hole in the side of his chest to treat his collapsed lung. We needed to apply a neck collar to protect his spine and put a splint around his pelvis to reduce further bleeding. Ben also needed a blood transfusion. I asked them to gather some equipment including suction units and oxygen cylinders from their ambulance, including spares as backup. I asked one of the paramedics to place intravenous cannulae into Ben's arms. Ben was so shocked that this wasn't possible so the paramedic, using an electric drill, placed two needles into the bones in Ben's shoulders. This would allow us to give drugs and blood straight into his bone marrow.

While I was doing this, Stuart had set up a blood transfusion. Blood for transfusion needs to be stored cold. However, giving cold blood to an injured patient worsens their blood's already compromised clotting ability. Blood, even when used pre-hospital, needs to be warmed before it goes into the patient. We carry a compact, battery-powered blood warmer for this purpose. Stuart had drilled our blood transfusion setup numerous times on base. He had prepared the full setup in record time. Once it was ready to go, we both ran through our blood transfusion checklist before giving Ben the blood.

I had taken over management of the child's airway shortly after we arrived. I removed the vomitus and blood using one of the electrical suction units. I inserted small plastic airway devices into his mouth and nose to help keep his airway open and replaced his oxygen mask. These interventions weren't good enough, however. I was unable to keep his airway fully open with these basic interventions. He was at risk of regurgitating his stomach contents, resulting in an obstructed airway followed by the inhalation of acidic fluid into his lungs. Also, his head injury meant that his breathing rate was slower than it needed to be. I needed to insert a breathing tube into his trachea. This would maintain his airway and protect Ben from aspirating stomach contents. It would also allow me to take control of the rate and depth of his breathing. This would hopefully bring up his blood oxygen level. I also wanted to control the level of carbon dioxide in Ben's blood. These measures would help reduce the risk of long-term brain damage and improve his chances of making a full recovery with normal brain function.

Everyone knows that receiving a general anaesthetic carries risk. Even well patients going in for planned surgery inside a hospital, who have been assessed in advance by the anaesthetist, and have an empty stomach from fasting overnight can experience problems. Giving an anaesthetic involves administering a drug to put the patient off to sleep and a second drug

to stop them moving and breathing. It's necessary to stop them moving in order to allow you to open their mouth and place the breathing tube into their airway. The muscle paralysing drug also allows us to take over their breathing for them, with fine control over the rate and volume of breaths. The drug to put them to sleep can cause a marked drop in blood pressure, in extreme cases to the point of cardiac arrest. This is much more likely in a patient with severe bleeding, like Ben.

Most of the time it's straightforward to look in the mouth with a device called a laryngoscope, identify the top of the trachea, and pass the tube into it. However, sometimes it's difficult. If you're unable to place the breathing tube correctly, the patient's oxygen level may fall dramatically. In trying to make things better for the patient you've taken them from a situation where they have been breathing for themselves to a point where they're now not, and you are unable to take over their breathing for them. The muscle relaxant drug used to stop them breathing takes half an hour to wear off; it is half an hour before the patient starts to breathe by themselves again. If you're unable to support their breathing effectively for that amount of time, the patient will die.

With emergency anaesthesia at the roadside for major trauma, the risks are much greater than with a pre-planned anaesthetic in hospital. We don't have the luxury of meeting the patient the day before, taking a history from them and planning our anaesthetic strategy. We don't know about pre-existing illnesses, drugs or allergies. We haven't been able to assess their airway to predict if we might have difficulty intubating them. Often, they may have injuries that have compromised their breathing and circulation before we start. Unlike in a hospital, skilled assistance is minimal and, if it goes wrong, no one is going to come and bail you out.

Before we started preparing for the anaesthetic procedure, Julie and Stuart turned on the badge cameras that were attached to their breast pockets. I did the same. During the procedure Stuart would be filming and recording me, and I him. This is vital for effective post-mission debriefing.

Craig helped us by bringing any additional equipment we needed from the helicopter. He also gave us ten-minute notifications. When the medical team becomes task fixated with a seriously injured patient, their situational awareness deteriorates. They lose track of time. The pilots' time checks reminded us of how long we had been on scene.

Julie opened our airway equipment bag. Following many years of experience, our emergency anaesthesia equipment bag had been designed bespoke to our service and our needs. Everything we needed to intubate

Ben was there, including equipment to rescue the situation if I was unable to pass the breathing tube into his airway. This included a scalpel and instruments for me to open the front of his neck and perform a surgical airway. Stuart opened our sealed anaesthetic drug bag. The drugs we needed were already drawn up into pre-filled syringes and were clearly labelled. These pre-prepared packs reduce time and cognitive load when we're on scene. They reduce the chance of errors. Stuart and Julie had drilled the setup procedures so often that they performed the role with only a minimal need to think about what they were doing. As a result of the repeated drilling of these skills during training, they were using automatic cognition. They could still talk to me and discuss the situation while their hands were sorting the kit.

We briefed the paramedics on what was about to happen and what role they would be playing to assist us. For the majority of paramedics and technicians, this would be the first pre-hospital anaesthetic they will have witnessed. We needed to ensure they clearly understood what was happening and what they had to do. This was especially the case if Ben's blood pressure deteriorated or he had an airway that proved difficult to manage.

Using the EMRS smartphone app, I identified what dose of drugs to give to Ben. I knew the adult doses in my head, but each needed to be tailored to a child's age and weight. In the cold light of day, Jon, an EMRS doctor who is a paediatric anaesthetic consultant, has developed a drug formulary with the doses of every drug we might want to give to any size of child. This reduces the chance of an error being made, and removes a lot of unnecessary thought and stress from me. I found the correct doses in the app in under five seconds.

The EMRS team have our own detailed anaesthetic clinical guideline. This is based on evidence, expert opinion and the team's experience. Julie, Stu and I knew how we were going to carry out the procedure and how we were going to handle any difficulties. At the medical briefing that morning we had discussed our approach to this type of situation. We were all sharing the same mental model.

Next, we went through our pre-anaesthetic checklist. We asked for quiet and, step-by-step, confirmed we had the right kit. We confirmed drug doses and allocated roles. We discussed our strategy for airway management difficulties. We ensured that the drugs and kit for emergencies were ready. This checklist also has other effects. I started to focus on the task ahead and became confident and committed to following the task through. Going through the checklist got me into the zone of flow. I also

visualised the stages of the procedure and what my actions would be if things went wrong.

For those working alongside us at accident scenes, the checklist also acts as a briefing. It makes it clear that what we are about to do carries risk and requires silence and support. They, too, needed to get their head in the game.

We asked for quiet during the procedure. Helicopter pilots request that no unnecessary talking occurs during take-off and landing, a sterile cockpit. Interruptions break trains of thought, vital steps are subconsciously omitted and accidents occur. We tried to create a sterile cockpit in this street in Lanarkshire.

After Stuart gave the anaesthetic drugs we waited for 30 seconds for them to work. Ben stopped moving. He stopped breathing. This was due to the muscle relaxant medication we had given him.

Julie started to pass me the equipment. I inserted the laryngoscope into Ben's mouth and slid it to the back of his throat. I needed to see the top of his trachea in order to insert the breathing tube. Julie and I used pre-prepared, concise and unambiguous phrases to communicate: 'I have a grade 1 view', 'bougie please', 'tube on' and 'I have the bougie'. During this process, Stuart also quietly reassured me that Ben was remaining stable, 'oxygen saturations are good, heart rate is normal'. By doing this he helped me remain in a state of calm and flow.

Once the breathing tube was in place we connected Ben to a ventilator breathing machine. We measured his blood oxygen level and the amount of carbon dioxide in his breath. We titrated the settings on the machine to achieve the numbers that would best protect Ben's brain from further damage. While I gave drugs to keep Ben asleep and to stop him from moving, Stuart prepared equipment to cut a fingertip-sized hole on the side of Ben's chest. After starting the incision with a scalpel, Stuart enlarged it with a pair of forceps. We heard a small rush of air. Ben's lung on that side had been punctured by his broken ribs, had collapsed and pressure had built up on that side of his chest. We treated his tension pneumothorax. Once his airway had been optimised, he was being ventilated and his chest injury treated, Ben's blood oxygen level normalised.

I inserted a tube through Ben's mouth into his stomach. Ben had swallowed large amounts of air. This built up in his stomach below his diaphragm and stopped his lungs from fully expanding. We started a second unit of blood and gave him a drug, tranexamic acid, to improve his blood's clotting ability. Using our packaging drill, we placed him, in one movement, onto a scoop stretcher with an insulating blanket to maintain his temperature, and into his pelvic splint. Avoiding hypothermia is essential to maintaining

his blood's ability to clot and minimise ongoing bleeding. The pelvic splint reduces movement and bleeding from fractured pelvis bones.

Using the location finder function on the app, we identified that the children's hospital was 40 miles and 45 minutes blue light driving time away. Rather than driving to the trauma centre in a road ambulance, we made the decision to fly. The emergency number I needed to pre-alert the hospital emergency department was in the app. With one button press I was speaking to the nurse in charge.

Before we moved Ben to the helicopter, we ran through our 'leaving scene checklist'. Had we completed all the tasks we needed to? Had we talked through how Ben might deteriorate en route to hospital and what each person's action would be? Did we have all of the emergency drugs and equipment to hand?

Ten minutes after taking off we landed on the roof of the Queen Elizabeth University Hospital in the centre of Glasgow, Scotland's largest trauma centre. We took Ben down in the lift directly to the emergency department. We were met by a ten-person trauma team of emergency physicians, nurses, surgeons and intensive care doctors.

In the resuscitation room at the hospital, we gave a 'hands off handover'. This means that we gave a verbal handover while Ben was still on our ambulance trolley. The receiving staff were asked not to touch the patient or equipment during the handover to ensure we had their full attention for the transfer of information. This ensures maximally effective communication, without distractions. Only once the handover is complete does the transfer of care take place. The team's handovers are structured and include time and mechanism of injury, pre-existing illnesses, injuries sustained, treatments administered and suggestions for immediate clinical priorities.

Once we were back at the retrieval base, we debriefed the job. We talked over how we performed as a team and how we performed as individuals. We connected our badge cameras to a dedicated computer terminal and viewed the footage we had recorded. We used this to assess how well we had performed and long each stage took. How well did we communicate with each other? Did we express ourselves clearly to the paramedics who were assisting? What could we have improved on? We filled in a debrief pro forma, which allows for service learning and change based on experience gained on each mission.

Following this, we restocked the helicopter and the kit bags. We used a number of post-mission and equipment pack checklists for this. Each is strictly a two-person check and response procedure. One person reading from the list and the other confirming that the task or piece of equipment

is present. Following this, each pocket of the kit bags is sealed with a plastic tag.

The next day, another consultant examined and reviewed the clinical notes we had written regarding Ben's care. They then phoned the doctor looking after him in the hospital. Were there any significant injuries we missed? Did the receiving hospital staff have any concerns about the care we provided? Again, all of this information is recorded for individual and team learning. Every drug, time, blood pressure and heart rate we recorded is then entered into a database.

Nowadays, the EMRS undertake these types of retrieval every day. We operate in teams of two, a consultant with a retrieval practitioner. Both members of the team have a full understanding of their teammate's skillsets and responsibilities. The team has an extensive set of clinical and operational guidelines based on medical evidence and service experience that shape our response to a broad range of situations. We use checklists extensively. We drill, and we simulate. We debrief, we share information about significant events. We learn and adapt as a team. These systems allow us to perform to the highest standards, even when we're under extreme pressure. They allow us to own the pressure.

We also strive to continually improve the safety and standard of what we do. We are continually looking for potential marginal gains in performance.

The contrast in how I undertook my first retrieval mission in 1998 compared to how we do it today is massive. Twenty years ago, the success or failure of patient care was largely dependent on the technical skill of the doctor, and on luck. Since then, however, we have created and perfected systems to improve speed, safety and efficiency. These systems manage the pressures of the environment we work in. They cognitively offload our teams and manage our emotional and stress responses. Through pressure management, these systems allow us to use increasingly advanced lifesaving treatments for more and more patients in challenging environments.

Glossary

Analytical processing	A type of decision-making used for complex and unfamiliar problems. Information is gathered and evaluated, options are considered and a conscious decision on what action to take is made.
Anchoring bias	When evaluating a situation, we can place excessive weight on a judgement made or piece of information encountered early in the evaluation process. This initial piece of information influences our subsequent decision-making. In some cases, the judgement or piece of information may be erroneous and may be supplied by another person who was involved with the situation prior to us taking responsibility.
Automatic processing	Most judgements our brains make are based on experience of similar situations we have encountered in the past. We recognise familiar patterns of incoming information and react to them in an automatic and intuitive manner. This decision-making method is known as intuitive processing. Automatic processing is fast and consumes very little of our cognitive capacity. In the majority of situations, this method of processing brings us to accurate decisions and the correct course of action. For familiar, routine, low-risk tasks it's an ideal method of thinking.
Availability bias	This occurs when we associate what we are encountering with previous similar experiences, especially recent ones. We, possibly erroneously, judge that the problem is the same as the previous one which superficially appeared the same.
Choking	Choking, or freezing, occurs as a result of extreme stress. We are rendered unable to make decisions or carry out physical tasks.
Closed-loop communication	Information is passed from an informant to a recipient. The recipient then reads the information back to the informant. The informant then confirms that the information has been received accurately.

Cognitive aids	These are prompts or structured pieces of information designed to enhance cognition and support practice. These may range from simple aids including checklists, guidelines or mnemonics to aid memory and cognition – to more complex aids such as an interactive digital interface.
Cognitive appraisal	Cognitive appraisal is how we perceive the magnitude and complexity of a situation, and our ability to manage it. We also evaluate how the situation could potentially affect our well-being. Our appraisal of a situation can be divided into primary and secondary appraisals. During our primary appraisal we consider whether we have anything at stake relating to the encounter. This could be a potential benefit, or it could result in physical, emotional or reputational harm to us. In our secondary appraisal we evaluate what resources and abilities we have to deal with the situation, i.e. how equipped are we to cope successfully with the problem? A key part of owning the pressure is having an understanding of how our brains appraise and perceive situations, and our capability for dealing with them. Assessing the situation as a difficult but achievable challenge helps motivate us and improve our performance. We can, however, make a judgement that the situation is insurmountable or even a potential threat to our well-being.
Cognitive biases	Ideally, we would accurately and rationally interpret all of the information available to us when making decisions and judgements. Unfortunately, however, our minds can subconsciously misinterpret or even ignore some of the information presented to us. Cognitive biases result from inaccurate pattern recognition and from our brains trying to simplify the information we are receiving to speed up decision-making.
Cognitive dissonance	Dissonance occurs when a person has a belief or a perception of a situation that is challenged by new, contradictory information. Individuals strive to reconcile their existing belief with the new evidence.

	Cognitive dissonance is often observed when reviewing episodes of suboptimal performance. Those involved may try to justify their actions in spite of evidence suggesting that they should have done things differently.
Cognitive distortion	An exaggerated or irrational thought pattern which causes individuals to perceive reality or a situation inaccurately.
Cognitive offloading	The practice of minimising the cognitive burden on an individual or team. This can be achieved through the use of cognitive aids and delegation.
Cognitive overload	Cognitive overload occurs when the cognitive demands on us exceed our cognitive capacity. This is related to us exceeding the capacity of our working memory.
Cognitive pause	Consciously taking the time to pause briefly without interruption to reflect on the task at hand.
Cognitive reframing	A method of recalibrating our appraisal of a situation. The aim is to achieve an accurate and rational judgement of the circumstances facing us.
Confirmation bias	Confirmation bias occurs when we place emphasis on information that supports our original judgement, and when we place less emphasis on evidence that contradicts that judgement. We subconsciously discount additional information if it doesn't fit with our existing assessment.
Cross check	A second person verifies the accuracy of our judgement, decision or completion of a task.
Deliberate practice	Training to achieve mastery of a skill by splitting it into small parts. The skill is repeatedly practiced, each time with the aim of improving performance of one small part of the task. This requires real-time expert review and coaching.
Diagnostic momentum	Accepting a previous diagnosis or judgement without questioning its accuracy
Disconfirming question	Disconfirming questions are used as a technique to reduce the effects of cognitive biases. We actively challenge our judgement and question if all of the information available is consistent with our decision.

Disengagement	When we experience situations with insufficient levels of pressure we have minimal stimuli to motivate us to perform to a high standard. This low arousal, low performance state is known as disengagement.
Dunning-Kruger effect	Less inexperienced individuals tend to overestimate their abilities.
Emergency Medical Retrieval Service	The Emergency Medical Retrieval Service (EMRS) is Scotland's aeromedical critical care retrieval team. Established in 2004 by a group of volunteer doctors, the service is now fully funded by NHS Scotland. The team of 50 doctors, paramedics and nurses operate from dedicated retrieval bases in airports at Glasgow and Aberdeen. The team has access to a helicopter, plane and fast response vehicles to respond to incidents. The EMRS team has five roles: ♦ Primary retrieval: providing early life-saving advanced medical care to patients at the site of their accident ♦ Secondary retrieval: travelling to small, rural healthcare facilities to assess and stabilise patients before transporting them by air to larger hospitals capable of providing definitive care. ♦ Major incidents: proving medical leadership and advanced medical care at the scene of multiple casualty major incidents. ♦ Outreach training for rural clinicians. ♦ Telemedicine advice for rural clinicians.
Episodic memory	A type of explicit memory. Memories of specific events which have happened in the past.
Explicit memory	Explicit memory is a type of long-term memory. It is also known as declarative memory. Recalling information from one's explicit memory is a conscious and intentional action. There are two types of explicit memory: episodic and semantic.
Flash team	In emergency situations, individuals from different professional groups, who may not know each other, come together to form a team. This team must work together using effective communication and cooperative behaviour in a coordinated manner.

Flat hierarchy	A flat hierarchy in a team or organisation exists when, although there is an identified leader, each member of the team has autonomy and feels empowered to speak up in order to contribute to decision-making.
Flow	A state of optimal performance with the optimal amount of pressure. This results in motivation, arousal and focused attention. We perceive the situation as a challenge: It is difficult, but we are confident that we have the knowledge, skills and resources required to achieve a safe and favourable outcome.
Focused attention	Our ability to concentrate our cognitive abilities on a particular task or decision.
Framing effect	The manner in which information is communicated to us, which influences our decision-making. Identical information can be communicated with a negative or a positive 'spin'.
Frazzle	A state of suboptimal performance which occurs when we experience excessive levels of pressure.
Graded assertiveness	A communication technique for communicating concern about the judgement or actions of another person, who is often more senior. The technique involves sequentially escalating the force of what is communicated. One acronym for graded assertiveness is 'CUSS': ♦ Concern – 'I'm concerned that…' ♦ Unsure – 'I'm unsure that this is the correct…' ♦ Safety – 'I don't think what we are doing is safe…' ♦ Stop – 'Please stop what you are doing.'
Immersive simulation	Simulation that looks and feels as close to real life as possible. These are attempts to make the experience, environment, stimuli and decision-making credible and realistic. If training sessions appear unrealistic, it is difficult to engage the minds and enthusiasm of learners.
Implicit memory	Implicit memory is a type of long-term memory. It allows us to subconsciously recall information we have previously learned.

Just culture	A just culture within an organisation exists when individuals making errors or omissions due to systems failures, inexperience or challenging circumstances are not punished. Wilful errors and competence levels below the minimum expected are, however, not acceptable. Organisations with just cultures have higher rates of significant event reporting and more effective reflective practice.
Long-term memory	Used for storage of information for a prolonged period. There are two main types of long-term memory: explicit and implicit.
Major incident	An emergency situation of such magnitude that the capacity of the normal level of emergency services response is exceeded. Examples include train crashes and terrorist incidents.
Marginal gains	The process of analysing each part of a system and identifying where improvements, even very small ones, can be made. The cumulative effect is an overall significant enhancement in performance.
Mental model	Our perception of the surrounding environment and the relationship between its components and processes
Mental rehearsal	Repeatedly thinking through and imagining the stages and motor actions of predictable tasks. The imagery should be of us performing the task with excellence and confidence.
Metacognition	How our brains process information and make judgements and decisions. Thinking about thinking. Awareness of what cognitive processes are appropriate for different situations.
Overlearning	Repeatedly practicing a skill until mastery is achieved, and then practicing more. This leads to a longer lasting ability to maintain the skill. It also helps to achieve automaticity, i.e. the ability to carry out the skill without conscious thought.
Priming effect	Our perception and judgement of a situation are influenced by a preceding stimulus or experience.
Procedural memory	This is a type of implicit memory. Procedural memory allows us to carry out tasks and motor skills we have previously practiced without the need for conscious

	thought. Procedural memory is used in automatic processing. Procedural memory is carried out by the cerebellum and the basal ganglia.
Psychological safety	In psychologically safe teams, individuals feel respected and accepted. They also feel that their performance is respected. They understand that speaking up about errors is more likely to have a positive impact on the team than a negative impact on them as an individual.
Rally point	A pause in a high-pressure situation where the team communicate their personal mental models and plans of action. The aim is to achieve a shared, accurate mental model and a prioritised list of tasks.
SBAR	This is a structure for verbal and written communication. Used in situations such as team briefings, emergencies or when handing over responsibility to another team. ♦ Situation – A summary of the situation currently. ♦ Background – How we've arrived at this situation together with any useful supporting information. ♦ Assessment – What I believe to be happening. ♦ Recommendations – What I think needs to be done.
Semantic memory	A type of explicit memory. Knowledge of factual information that has been previously learned.
Serial position effect	When receiving information we have a tendency to focus and put weight on the things that are at the start of the communication and at the end. We pay less attention to information in the middle.
Shared mental model	The team has the same perception of the challenges being faced and the actions required. A common understanding of the situation.
Situational awareness	An understanding of what is happening around us.
Sterile cockpit	A term originating in the aviation industry. During complex and high-stakes procedures, all non-essential communications and actions are stopped. This reduces the cognitive load on the main operator and stops the negative effects of interruptions and distractions.

Stress inoculation	Stress inoculation is achieved in three stages. Initially, participants learn about stress and its effects on how we think, feel and behave. They then learn and practice coping mechanisms to mitigate the effects of excessive pressure. Finally, in simulation under pressure, they practice the techniques in a controlled environment. This is all done under the supervision of an experienced simulation coach. With repeated simulation scenarios, the pressure and cognitive load are gradually increased. Over time, learners come to recognise and react to the early stages of stress and cognitive overload in both themselves and their colleagues.
Stress response	Also known as the fight or flight response. Our sympathetic nervous system is activated, causing the release of two stress hormones: cortisol and adrenaline. These cause physiological changes throughout our body. The changes prepare us for a physical confrontation or to extricate ourselves from the situation. Perceptions of threat trigger a fight or flight response. Our hearts start to beat faster in order to supply our muscles with sufficient blood and oxygen for sudden movements and prolonged activity, i.e. violence or running. Our pupils widen. Our muscles tense. We start to sweat. At extremes, we have a desire to empty our bladder and bowels to reduce weight while fleeing. Our peripheral vision is compromised, as is our ability to hear.
Task fixation	Task fixation occurs when an operator fully focuses all of their attention on a task or on a decision. This reduces their overall situational awareness.
Working memory	This is the type of memory we use to retain information for a temporary period while making a decision or carrying out a task. It has a limited capacity. Working memory involves the prefrontal cortex and parietal areas of the brain. Stress impairs the function of our working memory

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References

1. Yerkes RM and Dodson JD (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology*, 18(5): 459–482.
2. Goleman D (2011). *The brain and emotional intelligence: New insights*. Northampton, MA: More Than Sound LLC.
3. Csíkszentmihályi M (2009). *Flow: The psychology of optimal experience*. New York: HarperCollins.
4. Csíkszentmihályi M (1990). Flow: The psychology of optimal experience. *Journal of Leisure Research*, 24(1): 93–94.
5. Nideffer RM (2002). Getting into the optimal performance state. Available at: https://www.epstais.com/articles/optimal.pdf [Accessed 17 July 2019].
6. Jansen A, Nguyen X, Karpitsky V and Mettenleiter M (1995). Central command neurons of the sympathetic nervous system: Basis of the fight-or-flight response. *Science Magazine*, 270(5236): 644–646.
7. Roelofs K (2017). Freeze for action: Neurobiological mechanisms in animal and human freezing. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 372(1718): 20160206.
8. Crosskerry P (2003). The importance of cognitive errors in diagnosis and strategies to minimize them. *Academic Medicine*, 78(8): 775–780.
9. Eysenck MW and Keane MT (2010). *Cognitive psychology. A student's handbook* (6th edition). London: Psychology Press.
10. Lazarus RS and Folkman S (1984). *Stress, appraisal, and coping*. New York: Springer.
11. Tomaka J, Blascovich J, Kelsey RM, and Leitten CL (1993). Subjective, physiological, and behavioural effects of threat and challenge appraisal. *Journal of Personality and Social Psychology*, 65(2): 248–260.
12. Kahneman D (2013). *Thinking, fast and slow*. New York: Farrar, Straus and Giroux.
13. *BBC News* (2017). Bin Laden family members 'incinerated' in plane crash. Available at: https://www.bbc.co.uk/news/uk-england-hampshire-39193485 [Accessed 20 June 2019].
14. AAIB (2016). Air accident investigation branch report. Embraer EMB-505 Phenom 300, HZ-IBN. Available at: https://assets.publishing.service.gov.uk/media/58749d5bed915d0b1200011a/Embraer_EMB-505_Phenom_300_HZ-IBN_12-16.pdf?_ga=2.268942705.1879664370.1566895539-869824236.1526045364.
15. Harvey A, Nathens AB, Bandiera G, and Leblanc VR (2010). Threat and challenge: Cognitive appraisal and stress responses in simulated trauma resuscitations. *Medical Education*, 44(6): 587–594.

16. Folkman S, Lazarus RS, Dunkel Schetter C, DeLongis A and Gruen RJ (1986). Dynamics of a stressful encounter: cognitive appraisal, coping and encounter outcomes. *Journal of Personality and Social Psychology,* 50(5): 992–1003.
17. Peters S (2012). *The chimp paradox*. London: Vermillion.
18. Sandi C (2013). Stress and cognition. *Wiley Interdisciplinary Reviews: Cognitive Science*, 4(3): 245–261.
19. LeBlanc V, Woodrow SI, Sidhu R, and Dubrowski A (2008). Examination stress leads to improvements on fundamental technical skills for surgery. *American Journal of Surgery*, 196(1): 114–119.
20. Chajut E and Algom D (2003). Selective attention improves under stress: Implications for theories of social cognition. *Journal of Personality and Social Psychology*, 85(2): 231–248.
21. Seyle H (1956). *The stress of life.* New York: McGraw-Hill.
22. McEwen BS (2005). Stressed or stressed out: What is the difference. *Journal of Psychiatry & Neuroscience*, 30(5): 315–318.
23. Muse LA, Harris SG, and Feild HS (2003). Has the inverted-U theory of stress and job performance had a fair test? *Human Performance, 16*(4): 349–364. Available at: http://dx.doi.org/10.1207/S15327043HUP1604_2 [Accessed 17 July 2019].
24. Personal communication with Johnny.
25. Miller GA (1956). The magical number seven, plus or minus two. Some limits on our capacity for processing information. *Psychological Review*, 63: 81–97.
26. Schacter DL (1987). Implicit memory: History and current status. *Journal of Experimental Psychology: Learning, Memory, and Cognition,* 13: 501–518.
27. Tecmark (2019). Tecmark survey finds average user picks up their smartphone 221 times a day. Available at: https://www.tecmark.co.uk/blog/smartphone-usage-data-uk-2014 [Accessed 17 July 2019].
28. Byyny RL (2016). Information and cognitive overload. The Pharos Autumn. Available at: http://alphaomegaalpha.org/pharos/PDFs/2016-4-Byyny.pdf [Accessed 17 July 2019].
29. Levitin DJ (2015). *The organized mind: Thinking straight in the age of information overload*. New York: Penguin.
30. Watson JM and Strayer DL (August 2010). Supertaskers: Profiles in extraordinary multitasking ability. *Psychonomic Bulletin & Review*, 17(4): 479.
31. Syed M (2011). *Bounce: The myth of talent and the power of practice*. London: Fourth Estate.
32. Rodman J (2015). Cognitive biases and decision making: A literature review and discussion of implications for the US Army. Available at: http://cgsc.contentdm.oclc.org/cdm/ref/collection/p16040coll2/id/19 [Accessed 17 July 2019].
33. Morgenstern J (2015). Cognitive errors in medicine: The common errors, First 10EM. Available at: https://first10em.com/cognitive-errors/ [Accessed 10 July 2019].
34. Ebbinghaus H (1913). *On memory: A contribution to experimental psychology*. New York: Teachers College.

35. Kruger J and Dunning D (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology,* 77(6): 1121–1134.
36. Dawson D and McCulloch K (2005). Managing fatigue: It's about sleep. *Sleep Medicine Reviews*, 9(5): 365–380.
37. Lieberman HR, Tharion WJ, and Shukitt-Hale B et al. (2002). Effects of caffeine, sleep loss, and stress on cognitive performance and mood during U.S. navy SEAL training. *Psychopharmacology*, 164(3): 250–261.
38. Davenport N, Lee J (2007). Assessing how fatigue causes mishaps. *Approach: The Naval Safety Center's Aviation Magazine,* 52(5): 6.
39. Weinger MB (2002). Sleep deprivation and clinical performance. *Journal of the American Medical Association*, 287(8): 955–957.
40. Alhola P and Polo-Kantola P (2007). Sleep deprivation: Impact on cognitive performance. *Neuropsychiatric Disease and Treatment,* 3(5): 553–567.
41. Saper CB (2005). Homeostatic, circadian, and emotional regulation of sleep. *Journal of Comparative Neurology*, 493(1): 92–98.
42. Harrison Y and Horne JA (2000). Sleep loss and temporal memory. *Quarterly Journal of Experimental Psychology A*, 53: 271–279.
43. Iyer EM (2000). Effect of hypoxia, noise and vibration stress on human performance and neuro-endocrine reactions. *Indian Journal of Aerospace Medicine*, 44(2): 21–27.
44. McKenna H and Wilkes M (2018). Optimising sleep for night shifts. *British Medical Journal*, 360: j5637.
45. Pejovic S, Basta M, and Vgontzas A et al. (2013). Effects of recovery sleep after one work week of mild sleep restriction on interleukin-6 and cortisol secretion and daytime sleepiness and performance. *American Journal of Physiology, Endocrinology and Metabolism*, 305(7): 890–896.
46. Kellogg KM, Wang E, Fairbanks RJ, and Ratwani R (2016). 286 sources of interruptions of emergency physicians: A pilot study. *Annals of Emergency Medicine*, 68(4, Supplement): 111–112.
47. Hearns S (2003). The Scottish mountain rescue casualty study. *Emergency Medicine Journal*, 20(3): 281–284.
48. Personal communication with Dr Eddie Crawford.
49. Personal communication with Wayne Auton.
50. Harrell E (2015). How 1% performance improvements led to Olympic gold. *Harvard Business Review.* Available at: https://hbr.org/2015/10/how-1-performance-improvements-led-to-olympic-gold [Accessed 17 July 2019].
51. Lowe DJ, Dewar A, and Lloyd A et al. (2017). Optimising clinical performance during resuscitation using video evaluation. *Postgraduate Medical Journal*, 93(1102): 449–453.
52. Personal communication with Angela Lewis.
53. Dekker S (2012). *Just culture* (2nd edition). Oxford: Routledge.
54. Reason J (1990). *Human error.* Cambridge: Cambridge University Press.
55. Festinger L (1962). Cognitive dissonance. *Scientific American*, 207(4): 93–107.
56. Gawande A (2010). *The checklist manifesto: How to get things right*. New York: Metropolitan Books.

57. Kotter JP (2012). *Leading change*. Brighton: Harvard Business Review.
58. Business balls (2012). Iceberg model of the psychological contract. Business balls. Available at: https://www.businessballs.com/building-relationships/the-psychological-contract-2012 [Accessed 17 July 2019].
59. Herzberg F, Mausner B, and Snyderman BB (1959). *The motivation to work* (2nd edition). New York: John Wiley.
60. Maslow A (1987). *Motivation and personality* (3rd edition). London: Harper & Row.
61. Marquet LD (2015). *Turn the ship around!* Austin: Greenleaf Book Group Press.
62. Quinn B (2013). Police helicopter crashes into roof of Glasgow pub. *The Guardian*.
63. BBC News (2014). Glasgow bin lorry crash. *BBC News*. Available at: https://www.bbc.co.uk/news/live/uk-scotland-30573149 [Accessed 23 August 2019].
64. Performance Psychology in Medicine, June 2017: http://iophc.co.uk/education/courses/performance [Accessed 17 July 2019].
65. The Telegraph (2011). RAF fast jet pilots: £4m training scheme selects only the most talented airmen. Available at: https://www.telegraph.co.uk/finance/newsbysector/industry/defence/8446324/RAF-fast-jet-pilots-4m-training-scheme-selects-only-the-most-talented-airmen.html [Accessed 10 July 2019].
66. Personal communication with Andy Ross.
67. McCormack J and Percival D (2016). HEMS advanced trauma team retrieval of a patient with accidental hypothermic cardiac arrest for ECMO therapy. *Resuscitation*, 105: e23.
68. James K and Styner MD (2006). The birth of advanced trauma life support. *Journal of Trauma Nursing*, 13(2): 41–42.
69. SIGN guideline 110 (2009). Early management of patients with head injury. Available at: http://www.sign.ac.uk/assets/sign110.pdf
70. NICE guideline CG176 (2017). Head injury: Assessment and early management. Available at: https://www.nice.org.uk/guidance/cg176
71. Association of Ambulance Chief Executives (2019). JRCALC Clinical Guidelines 2019. Bridgwater: Class Professional Publishing.
72. Winters BD, Gurses AP, and Lehmann H et al. (2009). Clinical review: Checklists – translating evidence into practice. *Critical Care*, 13(6): 210.
73. House of Commons Library 2019, NHS Key Statistics: England. Available at: https://researchbriefings.files.parliament.uk/documents/CBP-7281/CBP-7281.pdf. [Accessed 10 July 2019].
74. NHS National Services Scotland (2012). Central line insertion bundle. Available at: http://www.sicsag.scot.nhs.uk/hai/SICSAG-central-line-insertion-bundle-120418.pdf [Accessed 17 July 2019].
75. Longmate A, Ellis KS, and Boyle L et al. (2011). Elimination of central-venous-catheter-related bloodstream infections from the intensive care unit. *BMJ Quality and Safety,* 20(2): 174–180.
76. Clinical Human Factors Group. Report on Elaine Bromiley inquest. Available at: http://emcrit.org/wp-content/uploads/ElaineBromileyAnonymousReport.pdf [Accessed 17 July 2019].

77. CAA (2006). CAP 676 Guidelines for the design and presentation of emergency and abnormal checklists. Civil Aviation Authority. Available at: http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=158 [Accessed 17 July 2019].
78. Undre S, Sevdalis N, and Healey AN et al. (2007). Observational teamwork assessment for surgery (OTAS). *World Journal of Surgery*, 31(7): 1371–1381.
79. NHS (2010). Safer Care, SBAR. Available at: https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/SBAR-Implementation-and-Training-Guide.pdf. [Accessed 9 July 2019].
80. Coyle D (2018). *The culture code: The secrets of highly successful groups*. New York: Random House Business.
81. Personal communication with Captain Craig Trott.
82. Mathieu JE et al. (2000). The influence of shared mental models on team processes and performance. *Journal of Applied Psychology*, 85(2): 273–283.
83. Butchibabu A, Sparano-Huiban C, Sonenberg L, and Shah J (2016). Implicit coordination strategies for effective team communication. *Human Factors*, 58(4): 595–610.
84. Personal communication with Mike Henson.
85. Personal communication with Phil Munro.
86. Dyer C (2003). Doctor sentenced for manslaughter of leukemia patient. *British Medical Journal,* 327: 697.
87. Wrenn E (2012). Clean-up crews begin removing 40,000 litres of fuel from stricken cargo ship as Royal Navy hero is praised for rescuing sailors... on his FIRST day on the job. *The Daily Mail*. Available here: https://www.dailymail.co.uk/news/article-2124784/RAF-dramatic-rescue-cargo-ship-crew-North-Wales-coast-amid-race-stop-40-000-litre-fuel-spill.html [Accessed 10 July 2019].
88. Ministry of Defence (2012). MV Carrier Colwyn bay. Available at: www.gov.uk/government/news/search-and-rescue-crews-save-7-sailors-from-stricken-ship--2 [Accessed 17 July 2019].
89. Driskell JE (1992). Effect of overlearning on retention. *Journal of Applied Psychology*, 77(5): 615–622.
90. Ericsson A and Pool R (2016). *Peak: Secrets from the new science of expertise*. Boston, MA: Houghton Mifflin Harcourt.
91. Lauria M (2015). Stress inoculation training. Available at: https://emcrit.org/emcrit/on-stress-inoculation-training/ [Accessed 17 July 2019].
92. Saunders T, Driskell JE, Johnston JH, and Salas E (1996). The effect of stress inoculation training on anxiety and performance. *Journal of Occupational Health Psychology*, 1(2): 170–186.
93. Oakley E, Stocker S, Staubli G, and Young S (2006). Using video recording to identify management errors in paediatric trauma resuscitation. *Paediatrics*, 117(3): 658–664.
94. Lorello GR, Hicks CM, and Ahmed SA et al. (2016). Mental practice: A simple tool to enhance team-based trauma resuscitation. *Canadian Journal of Emergency Medical Care*, 18(2): 136–142.

95. Sandvik AM, Gjevestad E, and Aabrekk E et al. (2019). Physical fitness and psychological hardiness as predictors of parasympathetic control in response to stress: A Norwegian police simulator training study. *Journal of Police and Criminal Psychology* (March): 1–14.
96. Lauria MJ et al. (2017). Psychological skills to improve emergency care providers' performance under stress. *Annals of Emergency Medicine*, 70(6): 884–890.
97. Association of Ambulance Chief Executives (2019). *JRCALC Clinical Guidelines 2019 Pocket Book*. Bridgwater: Class Professional Publishing.

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PEAK PERFORMANCE UNDER PRESSURE

Lessons from a
Helicopter Rescue Doctor

- **How can we maintain optimal levels of pressure so we perform at our best?**
- **What systems and tools can we use to own the pressure?**
- **What techniques can we apply to regain composure and situational control when under pressure?**

All of us experience moments when we are under pressure and need to perform to a high standard. While the right level of pressure enhances our performance, excessive pressure leads to cognitive overload, stress and compromises our ability to perform. How can we own the pressure to achieve peak performance?

Drawing on 20 years of leadership experience in high-pressure emergency medical and rescue situations, the author describes the consequences of pressure, both positive and negative, and teaches the strategies we need to attain states of peak performance. Using first-hand accounts of high-pressure situations within emergency medicine, the book covers relevant aspects such as cognitive aids, teamwork, organisational culture and tactical leadership. It also describes how we can use different training and simulation techniques to prepare teams to deal with excessive pressure in practice. It will appeal to doctors, ambulance clinicians, firefighters, military personnel, rescue teams and business leaders as well as anyone hoping to improve their own performance during high-pressure situations.

Contents include:

- Flow, frazzle and owning the pressure
- Thinking under pressure
- Back pressure – barriers to high performance
- Cultures of excellence
- Strategic leadership of high-performing organisations
- Selecting high performers
- Guidelines and accessing information under pressure
- A checklist for checklists
- The high-performing team
- Frontline leadership
- Tools of the trade
- Training for high performance
- Simulation and competency assessment
- Personal preparation for high performance
- Reducing the pressure from frazzle to flow
- Pressure management case studies

Dr Stephen Hearns is a consultant in emergency medicine based in Glasgow. He has led the development of Scotland's EMRS aeromedical retrieval service since it was established in 2004. With 20 years of mountain rescue experience behind him he leads a team of 50 helicopter consultants, paramedics and nurses who provide lifesaving critical care in remote hospitals and at the site of accidents. Stephen also provides training courses, conferences and regular blogs on Performance Under Pressure. Details can be found on the Core Cognition website: **www.corecognition.co.uk**

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