

# The neurobiology of resilience

**N**euroscience makes possible a new understanding of human nature. The practice of medicine is particularly stressful, and neuroscience helps explain why this is the case. When work is demanding and recovery poor, persistent stress begins to distort our view of ourselves, our patients, and our working world. Empathic doctors are safer, more effective and happier in their work, yet empathy fades as stress levels rise and this fuels the journey into 'burnout'. If an unrelenting flight-or-fight mode makes us cognitively slower, less able to be empathic and communicative, family medicine turns into an overwhelming uphill struggle. Can this downward spiral be reversed? Resilience varies over time, depending on the balance of positive and negative influences; many of these needs being determined by our evolutionary heritage. A better grasp of current ideas about the interpersonal neurobiology of stress, emotion, social engagement and empathy can help us make sense of our predicament and find ways to embark on personal, organisational and cultural change. In challenging and stressful circumstances, if we can cultivate self-care and self-awareness, core values, and especially the ability to self-soothe, we may give ourselves a better chance to flourish both individually and as a profession.

## The GP curriculum and resilience

**Core statement 1: Being a general practitioner** requires GPs to:

- Comply with professional demands whilst showing awareness of the importance of addressing personal needs, achieving a balance that meets your professional obligations and preserves your resilience and health
- Anticipate and manage the factors in your work, home and wider environment that influence your day-to-day performance, including your ability to perform under pressure, and seek to minimise any adverse effects

Fitness to practice is a core capability that concerns a GP's development of professional values, behaviours and *personal resilience* and preparation for revalidation. It includes insight into when your own performance, conduct or health, or that of others, might put patients at risk, as well as taking action to protect patients.

With a rising interest in neuroscience, we have an opportunity, which we must not squander, to sophisticate our understanding of ourselves.

## Thriving in medicine: A question of balance

In the ebb and flow of daily life, people are confronted with changing circumstances to which they must adapt.

Iain McGilchrist (2009), in *The Master and his Emissary*

Resilience is the ability to navigate these changes successfully (Block & Kremen, 1996)

Long before a loss of resilience leads to illness, the stress response makes us less sharp-witted and more unfriendly. Even quite mild acute stress triggers a striking dip in cognitive abilities, a loss of judgment, and a

significant loss of interpersonal skills. This is no recipe for a successful consultation, still less for a safe and satisfying career in medicine.

Doctors who are resilient are less prone to burnout and better able to do their job well (see Box 1). Of course there are evidence-based resilience top-tips aplenty to be had, but being told how to swim with more style will be no help when you are already drowning. The parallels are apposite: when we feel in danger we do not take in new information, still less when we are beyond saving ourselves and, feeling overwhelmed, can only sit and stare like rabbits in the headlights. To cope with the draining demands of medical practice we need to be getting enough of the things that feed and sustain us. Figure 1 contrasts the *drainers* (Maslach, Schaufeli, & Leiter 2001) with the sorts of *drivers* that doctors say sustain them (Zwack & Schweitzer, 2013). Certain temperamental factors support (+) or tend to erode (–) resilience (Eley et al., 2013).



Figure 1. Resilience: A question of balance.

### Box 1. Resilience.

Resilience results in:

- Better quality of care, quality of caring, and sustainability of the healthcare workforce. (Epstein & Krasner, 2013)
- Resilience depends on individual, community, and institutional factors (Firth-Cozens, 2003)
- Resilient people have over time (perhaps by their having dealt with challenging experiences), developed healthy techniques for coping effectively (American Psychological Association, 2014)
- Resilient people have the 'emotional flexibility' to balance negative emotions with positive ones (Tugade & Fredrickson, 2004)

## 'Burnout'

Everyday encounters with distress are part and parcel of family medicine, so to practice it well we must make ourselves highly adaptable: be empathic without over-arming ourselves against suffering, effective without becoming a workaholic, efficient without isolating ourselves behind our office doors, available but without allowing demands to overwhelm us. No pressure then!

The perspectives of evolutionary biology and neuroscience help us find ways through these predicaments. Functional magnetic resonance imaging and new electroencephalograph technology reveal connections between emotions and activity in particular parts of the brain. This hard data about a formerly soft subject provokes us to

take more notice of how mind and body affect one another.

### Box 2. Maslow's dimensions of burnout.

- Exhaustion: Feeling overextended, both emotionally and physically
- Cynicism: Taking a cold, cynical attitude toward responsibilities
- Ineffectiveness: Unproductive and with a growing sense of inadequacy

The difference between stress and burnout is a loss of the ability to recover in time off. Burnout begins when you are NOT able to recharge your batteries between on-call nights or days in the practice.

#### The downward spiral has three characteristics:

- Physical and emotional exhaustion: Emotionally drained, depleted and worn out by work and unable to recover in non-working hours. *Tired and disorganised*
- Depersonalisation: A negative, callous and cynical attitude toward patients and their concerns. The cardinal sign is cynicism, sarcasm and feeling put upon by patients. *Grumpy and detached*
- Reduced sense of personal accomplishment: Tending to see one's work negatively, without value or as meaningless ('What's the use?') and see oneself as incompetent. *Cannot be bothered*

Source: *The Happy MD. Physician burnout: Why it's not a fair fight.* [www.thehappymd.com/blog/bid/295048/Physician-Burnout-Why-its-not-a-Fair-Fight](http://www.thehappymd.com/blog/bid/295048/Physician-Burnout-Why-its-not-a-Fair-Fight).

Burnout, whose 'symptoms' Maslach defined in the 1980s (see Box 2) is widespread among healthcare workers. Although 90% of people who feel 'burned out' also meet the criteria for depression, compared with

depressed people, individuals with high levels of burnout seem to enjoy things despite feeling short of energy; they rarely lose weight or have thoughts of suicide and their feelings of guilt are more realistic; they tend to perform despite indecision and fatigue, and often have difficulty getting to sleep, rather than waking early (Brenninkmeyer, van Yperen, & Buunk, 2001).

## Evolution and emotions

Darwin observed that all humans express emotions in physically similar ways, and that animals show emotion-like behaviours. He proposed that emotions have evolutionary value, as they motivate crucial survival-related behaviours. Neuroscientist Jaak Panksepp proposed that positive affects are associated with safety, whereas negative affects reflect situations that feel unsafe (Panksepp, 2005).

In survival-oriented terms, emotions either feel safe or unsafe, and the body either activated or inactive. These polarities combine into four 'core affects' (Russell, 2003). In Figure 2 the left-hand side represents threat avoidance: negative affects, whether active or relatively still. 'Hunted' mode is active and unsafe: flight or flight, feeling angry or fearful. Unsafe stillness is 'Fatigue and fold' when shocked, trapped or overwhelmed: feeling numb and giving up, unhealthy fatigue and despair. On the right-hand side, the 'Hunting' mode of safe activation spurs us towards goals: food, shelter and mates; feeling enthusiastic, excited and joyful. The 'Rest, digest, and connect' mode requires safe stillness for recuperation and recovery, but also for relationship, mutual protection and nurturing: feeling contented.

Paul Gilbert's threefold model helps us understand how these states interact (Gilbert, 2010). A crucial moment before we are *conscious* of danger: 'hunted' feelings of fear, aggression or disgust switch in. Due to its survival value being so great, this adrenaline-fuelled *threat-avoidance* system, though over-eager and error-prone



Figure 2. Core affects provoke behaviours intended to enhance survival.

(act first think later; better safe than sorry) is the brain's default mode.

Gilbert's *incentive and resource-seeking* ('hunter') system motivates animals to seek food, shelter, comfort, friendship: if we get them we feel excitement and pleasure. This dopamine-linked system turns on positive feelings and motives. However, if something gets in the way of goal-seeking, we may flip into feeling threatened and frustrated.

After hunting, fighting or escaping we need safe-stillness to calm and heal the mind-and-body. In this *soothing/affiliation* state ('cave-time') we can be affectionate, caring and kind. Also, since we are wired for relationship and empathy, when someone is feeling upset, other humans can co-regulate them by showing kindness and caring. High levels of drive and/or threat avoidance get in the way of the affiliation system. Contentment releases endorphins; oxytocin 'the bonding hormone' connects with feelings of trust, affiliation and safe attachment.

## Higher brain hijack

The acute stress response can be life-saving; stress hormones, cortisol and adrenaline, and pro-inflammatory cytokines are there to induce useful adaptive short-term physiological changes. The problem, however, is that although we no longer hunt and gather or flee from predators, the same primitive reactions still hijack the neocortex. However, we cannot fight off or run away from modern life's many metaphorical dangers, so when these illusive stressors persist, pent-up cardiovascular and endocrine overload cannot discharge and these processes do not switch off. Persistent stress activation damages tissues (McEwen, 1998), causes structural changes in prefrontal cortex dendrites and, by stopping the hypothalamic-pituitary-adrenal axis from returning to baseline, prepares the way for chronic illness. Persistent workplace stress is associated with an increased coronary heart disease risk, which is probably mediated by the higher prevalence of physical inactivity, smoking and diabetes among participants with job strain (Nyberg et al., 2013).

MacLean's idea of the triune brain highlights the different evolutionary layers of the brain and their different endowments. The *neocortex* gives us higher cognition: abstract thought, planning, modelling and simulation, the capacity for a sense of self and crucially for regulating emotions. The *limbic brain* is the seat of typical mammal-era emotional, social and nurturing behaviours. When we feel stressed, the limbic system (whose priority is survival) responds to perceived threats by triggering the flight-or-fight mode. Beneath all this, the *reptilian brain* (stem) maintains vital functions, arousal levels and reptilian survival behaviours including the freeze mode.

In 'civilised' society (though less so in sport or war) we have to moderate our displays of emotion. This 'affect regulation' requires a healthy integration of the three brains. Doctors, dealing with peoples' impaired bodies and powerful emotions learn to suppress their reactions even when under pressure or distressed. Soon after we enter medical schools, we are confronted with patients who are ill, needy, uncertain, fragile and suffering; confused, and sometimes angry or terrified. Having self-selected for this kind of encounter, medical students learn to swallow any instinctive responses and appear unmoved. However, below the calm neocortical surface, there can be troublesome limbic turbulence, if our patients are perceived unconsciously as stressors.

## Affect regulation

The autonomic nervous system (ANS), manages the physiology of affect regulation. In order to tolerate intense positive and negative affects we need the ANS not to overshoot too easily into sympathetic flight or fight, or into parasympathetic freeze and fold. This stability is a key determinant of lifelong reaction to stress and recovery from it (i.e. resilience). The neural pathways in the brain that bring about this control are formed in the first 2 years of life. Infant humans cannot make sense of their emotions, or control ANS overshoots, so their emotion systems must be co-regulated by what Winnecott called a good enough carer (Gerhardt, 2004).

The template on which an infant's nervous system grows is actively shaped by the emotional state of the people with whom they are interacting. This is because brain pathways that are used frequently are enhanced (neurons that fire together eventually wire together), whereas pathways lacking stimulation will be underdeveloped.

Paul Gilbert points out that people with psychological difficulties tend to have a very active threat and self-protection system, which keeps anxiety and anger near the surface. This might be because they lacked a carer's co-regulating presence to bring their soothing/contentment system online; or perhaps because later abuse or trauma turned up the volume on their threat detection systems. He also emphasises the way that our core affective states interact (see Fig. 3) so that high threat or high drive activation tend to suppress affiliation.

## Sustained stress makes us more dull-witted and unfriendly

The prefrontal cortex (PFC), which is the newest part of the neocortex, makes higher forms of social and emotional intelligence and affect regulation possible (Siddiqui, Chatterjee, Kumar, Siddiqui, & Goyal, 2008). However, its extensive connections make it very susceptible to upward emotional arousal from the ancient mammalian and reptilian brains (Arnsten, 2009). These threat-avoidance effects (see Box 3) impair decision-making, reduce mirror neuron activity/empathy, down-regulate the social engagement system, increase negative affects and invite ruminative thinking. Humans, although wired for empathy, turn it off when they feel threatened.

It seems there may be a deep tension at the heart of medicine: patients expect doctors to look comfortable and confident, but they also hope they will be empathic; yet doctors in order to do a job that calls for sensitivity and kindness, risk becoming emotionally numb. Rarely are undergraduates given the skills needed to square this circle, which may be why empathy declines during

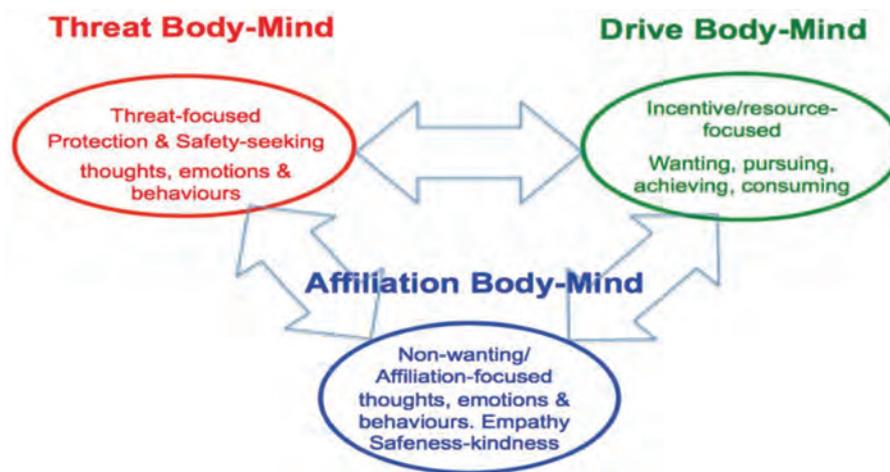


Figure 3. Three types of affect regulation system. From Gilbert P (2009) *The Compassionate Mind*. With kind permission from Constable Robinson

**Box 3. Impact of the stress response.**

- The stress response interferes with empathy and communication, as well as mental processes such as memory, concentration, judgments and decision-making
- Feeling stressed narrows our field of vision (literally and metaphorically)
- Research demonstrates it makes us:
  - Less generous
  - Less cooperative
  - More xenophobic
  - More likely to interpret ambiguous expressions as hostile ones
  - More likely to displace frustration and aggression onto those around us

Source: Martin et al. (2015).

medical school and residency (Neumann et al., 2011). Furthermore, once qualified we are unlikely to resolve these tensions while struggling to juggle multiple clinical and appraisal targets, seeing 40 patients a day and working in under-resourced, suboptimal teams against the troublesome background noise of family life and finances.

## Professional numbing

Normally, watching or even just imagining someone experience pain activates the brain's pain network *in the observer*. This is an example of mirror neuron activation. However, when researchers in Taiwan presented doctors and matched controls with images of body parts being pricked with a needle, the doctors' brains showed greatly reduced arousal in response to the pain of others (Decety, Yang, & Cheng, 2010). The authors suggest this 'professional numbing may free up cognitive resources necessary for being of assistance' under stress.

However, as Bruce Newton reminds us (see Box 4) doctors must walk a tightrope: neither seeming so detached as to appear unsympathetic, nor feeling so empathetic that our patients' suffering and reactions interfere with our ability to provide effective care. However, when burnout causes empathy to plummet, work-related stressors spoil our ability to relate to patients. *Conversely*, how doctors relate to patients will affect how we experience our work and how stressful it feels.

## The neurobiology of burnout

Maslach lists the factors that predispose us to burnout (see Box 5) a journey that makes its way through all the four *core affects*. The young doctor sets out enthusiastic

**Box 4. General practice involves high levels of patient contact, so being able to communicate and establish empathic patient relationships are essential skills.**

The evidence suggests empathic communication skills:

- Increase patient satisfaction
- Establish trust
- Reduce anxiety
- Increase adherence
- Lead to better health outcomes
- Lead to fewer complaints.

In one study, patients felt that clinically competent doctors were relatively ineffective if they lacked these skills (Van Dulmen & van Bensing, 2002)

Empathic doctors:

- Are happier in their work
- Enjoy seeing patients more
- Are less prone to severe burnout
- May be more clinically competent.

Source: Newton (2013).

**Box 5. Maslach's predisposing factors.**

- We feel overloaded
- We lack control over what we do
- We feel work is no longer rewarding
- We experience a breakdown in the workplace community
- We feel unfairly treated
- We have to deal with conflicting values

and conscientious to drive himself or herself to achieve his or her best. At some point, and for various reasons, the energy expended at work gets to be more than he or she can restore in his or her time off. Thus, he or she works harder, but feels increasingly unsafe as he or she struggles to meet his or her targets, and as sympathetic arousal (both hunting and hunted) kicks in and his or her limbic emotions start getting in the way. Unable to find safe stillness or discharge the excess arousal, he or she finds it ever harder to switch off his or her ruminative negative thoughts and maintain empathy. Eventually, in a slow tail-spin, his or her sense of being overwhelmed, dissociation and failure build-up as he or she moves through freeze, and finally into parasympathetic fatigue and fold. Perfectionism (Hill & Curran, 2015) and 'harm avoidance' (Eley et al., 2013) are traits that predispose to burnout.

## Beating burnout

Can neurobiology help us understand this turmoil and take remedial action?

Humans are a challenge-seeking species: too little threat and drive and we feel empty and bored: too much, and we risk overload. When in harmony with the other emotion-systems, the drive-excitement system steers us towards our goals, but too much drive-activation and we overshoot into insatiability, addiction to excitement, even mania; or, if we persistently ignore the warning signs and keep driving ourselves beyond our capacity to deliver, and lose the ability to recover we risk burnout and breakdown.

Cardiologist Peter Nixon conceived the Human Function Curve to describe the trajectory into physiological breakdown (Nixon, 1982). Arousal and performance go hand-in-hand until the point of overload, but with increasing levels of demand and activation performance deteriorates. On the downslope, negative emotions and catabolic stress physiology snowball. In cognitive decline, the insight to master this predicament (and get the rest and support needed to climb back to the upslope) is lost.

## The polyvagal system and social engagement

The ANS is not just about flight-or-fight and freeze-or-fold. Steven Porges, Director of the Brain-Body Center at the University of Illinois at Chicago, describes a *threefold* ANS, a polyvagal system that allows higher mammals, before they switch into flight or fight or freeze to attempt social engagement.

Vagus nerve traffic is between 80% and 90% afferent: mostly conveying sensory information about the body's organs to the central nervous system (Berthoud & Neuhuber, 2000). The more recently evolved *ventral* branches of the vagal system (ventral vagal complex (VVC)) provide a steadying level of vagal tone that produces a resting heart rate. A high vagal tone makes affiliation and self-calming possible: it promotes *cave-time*. Releasing the vagal brake results in very rapid mobilisation of sympathetic ('fight/flight') activation, because when we really need flight or fight, we need them in a hurry. However, if the vagal brakes are poorly adjusted or too easily or inappropriately released, this interferes with affect regulation and gets in the way of clear thinking, empathy and communication.

## Mirror neurons and empathy

According to Damasio's 'somatic marker' hypothesis, we can tell how distressed another person is because we experience it through our own brain-and-body network. This enables humans to be empathic and potentially to act compassionately (Damasio, 2000). Neuroscientist Marco

Iacoboni at UCLA believes mirror neuron systems in the human brain help us understand the actions and intentions of other people (Iacoboni et al., 2005). Mirror neurons in the pre-motor cortex respond to seeing or even hearing the sound of an action: when someone yawns, you are likely to yawn within the next half minute; the larynx mirrors another's speech; we mirror breathing patterns. (Try to catch your own breathing speeding up next time an anxious patient comes to see you).

When we genuinely engage with someone there is more musical 'prosody' of voice-tone, a slower pace of breathing, lively facial expressions and more spontaneous and more genuine smiling; perhaps a mirroring of body language and posture too, and we attune better to the human voice as ear ossicles adapt. Steven Porges explained that these shifts into affiliation-mode depend on the VVC and 'a face-heart-brain connection' (Porges, 2012); the VVC keeps flight and fight at bay, but also facilitates the *social engagement system* – the muscles of gaze and facial expression, larynx and orientation that convey feelings of safety to others.

## Can we learn to regulate our emotion systems?

### Positive emotions

Might it be possible to generate positive affect and so calm down the threat system? Former GP Alistair Dobbin has developed a programme called Positive Mental Training for use in primary care (see Box 6) based on 12 short audio tracks, one a week over the course of 12 weeks. Outcomes with patients and professionals have been impressive. He emphasises that the foundation for this kind of work is in calming the body; only then can positive emotions be induced.

#### Box 6. Positive mental training.

Part of my therapy-concept is that GPs can therapeutically mirror a sense of recovery to their patients and that this will have a powerful effect. But you cannot be compassionate if you feel in a bad way yourself, because then you will be in fight or flight mode. In threat-mode the compassionate mind simply will not work. As a GP you cannot generate compassion if you are sitting there feeling miserable or totally over-loaded. But I am afraid that's what many GPs are doing. From this perspective if you cannot access positive emotions, you cannot be compassionate to people. So if you are under stress, and have lost your resilience, the first step (whether you are a doctor or a patient the same applies) must be to access a positive representation of yourself

*Quote taken from Dobbin (2013).*

### Heart rate variability biofeedback

The vagus nerve is the key regulator for the body's major organ systems: heart, lungs, eyes, glands and gut. The measurement of vagal tone is an easy way to assess stress reactivity; for instance, low cardiac vagal tone (CVT) is a marker of major depressive disorder, anxiety and post-traumatic stress disorder, whereas higher CVT levels predict greater social connectedness and agreeableness and generally correlate with increased positive emotions and decreased depressive symptoms. Kok et al. (2013) showed that high CVT is linked to better psychological and physical health. Individuals with a high CVT appear cheerful and kind and deal well with stress. A high CVT is also related to the trait of positive emotionality (Oveis et al., 2009), prosocial behaviour, sympathy and decreased maladaptive coping (Porges, Doussard-Roosevelt, & Maiti, 1994). Conditions as varied as asthma and depression respond to CVT feedback training using slow-breathing techniques that regulate the baroreceptor mechanism. CVT biofeedback may affect the vagal afferent pathway from the heart to the brain stem (Lehrer & Gevirtz, 2014).

HeartMath (<https://www.heartmath.org>) uses a tablet-based app with a pacer to slow breathing down and an ear-clip sensor to monitor variability in heart rate. Slow breathing produces sinus arrhythmia and promotes relaxation. The method also encourages the recall of positive emotion, and a mindful focusing on the centre of the chest. In a randomised trial in the USA, 20 staff physicians used HeartMath three times daily. Lower mean stress scores in the intervention group were maintained during the trial extension to day 56. (Lemaire, Wallace, Lewin, de Grood, & Schaefer, 2011).

### Mindfulness

Mindfulness involves learning to pay attention to the present moment rather than worrying or dwelling on the past, and an attitude of friendliness toward oneself, rather than one of criticism and judgment. This shift in self-perception may involve a PFC brain network that reduces the amygdala's threat sensitivity. Mindful Self-Compassion training (which we are teaching and researching at our Centre for Resilience) turns compassion back on oneself. Dan Siegel suggests that this particular form of attention, which lets us sense the inner working of our minds, can get us off the treadmill of habitual ways of being, doing and reacting (Siegel, 2012).

## Organisational resilience: A matter of values?

We need look no further than the essential book *Intelligent kindness* written by Ballatt and Campling (2011) who remind us that:

... the NHS is a profoundly values-driven system that calls on society to treasure and look after its deepest common interests. The NHS is a vital expression of community and one that can improve if society, patients and staff can reconnect to these deeper values. To do so will improve quality and patient experience, as well as morale, effectiveness, efficiency and value for money."

Relentless regulatory and structural NHS 'reforms' have failed to avert scandals and left many health service staff feeling alienated. Industrial and market approaches to reform, whatever their merits, urgently need to be balanced by an applied understanding of what motivates and assures compassionate practice. The authors examine this topic from a wide variety of perspectives, including psychoanalytic thinking, group relations, neuropsychology, social psychology and ethology.

The authors call on policymakers, managers, educators and clinical staff to apply and nurture intelligent kindness in the organisation and delivery of care, and they offer advice as to what this approach means in practice.

### Key points

- The practice of medicine is particularly stressful because, despite having high levels of responsibility and little control over outcomes, we encounter suffering and distress, but receive too little training about empathy, emotional intelligence and leadership skills
- When survival-mode emotions persistently arise in the body, the brain regions they activate may come to guide what we pay attention to, and so distort our experience of the world
- Feeling overloaded, out of control, undervalued and conflicted promote burnout, but before persistent stress makes us ill and dissociated, it interferes with decision-making, empathy and social engagement
- Self-care skills (good boundaries, mindfulness etc.) can help regulate affects and initiate positive emotion, so protecting our wellbeing
- Being empathic and better able to provide whole-person care can increase our clinical effectiveness and professional enjoyment, so creating an upward spiral of resilience

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## AKT question relating to improving your resilience at work

### Single Best Answer Question

You are seeing a 38-year-old patient who is also a GP partner in a local practice. He has been suffering from work related stress. You suggest attending a training course to help him deal with adversity and improve his capacity to cope with stress.

**Which SINGLE training is MOST appropriate? Select ONE option only**

**Dr Yasser Abdel Kerim**  
**GP Partner, Banks and Bearwood Medical Centre, Bournemouth**

- A. Anger management training
- B. Anxiety management training
- C. Cognitive behavioural therapy (CBT)
- D. Communication skills training
- E. Resilience training

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