



Review Article

The value of empathy in medical practice: A neurobehavioral perspective

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ABSTRACT

Empathy is fundamental to healthcare, as it improves patient outcomes, satisfaction, trust, and adherence to treatment. In this paper, we critically examine the role of empathy in doctor-patient interactions, emphasizing the need to distinguish its key dimensions: emotional resonance, cognitive, and empathic concern. We review and integrate the recent empirical literature on the neurobiological and psychological perspectives to illuminate the significance of empathy-driven care, as well as its shortcomings. As artificial intelligence and other technological innovations such as digital avatars increasingly shape the healthcare landscape, it is vital to ensure that empathy remains integral to clinical practice. This understanding provides important implications for medical training and education.

1. Introduction

Empathy is widely regarded as a desirable and necessary aspect of effective clinical care in both psychology and medicine. Perceived expressions of empathy can leave patients feeling that their doctor is concerned for them, that they are validated and understood (Inzlicht et al., 2024). Yet, in medical contexts, healthcare providers may be perceived as lacking empathy, even when they genuinely experience it, simply because they struggle to express it well. This makes strong communication skills essential—not only for listening attentively and responding to patients' needs, but for expressing empathy in a way that builds trust and therapeutic rapport (Rodríguez-Nogueira et al., 2022; Wu et al., 2022). Despite the importance of empathic communication, however, 64 % of U.S. adults express a wish that healthcare providers take more time to understand them, and 70 % of Americans feel that the healthcare system has failed them in some way (American Academy of Physician Assistants, 2023).

In this paper, we critically review psychological and neurobiological empirical studies that examined the significance of empathy in medicine, focusing on two key domains: 1) its positive impact on patients, and 2) its beneficial effects on healthcare providers, such as promoting resilience and mitigating burnout. We begin by underscoring the multidimensional nature of empathy and its importance in medical practice. We then review research that links patients' perceptions of clinicians' empathy to improvements in both physical and psychological health. Next, we provide empirical evidence on the benefits of

expressing empathy for healthcare providers, highlighting the bidirectional nature of this relationship. Throughout, we integrate findings on the neurological, endocrinological, and psychological mechanisms underpinning these positive effects. We conclude by exploring potential interventions for promoting empathy in healthcare, including the positive role of AI and digital avatars in doctor-patient relationships.

2. The value of empathy in medicine

Empathy is considered essential to clinical practice. However, it is critical to recognize that empathy is not a monolithic construct. It is shaped by various situational factors and encompasses multiple dimensions (Decety, 2015; Gamble et al., 2024; Weisz & Cikara, 2021). Developing effective tools for assessing and fostering empathy in clinical settings and medical education requires a clear definition of this phenomenon. There is a consensus that empathy comprises several inter-related dimensions, each supported by distinct neural circuits which have different functions (Decety & Jackson, 2004) (see Box 1). While empathy is often framed as unambiguously positive, its consequences for patients and providers depend on which dimensions are engaged, and how they are regulated.

Patients consistently value physicians who not only demonstrate technical expertise but also communicate with warmth, respect, and compassion. When patients perceive these humanistic qualities in their doctors and healthcare providers, they feel acknowledged, understood, and cared for, which enhances their overall well-being across a wide

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range of health conditions (Broadbridge et al., 2023; Pozzar et al., 2022). This perception translates into trust in the provider, which fosters greater adherence to treatment plans and enhances patient satisfaction and engagement (Arshad et al., 2024; Derksen et al., 2022; Srivastava et al., 2021).

For clinicians, expressing empathic concern can also be intrinsically rewarding. Compassionate engagement promotes affiliative bonds and triggers positive neurobiological responses, thereby reducing clinician stress and protecting against burnout (Gleichgerrcht & Decety, 2013; Jensen et al., 2020; Rojas et al., 2023). Empathy is also socially contagious. People learn from observing others, and experimental studies have shown that empathy can be socially transmitted interpersonally through observational learning. That is, individuals update their own empathic behaviors by comparing what they observe in others to what they expect from others in similar situations (e.g., Zhou et al., 2024). Indeed, the benefits of empathic concern are particularly salient in healthcare environments that cultivate a *culture* of compassion, reinforcing the emotionally rewarding feedback clinicians experience when they engage in patient-centered care (Salminen-Tuomaala & Seppälä, 2022).

Given the high proportion of patients who report unsatisfactory clinical experiences, alongside the high rates of burnout among healthcare professionals, there is an urgent need to promote effective, sustainable expressions of empathy in medicine. Crucially, this calls for a clear understanding of the specific dimension of empathy at play. As we will discuss in this paper, research suggests that empathic concern, when combined with emotion regulation, can function as a stress-coping mechanism for healthcare providers, thereby mitigating personal distress and enhancing resilience. In contrast, greater emotional empathy—especially in the absence of regulation—is more likely to contribute to empathic distress and burnout.

This knowledge is also essential for guiding interventions and innovative solutions to sustain empathetic interactions in healthcare, especially at a time where recent advancements in artificial intelligence (AI), including chatbots, digital avatars and virtual assistants, have emerged as tools that can facilitate empathic communication in healthcare settings (Karafelis et al., 2024; Xu et al., 2024). By leveraging AI technologies to reduce administrative burden and streamline workflows, healthcare professionals may have more time and cognitive bandwidth to focus on building genuine connections with patients, potentially improving health outcomes and patient satisfaction.

3. Physicians' expressed empathic concern on patient outcomes

Perceiving empathy from physicians has a profound influence on patient outcomes. It can reduce psychological stress, modulate pain perception, enhance endocrine and immune function, and promote patient self-care beyond clinical settings.

Psychological stress, which often accompanies physical illness, can lead to significant systemic harm (Decker et al., 2021). Empathic communication from the physician helps buffer this stress. For instance,

pediatricians who expressed supportive affective verbal and nonverbal communication attenuated parents' cortisol responses, serving as a source of social and emotional support (Gemmiti et al., 2017). In a study of patients with advanced lung cancer, physician communication skills helped mitigate symptom burden for patients with limited understanding of their disease (Chen et al., 2022). Other studies in oncology have shown that clinician behaviors reflecting sensitivity to the clinician-patient relationship, such as attending to and listening to the patient's holistic experiences, are perceived as empathetic by patients (Sanders et al., 2021), which is associated with improved patient outcomes (Lelorain et al., 2023).

Furthermore, such caring clinician attitudes, as perceived by patients, reduce anxiety and emotional distress, and are independent of the clinician's own perceptions (Hoffstädt et al., 2020). This stress-buffering effect extends beyond oncology, as evidenced by a study on diabetes that demonstrated that patient-centered communication, characterized by compassion and respect, was associated with lower levels of diabetes-related distress, even after controlling for disease burden (Peimani et al., 2022). These studies suggest that patient perceptions of clinicians' affective communication and expressed empathy during medical interactions buffer cortisol responses and improve psychological outcomes associated with health conditions.

Clinician-patient interactions perceived as empathic by the patient have analgesic effects, or pain-alleviating effects. Studies show that providing empathetic comments alone to individuals receiving acute nociceptive stimuli attenuates pain intensity reports (Fauchon et al., 2017; Krahé et al., 2013). For instance, in an fMRI hyperscanning study, brain activity was recorded in both chronic pain patients and clinicians who interacted while the patients received nociceptive stimuli (Ellingsen et al., 2023). Results revealed that patients experiencing pain in the presence of a supportive clinician reported a reduction in pain intensity. Additionally, in such supportive contexts, patients were more likely to rate their clinicians as more *accurate* in estimating their pain levels. Importantly, this analgesic effect appears to be contingent on the patient's *perception* of the clinician's effectiveness in expressing empathy, rather than requiring the clinician's emotional empathy response. In a study where participants observed clinicians behaving either empathically or not toward a third party—before later interacting with them in an emotionally neutral manner—researchers found that this prior observation alone was sufficient to modulate participants' pain tolerance (Käthner et al., 2021). This finding suggests that patients' perceptions of clinicians, shaped by observed empathic behavior, influence their own clinical experiences even in the absence of direct emotional engagement. The health benefits of perceived empathy extend well beyond momentary stress reduction or pain relief. Across various clinical contexts, perceiving clinicians' empathy has been linked to tangible improvements in long-term health outcomes. In emergency medicine, patients who experienced life-threatening events were significantly less likely to develop post-traumatic stress symptoms one month later when they perceived their providers as compassionate (Moss et al., 2019). In the management of chronic diseases, these effects

Box 1

Empathy includes three separate but intertwined dimensions:

- **Emotional empathy** refers to the capacity to resonate with another person's emotions, including pain.
- **Cognitive empathy** involves understanding another person's subjective experience from their perspective.
- **Empathic concern** (also known as **compassion** or **sympathy**) refers to recognizing another person's suffering and the motivation to care for and take action to improve their well-being.

Together, these dimensions—resonating, understanding, and caring—are integral to the empathic experience but they can produce different outcomes in clinical practice. Furthermore, **emotion regulation** plays a key role in enabling empathic concern by mitigating negative emotions that can be elicited by emotional resonance.

are even more pronounced. Among patients with type 2 diabetes, greater perceived physician empathy predicted a lower risk of cardiovascular disease events and all-cause mortality over time (Dambha-Miller et al., 2019). Similar patterns have been observed in ulcerative colitis and asthma care, where empathy has been associated with improved physiological markers—such as reduced inflammation—as well as better psychological outcomes, including improved sleep quality and reduced anxiety (Chen, Zhang, et al., 2019; Wu et al., 2020). Even brief empathic exposure in cancer care, such as expressions of reassurance and concern, has been shown to improve patients' psychological outcomes, including greater satisfaction, trust, and self-efficacy, as well as reduced expectations of side-effect intensity (Meijers et al., 2022).

Collectively, these findings demonstrate that perceived empathy is not just a nicety. It is a clinically meaningful factor with wide-ranging effects across various diseases and time frames. Whether by enhancing trust, supporting emotion regulation, or shaping neuroendocrine responses, empathic care appears to contribute to recovery and resilience at both psychological and physiological levels.

Empathic communication from physicians also motivates patients to engage more actively in self-care practices and disease management, which are essential for overall well-being beyond clinical settings. In analyses of online physician-patient interactions, providers who demonstrated empathic concern, acknowledged patients' emotions, and tailored responses to their needs showed higher compliance with medical advice (Lu & Zhang, 2021). In chronic pain consultations, patient-rated physician compassion strongly correlated with patient satisfaction during clinical consultations and treatment adherence, ultimately improving emotional well-being (Walsh et al., 2019). In diabetes management, physicians' empathy score, as rated by their patients on a measure of empathic concern, significantly predicted patient adherence to treatment, and low adherence was strongly associated with greater disease complications (Eltaher et al., 2020).

Overall, there is solid empirical evidence supporting the positive impact of perceived empathic concern on enhancing patient health outcomes. From reducing stress and pain to improving immune markers,

treatment adherence, and long-term outcomes, patients benefit when they feel understood and cared for. Empathic concern, especially when combined with clear communication, can serve as both therapeutic intervention and preventive care. These benefits are not only felt by patients—they reverberate back to providers, reinforcing the clinician-patient bond and supporting the emotional resilience of clinicians themselves. The result is a positive feedback loop that benefits both parties (Fig. 1).

4. Mechanisms underlying the positive impact of perceived empathy

The positive effects of a physician's perceived empathy can largely be explained through the synergy between two distinct but interconnected psychobiological mechanisms: 1) social support, and 2) patients' positive expectations (Decety & Fotopoulou, 2015). Together, this synergy provides an integrative model that highlights how empathic relationships promote healing by enhancing both emotional safety and confidence in the effectiveness of care.

1. **Social support theory** posits that the presence or proximity of others helps individuals conserve somatic and neural metabolic resources by co-regulating emotions (Beckes & Sbarra, 2022). Within this framework, social contexts, particularly those in which individuals perceive supportive cues, enhance the management of both emotional and physiological resources. In clinical settings, a physician who builds trust and provides reassurance helps mitigate the patient's stress response, creating a sense of safety. This, in turn, can improve the patient's subjective well-being by reducing physiological stress through decreased sympathetic nervous system activity and enhanced parasympathetic activity. This autonomic "switch" allows the body to shift from a state of heightened vigilance (the fight-or-flight response) to one of calm. Supporting this, research suggests that positive emotional states characterized by safety and contentment—key dimensions of interpersonal trust—are associated

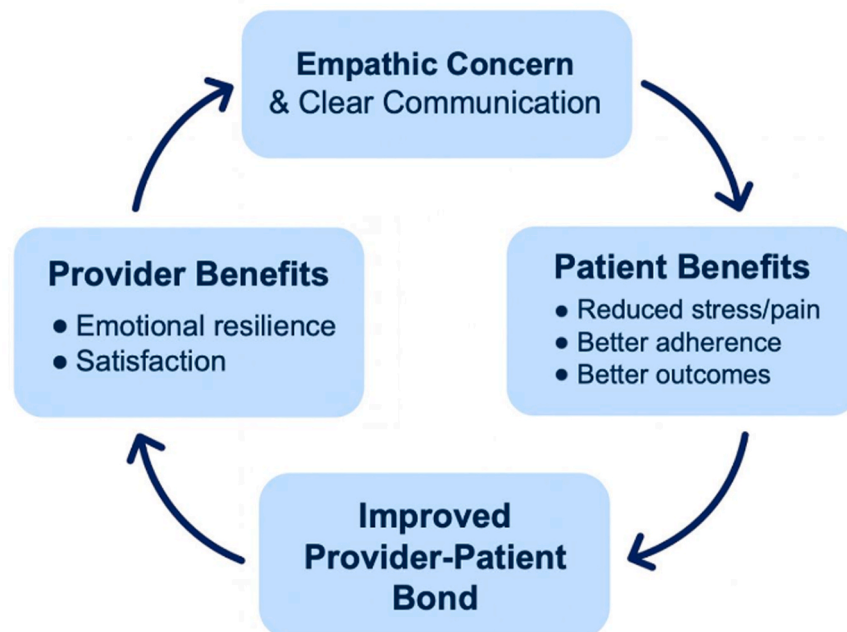


Fig. 1. Empathic concern and clear communication between clinicians and patients can initiate a positive feedback loop. When patients feel understood, validated, and supported, they experience reduced stress, improved treatment adherence, and better health outcomes. These benefits reinforce the provider-patient bond, enhancing providers' emotional resilience and job satisfaction. In turn, this emotional reinforcement empowers clinicians to sustain and deepen their empathic engagement, creating a continuous cycle of mutual benefit and healing.

with increased parasympathetic activity, as reflected in high-frequency heart rate variability (Duarte & Pinto-Gouveia, 2017). The ensuing cascade of physiological changes includes reduced blood pressure (Rodrigues et al., 2021) and a more stable immune response (Sloan & Cole, 2021), which contribute to overall health and healing. Crucially, empathy-rich interactions also promote the release of oxytocin. This neuropeptide plays a crucial role in social bonding, fostering attachment and trust between patients and healthcare providers. The release of oxytocin has potent anti-stress and analgesic effects (Gryksa & Neumann, 2022; Ito et al., 2019), contributing to improved adherence and patient outcomes. The emotional bond it fosters between patients and clinicians reinforces collaboration and treatment engagement, strengthening the therapeutic alliance.

- 2. Positive expectations** shape patients' perceptions and attitudes towards their health and treatment. This relies on the free energy principle, which explains how biological systems maintain order by optimizing the brain's response to environmental changes through a limited set of states (Decety, 2020; Kiverstein, 2020). According to this principle, the brain reduces uncertainty by integrating bottom-up sensory input with top-down expectations through predictive models (Friston, 2010). In clinical contexts, this means that sensory cues—such as eye contact, tone of voice, and warm language—interact with patients' prior experiences and beliefs to shape their expectations of care. Through predictive processing, the brain continuously updates its interpretation of incoming information based on these expectations. As a result, a physician's warmth or confidence can meaningfully shape how patients perceive symptoms, side effects, and overall treatment effectiveness. This mechanism is also supported by classical conditioning, wherein patients implicitly associate effective care with particular contexts, such as a doctor's reputation or the expectation of symptom relief. This appraisal of the treatment context is relevant to both placebo and nocebo effects. For instance, a clinician's belief in a treatment's effectiveness can increase patient responsiveness to therapy, even if the treatment is inert (Piedimonte et al., 2024). On the other hand, communicating potential side effects can increase the likelihood that patients experience them. Empathy helps mitigate this phenomenon. In a study, participants in empathic consultations reported significantly lower expectations of side effects—but only when the physician did **not** mention the side effects—suggesting that empathy can reduce negative expectations under specific conditions (De Brochowski et al., 2023). Key dimensions such as practitioner warmth and competence amplify this buffering effect (Howe et al., 2019).

Moreover, patients' subjective experiences of pain are directly influenced by the providers' expressed expectations of treatment success, demonstrating the power of socially transmitted placebo effects. When clinicians conveyed high expectations of pain relief, patients tended to rate their pain as less intense (Levenig et al., 2024). These effects are biologically grounded. Positive expectations activate specific brainstem nuclei involved in pain control and trigger the endogenous opioid system, including the nucleus accumbens and amygdala, creating feelings of relief and reward that reinforce engagement (Prossin et al., 2022; Sirucek et al., 2021).

Together, the mechanisms of stress-reducing social support and anticipatory positive expectations reduce pain perception, modulate stress response, and foster functional recovery. These processes, rooted in empathy, underscore the powerful role of interpersonal connection in the healing process.

5. Physicians' reaction to their patients' distress

Clinical expertise shapes how healthcare professionals respond to others' suffering. Importantly, research shows that physicians do not need to experience emotional resonance—the unconscious affective

sharing of another's feelings—to provide effective and compassionate care. Instead, they engage distinct neural systems that support perspective-taking, emotion regulation, and caregiving motivation.

Functional neuroimaging studies have consistently documented that physicians and nurses exhibit distinct patterns of neural response when perceiving painful scenarios, compared to individuals who are not healthcare professionals. In a seminal fMRI study, Cheng and her colleagues (2007) compared the neuro-hemodynamic response in a group of physicians and a group of matched control participants while they viewed short video clips depicting hands, faces, and feet being pricked by a needle (painful situations) or being touched by a Q-tip (non-painful situations). Only control participants showed strong activation in brain regions associated with nociception and aversive response during painful situations relative to non-painful ones, including the anterior cingulate cortex (ACC), insula, and periaqueductal gray (PAG). These areas are engaged in threat detection and withdrawal behavior (Lamm et al., 2011; Yamada & Decety, 2009). Furthermore, since this circuit underlies anticipation of aversive events, its activation may be associated with anxiety. In addition to being subjectively unpleasant, anxiety has costs in that it competes for bodily and cognitive resources.

Remarkably, a different pattern of brain activation was detected in the physicians when they perceived the same painful situations (see Fig. 2). Physicians did not show pain-related activity in the ACC and insula. Instead, their responses were characterized by activation in prefrontal regions that underpin executive functions, self-regulation, and top-down attention. Functional connectivity analysis, seeded in the medial prefrontal cortex, showed that increased activity in this region was associated with decreased response in the anterior insula, suggesting top-down modulation of aversive emotional reactions. This pattern reflects physicians' ability to downregulate automatic affective resonance while maintaining attentional engagement and clinical focus.

To examine the neural dynamics of such responses to painful stimuli with better temporal resolution, a follow-up study (Decety et al., 2010) recorded event-related potentials (ERPs) from physicians and matched controls as they were presented with the same visual stimuli (a needle vs. a Q-tip). Control participants showed an early N110 (a response that peaks 110 ms after stimulus onset) differentiation between pain and no pain, reflecting negative arousal over the prefrontal cortex, as well as late P3 components over centro-parietal regions. In contrast, no such early ERP response was detected in the physician sample, indicating that affect regulation has very early effects and inhibits bottom-up processing of negative arousal arising from the perception of painful stimuli.

Another fMRI study examined the influence of social context on medical practitioners' empathic responses by exposing 100 female nurses to stimuli depicting somatic pain, framed as occurring in a hospital or at home (Cheng et al., 2017). Nurses with longer hospital terms evaluated pain as less negative in terms of valence and intensity when it occurred in a hospital context, but not in a home context. Somatic pain perceived in a hospital compared to a home context produced stronger activity in the right temporoparietal junction (rTPJ), which supports the engagement of cognitive empathy and self-other distinction. The reverse comparison resulted in increased activity in the insula and anterior cingulate cortex, two regions involved in the affective processing of pain-related stimuli, both for self and vicarious pain (Valentini, 2010). Nurses with higher dispositional emotional empathy were more prone to emotional exhaustion, which was associated with lower activation in the right rTPJ (Tei et al., 2014).

Functional neuroimaging evidence also shows that clinicians who regularly engage in caregiving exhibit less personal distress and more prosocial behavior. For example, compared to control participants, nurses provided more help to those in need while experiencing less personal distress related to the suffering of others (Coll et al., 2017). The nurses' neuroimaging data also indicate a different response pattern compared to control participants, especially greater activation in the dorsolateral prefrontal cortex, a region that plays a key role in emotional regulation (Zhang et al., 2025).

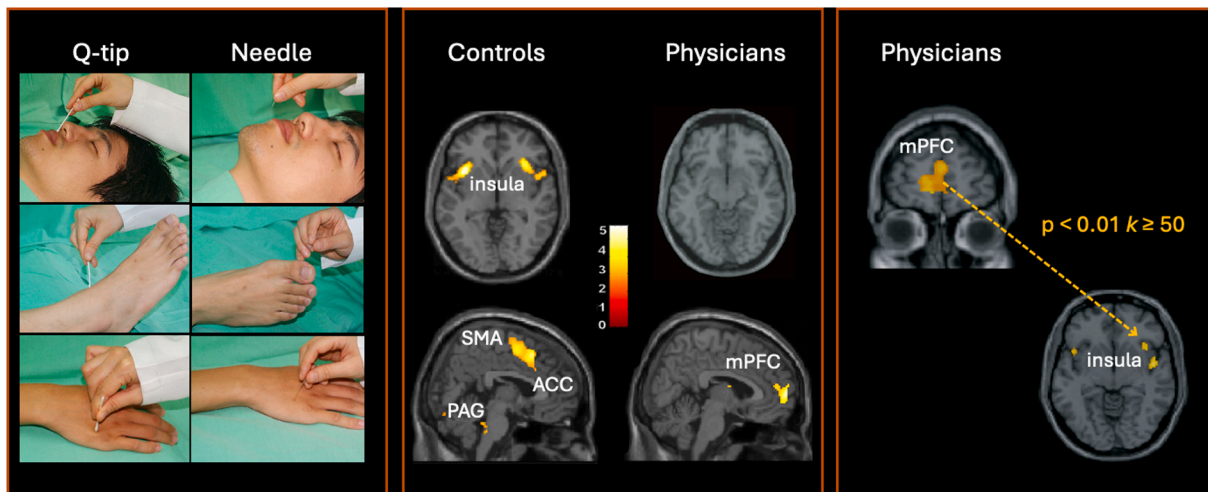


Fig. 2. Differential neural response in controls and physicians when they were presented with stimuli depicting body parts being touched by a Q-tip (no-pain) versus being pricked by a needle (pain). The perception of pain was associated with increased activity in the anterior cingulate cortex (ACC), insula, and periaqueductal gray (PAG) in control participants only. In physicians, increased activity was detected in the lateral and medial prefrontal cortex (mPFC). Functional connectivity analysis further demonstrated that physicians differed from the controls in how activity in the mPFC covaried with the response in the insula ($p < 0.01$). Adapted with permission from Cheng et al., 2007.

The effects of clinical expertise are especially pronounced when perceptual cues are ambiguous. A study examining how pediatric nurses evaluate infant pain from pre-recorded videos found that those nurses, compared to control participants, have significantly reduced activation in the brain regions involved in emotional empathy, including the anterior insula and anterior cingulate cortex (Jackson et al., 2017). Their estimate of the pain intensity perceived from the infant videos was higher than that of the control participants. This result is even stronger for low-intensity pain expressions, highlighting how clinical expertise supports empathic accuracy without over-emotional arousal.

A few functional neuroimaging studies have directly examined the neurobiology of caregiving in action. One fMRI study investigated physicians' neural responses during patient-physician interaction while the patient was experiencing pain, including a treatment and a no-treatment condition (Jensen et al., 2014). Physicians activated brain regions previously implicated in expectancy for pain relief and increased top-down attention during the treatment of patients, including the right ventrolateral and dorsolateral prefrontal cortices. Importantly, physicians' ability to adopt the patients' perspective was associated with increased brain activity in the ventral striatum and ventromedial prefrontal cortex, regions involved in the processing of reward and

subjective value. These data suggest that physician treatment involves neural representations of treatment expectation, reward processing, and empathy, paired with increased activation in attention-related structures. These brain regions are central to reward processing and dopamine release, which may reflect the motivational satisfaction physicians feel from helping their patients. In essence, medical expertise appears to enhance emotional regulation, down-regulating sensory processing in response to perceived pain. This insight underscores the importance of developing strategies to help healthcare professionals assess and manage their emotional reactions, ensuring that empathetic care remains balanced, sustainable, and supportive of both patients and providers.

Expressing empathic concern enables physicians to foster human connection, evoke positive emotions, and build resilience, thereby maintaining their well-being despite stressors such as witnessing suffering. Compassion and reward-related neural activations play a vital role in effective doctor-patient interactions. In an fMRI study, physicians were scanned while interacting face-to-face with a patient (Fig. 3). Physicians exhibited greater brain activation in areas related to reward processing, particularly the striatum and ventromedial prefrontal cortex, during treatment tasks (Jensen et al., 2020). Patients rated their

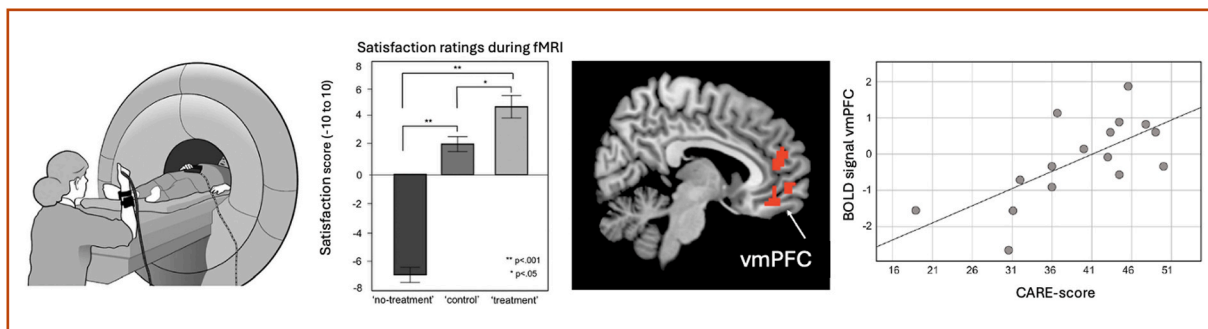


Fig. 3. In this study, physicians' brain activity was measured using functional MRI while performing a treatment task that involved the use of an analgesic device to alleviate a patient's pain outside the scanner. The physicians also rated their empathic concern (equivalent compassion) and personal distress before the scanning session. The patient's rating of CARE, a standardized protocol assessing a clinician's social interaction during a consultation, was robustly related to the physicians' ratings of trait empathic concern and to compassion-related, as well as reward-related activation of ventromedial prefrontal cortex (vmPFC) during treatment. In contrast, there was no relation with physicians' distress, nor with activation in regions associated with the aversive component of experiencing emotional empathy. A patient's positive experience of a medical examination is reflected in doctors' empathic concern and reward-related brain activations during treatment. Adapted with permission from Jensen et al., 2020.

perception of clinicians' relational empathy and communication skills more positively when these brain areas were activated in the physician, suggesting that doctors who are perceived to express compassion and derive intrinsic satisfaction from caregiving tend to create better patient experiences. Doctors' personal distress levels did not correlate with successful patient interactions, emphasizing that compassionate concern, rather than emotional distress, is more important for clinical effectiveness. The activation of the reward circuitry during treatment may reflect a motivational aspect of relieving the patient's pain, similar to the suggestions by Decety and Porges (2011), who found increased involvement of the striatum and ventromedial prefrontal cortex when participants were imagining relieving the suffering of others compared to passively watching them in physical pain.

Taken together, functional neuroimaging studies with medical practitioners underscore the role of medical expertise in modulating pain perception and its central function in downregulating vicarious responses to suffering. These findings also demonstrate that physicians engage neural circuits associated with pain-reliant expectancy and reward processing during the treatment of patients. Importantly, physicians and nurses do not need to *share* a patient's affective and sensory experience to practice compassionate care. Excessive emotional empathy can be a source of personal distress and be detrimental to clinical effectiveness and well-being. Instead, the ability to regulate and suppress aversive responses to vicarious pain, while simultaneously expressing compassion and deriving reward from patient care, serves as a protective mechanism against burnout.

6. The importance of emotion regulation

Prolonged exposure to the suffering of others can have detrimental effects on mental health. This is particularly evident in the elevated stress levels and high rates of burnout reported among health professionals who are frequently exposed to the suffering of patients (Edú-Valsania et al., 2022; Figley, 2012). Effective emotion regulation strategies are therefore essential for managing the psychological impact of witnessing suffering and maintaining professional well-being.

Across studies in developmental psychology, clinical neuroscience, and personality psychology, emotion regulation has been theorized to facilitate empathic concern (or compassion) by mitigating the negative emotions elicited by others' distress (Decety & Lamm, 2009; Thompson et al., 2019). Emotion regulation, whether relying on explicit or implicit reappraisal strategies, modifies (decreases, maintains, or increases) one's emotional reactions in accordance with an adaptive response, allowing the person to shift their focus and cognitive resources from the self to others in challenging social situations, such as in clinical practice. People who empathize tend to engage in increased other-focused regulation when experiencing empathy concern (Geiger et al., 2025).

A meta-analytic review, comprising 58 studies (75 effect sizes, $N = 25,831$) across various ages and cultures, examined the associations between emotion regulation and emotional empathy, as well as empathic concern (Yavuz et al., 2024). The results show that higher emotion regulation is associated with greater empathic concern (sympathy and compassion) for other individuals in need, but not with more emotional empathy or affective resonance. This finding reinforces the idea that emotion regulation facilitates constructive, prosocial responses to distress rather than intensifying one's own emotional overwhelm. Regulation makes empathic concern sustainable.

Neuroscience research supports the neural separability between emotional empathy and empathic concern. The perception of pain in others recruits brain areas involved in the affective and motivational processing of firsthand experience of pain. This vicarious experience is accompanied by overlapping neural representations within specific regions of the somatosensory, cingulate, and insular cortices (Jackson et al., 2006; Lamm et al., 2011; Rütgen et al., 2015). While this neural overlap allows for a visceral understanding of others' pain, it can also trigger personal distress and contribute to burnout when chronically

exposed to suffering. In one study, participants listened to true biographies describing human suffering while undergoing fMRI scanning. They showed that moment-to-moment experienced distress was associated with increased activity in the somatosensory cortex, whereas experiencing empathic concern was linked to activation in the ventromedial prefrontal cortex and ventral striatum—regions involved in reward and affiliation (Ashar et al., 2017). Only the latter neural activity predicted participants' post-scan prosocial decisions (actual donations from the participants to charities). This study demonstrates that distinct neural systems support emotional distress and empathic concern, leading to different behavioral outcomes. In particular, empathic concern and prosocial behavior are associated with ventromedial prefrontal-striatal systems supporting reward, valuation, and affiliation (Decety et al., 2016; FeldmanHall et al., 2015).

Not only does emotion regulation support the expression of empathy, but it also protects the clinicians themselves. Medical students and physicians with high levels of dispositional empathic concern are less likely to experience burnout and compassion fatigue (Brazeau et al., 2010; Gleichgerrcht & Decety, 2013, 2014). Empathic concern is associated with greater compassion satisfaction and inversely related to emotional exhaustion and distress (Delgado et al., 2023; Lamothe et al., 2014). Importantly, prosocial behavior also acts as a buffer against the psychological and metabolic costs of stress, in part by promoting the release of oxytocin and increasing dopaminergic activity in the brain's reward circuitry (Marsh et al., 2021; Raposa et al., 2016). In this way, caregiving behaviors become self-reinforcing rather than draining (Fig. 4).

One common strategy for managing burnout is emotional avoidance. Healthcare providers may attempt to protect themselves by distancing from negative emotional experiences. Yet, research suggests that avoidance strategies yield only modest effects (Costa et al., 2022). In contrast, studies show that acting with compassion not only benefits others but enhances the well-being of caregivers themselves (Klimecki et al., 2012). In fact, high levels of burnout are associated with *reduced* activation in brain areas related to compassion (Gleichgerrcht & Decety, 2013; Lamothe et al., 2014; Tei et al., 2014). Avoidance may temporarily suppress suffering, but compassion transforms it. As discussed above, engaging in meaningful, prosocial acts—such as relieving another's distress—activates reward-related brain regions and triggers the release of endogenous opioids. This produces a sense of satisfaction and reinforces caregiving behaviors over time. Compassionate engagement fosters human connection, evokes positive emotions, and builds resilience, empowering providers to remain present even in challenging circumstances.

Evidence from compassion training interventions further supports this link. Programs that cultivate compassion have been associated with reduced markers of systemic inflammation, lower psychological distress, and strengthened brain networks related to positive emotion and affiliation (Jazaieri et al., 2014; Weng et al., 2018). These findings suggest that compassion is not just a trait—it is a skill that can be practiced, enhanced, and neurologically reinforced.

Given the central role of emotion regulation in transforming distress into sustainable care, it is vital that clinicians receive training not only in empathic communication but also in emotional self-regulation. Equipping medical professionals with tools to navigate their own emotional experiences can help preserve their capacity to provide high-quality care while supporting their own well-being.

7. Use of artificial intelligence and avatars in healthcare

Empathic concern and trust are core values of patient-centered healthcare. However, the growing emphasis on economic efficiency in the healthcare sector has often sidelined these values, making it challenging for healthcare professionals to integrate them into daily practice. Artificial intelligence (AI) is increasingly being adopted to enhance efficiency and reduce administrative burdens, potentially allowing

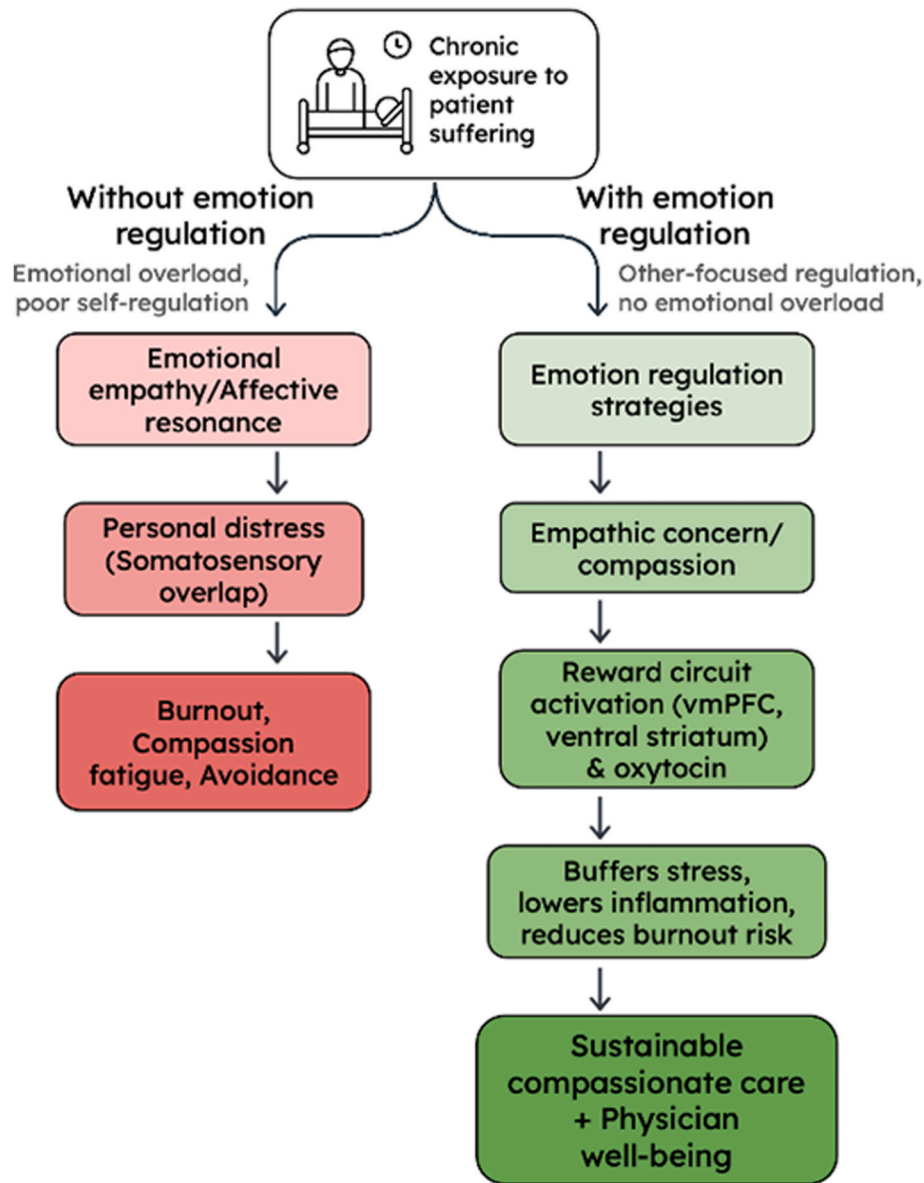


Fig. 4. *Emotion regulation promotes resilience and sustainable care in clinicians.* Chronic exposure to patient suffering can lead to divergent outcomes depending on whether clinicians engage in effective emotion regulation. Without regulation, emotional overload and affective resonance contribute to personal distress and burnout. In contrast, emotion regulation enables empathic concern without emotional overload, activating neural reward circuits and buffering against stress. This protective pathway supports the long-term well-being of physicians and the delivery of sustainable, compassionate care.

healthcare providers to dedicate more time to patient engagement and trust-building (Kerasidou, 2020). AI-generated doctors’ notes are transforming healthcare by improving accuracy, reducing workload, and enabling physicians to focus on meaningful patient interactions.

There is growing enthusiasm that AI has the potential to enhance various aspects of healthcare, from diagnostics to treatment (Bohr & Memarzadeh, 2020). Research documents that as people have more positive experiences with AI, they become increasingly receptive to interacting with these systems and seeking their advice (Nadarzynski et al., 2019; Pataranutaporn et al., 2023). Notably, patients may feel more comfortable discussing mental health issues with AI-driven chatbots than with human therapists, mainly due to a reduced fear of judgment (Manole et al., 2025; Chaudhry & Debi, 2024). This suggests that AI could serve as a valuable initial point of contact for individuals seeking mental health support. One key factor driving self-disclosure to chatbots is attributable to their perceived conversational breadth and depth. A 12-week longitudinal study found that people were not only

willing to disclose emotionally charged topics but also to engage in personal discussions about daily tasks, which were perceived as deeply conversational (Skjuve et al., 2023). Over time, participants reported increasing engagement with chatbots. Furthermore, concerns about the risks of self-disclosure (e.g., fear of negative consequences following candid chatbot interactions) diminished, while the perceived benefits of AI interactions — such as feeling heard and supported — grew. These findings highlight that AI-driven empathic interactions can be both effective and cost-efficient, potentially improving treatment outcomes by fostering a sense of connection. AI may thus enhance patient engagement and adherence to treatment, ultimately strengthening the therapeutic process.

AI-powered avatar technology has evolved over the past few decades to become increasingly realistic, which has led to valuable applications in medicine, including cognitive behavioral therapy (Yeo et al., 2024). Interestingly, an exact congruence between digital avatars and patients’ affective states is not necessary to perceive empathy from the avatars. A

study presented participants with digital health professionals exhibiting various postures, gaze directions, and facial expressions, including those conveying pain and sadness (Marcoux et al., 2024). The study participants were explicitly instructed to adopt the perspective of a patient in pain (“Imagine that *you* are the patient in pain, and the avatar reacts to you directly”). Perceived empathy from participants acting as analog patients in pain was significantly higher for facial expressions of sadness than of pain. Perceived similarity measures between participants and avatars were not correlated with perceived empathy. Avatars adopting a direct gaze and a forward-leaning posture heightened the perception of empathy for low-intensity and moderate-intensity sad facial expressions. In addition, the expression of empathy by avatars appears to be influenced by their gender. In one study, participants watched digital avatars—two male and two female—exhibiting a variety of nonverbal behaviors and were then asked to rate their perceived empathy (Laverdière et al., 2020). Results indicate that female avatars were perceived as significantly more empathetic, aligning with gender stereotypes. People generally prefer interacting with female bots and female avatars, as they are perceived as more human than their male counterparts (Borau et al., 2021). These preliminary findings demonstrate the relevance of specific nonverbal cues that digital avatars can emulate to be perceived as empathetic, offering valuable insights for improving virtual platforms and advancing our understanding of human-machine empathic interactions.

Initial randomized studies suggest that large language models, such as ChatGPT, surpass doctors in both the quality and empathy of their responses to patient inquiries (Ayers et al., 2023). Integrating AI into chatbots can enhance their conversational abilities and personality traits, enabling more human-like interactions with patients. AI systems that deliver empathetic responses significantly improve patient satisfaction, which in turn, may promote adherence to treatment plans (Yonatan-Leus & Brukner, 2024). Additionally, fine-tuning chatbots with specialized medical datasets can enhance their contextual understanding, resulting in highly accurate responses and improved patient outcomes. For instance, training AI with domain-specific language has been shown to improve diagnostic accuracy across various medical fields (Akhondi-Asl et al., 2024; Krašniković et al., 2025).

As AI continues to integrate into healthcare, patient attitudes toward this technology are evolving. Many patients express pleasant surprise at AI’s capabilities and demonstrate a growing willingness to use AI for mental healthcare (Moriuchi, 2022). Notably, the perceived competence of AI-powered medical avatars plays a key role in shaping patients’ willingness to adopt these tools.

Research on AI-based conversational agents, including chatbots, voicebots, and anthropomorphic digital avatars, suggests that avatar-based agents achieve higher user acceptance and compliance than other formats (Anisha et al., 2024; Stock et al., 2023). A comparative study found that human-like interactions, particularly those involving doctor avatars, have a positive influence on individuals’ intentions to engage with AI-driven healthcare services (Sestino & D’Angelo, 2023). This effect is strongly linked to the empathetic attributes associated with anthropomorphism, particularly among individuals with greater emotional receptivity. Social responses from anthropomorphic digital avatars enhance users’ perceptions of self-disclosure tendency, personalization, and overall satisfaction (Zhang & Rau, 2022). Additionally, anthropomorphic avatars portraying patients have been shown to help healthcare providers improve their communication skills, further underscoring the importance of emotional connections in healthcare delivery (Xu et al., 2024).

The rapid advancement of AI-powered technologies highlights the need to educate both physicians and patients about their potential applications in healthcare. As these technologies continue to evolve, a nuanced understanding of their capabilities and limitations will be essential for their responsible and effective integration into clinical practice. Empirical research on empathic virtual agents and social robots can be significantly enhanced by drawing on theoretical frameworks

that illuminate the key dimensions of human empathy, a product of millions of years of evolution (Decety, 2011).

8. Conclusion

Throughout history, doctor-patient relationships have been recognized as having a significant therapeutic effect, beyond that of prescribed drugs and other treatments. Although numerous factors influence patients’ enablement, perceptions of their doctors’ empathy and caring attitude are of key importance in improving outcomes in clinical practice. Over the past decades, numerous studies have contributed to a better understanding of the psychological and neurobiological mechanisms underlying clinical empathy. As healthcare continues to evolve, fostering empathic concern and emotional regulation within clinical practice is essential for optimizing both patient care and clinician satisfaction, ultimately leading to better health outcomes across diverse medical practices and specialties. Importantly, expressing empathy in clinical practice does not require medical professionals to experience vicarious negative emotions. Physicians and clinicians do not need to resonate with their patients’ suffering to be perceived as effective and empathetic. On the contrary, those with strong emotion regulation skills are more likely to convey concern and compassion, while also being less vulnerable to burnout and emotional exhaustion.

Healthcare practices have sometimes prioritized technical efficiency over human values. However, the advent of artificial intelligence offers a unique opportunity to reconcile these priorities. AI technologies, such as chatbots and virtual agents, have shown promise in enhancing the quality of patient interactions by providing timely, empathetic responses that foster trust and support.

Emerging research indicates that patients are increasingly accepting AI-driven solutions, often disclosing sensitive information more readily to virtual agents than to human providers. This trend suggests that AI can complement, rather than replace, the human factor in healthcare, freeing professionals to focus on direct patient care. Additionally, studies indicate that the effectiveness of AI in healthcare improves when it incorporates anthropomorphic design and demonstrates empathy. This approach leads to higher user satisfaction and better treatment adherence.

An integration of knowledge from the biological sciences, social sciences, and humanities has the potential to improve patient care and provide evidence-based training interventions for medical students and health professionals in general.

CRedit authorship contribution statement

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AI tools were not used in the preparation of this manuscript.

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All papers reviewed are accessible upon request to the corresponding author.

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