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REVIEW ARTICLE

Treatment of military-related post-traumatic stress disorder: challenges, innovations, and the way forward

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ABSTRACT

Post-traumatic stress disorder (PTSD) is one of the common mental disorders in military and veteran populations. Considerable research and clinical opinion has been focused on understanding the relationship between PTSD and military service and the implications for prevention, treatment, and management. This paper examines factors associated with the development of PTSD in this population, considers issues relating to engagement in treatment, and discusses the empirical support for best practice evidence-based treatment. The paper goes on to explore the challenges in those areas, with particular reference to treatment engagement and barriers to care, as well as treatment non-response. The final section addresses innovative solutions to these challenges through improvements in agreed terminology and definitions, strategies to increase engagement, early identification approaches, understanding predictors of treatment outcome, and innovations in treatment. Treatment innovations include enhancing existing treatments, emerging non-trauma-focused interventions, novel pharmacotherapy, personalized medicine approaches, advancing functional outcomes, family intervention and support, and attention to physical health.

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PTSD; military; veteran; treatment; trauma

Post-traumatic stress disorder in veteran and military populations

Post-traumatic stress disorder (PTSD) is one of the common mental disorders in military and veteran populations (Magruder & Yeager, 2009; Williamson, Stevelink, Greenberg, & Greenberg, 2018; Wisco et al., 2014). (The term 'veteran' has several meanings in different contexts. Sometimes, for example, it refers to anyone who has left the military, regardless of their combat experiences and deployment history, while at other times it refers to anyone who has completed an operational deployment, regardless of whether he/she is still serving. We recognize that this causes confusion in the research literature and have tried, where

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relevant, to differentiate the two.) While the disorder can present in mild forms, PTSD can often become a chronic disorder resulting in substantial functional impairment and reduced quality-of-life (Australian Centre for Posttraumatic Mental Health, 2013; Bruffaerts et al., 2012; Schnurr, Lunney, Bovin, & Marx, 2009). The Diagnostic and Statistical Manual of Mental Disorder 5th Edition (DSM-5) describes PTSD as having four symptom clusters: (1) re-experiencing the traumatic event, including recurring intrusive memories, flashbacks, or dreams of the trauma; (2) intentional avoidance of traumatic memory triggers; (3) changes in mood and/or thoughts, such as feelings of anxiety, sadness, shame or anger, negative thoughts about the self or others, or emotional numbing; and (4) hyperarousal in the form of irritability, hypervigilance, and trouble with concentration and sleep (American Psychiatric Association, 2013). The ICD-11 PTSD criteria are somewhat simpler and focus on the three symptom clusters of re-experiencing, active avoidance, and hyperarousal (Maercker et al., 2013). The DSM-5 also introduced a dissociative sub-type characterized by high levels of either depersonalization or derealization.

PTSD is not unique to military and veteran populations. Veteran populations, however, are characterized by several factors that may influence the development and nature of the disorder. In addition to the risk of exposure to the trauma of war, for example, adverse childhood experiences prior to joining the military (a risk factor for the development of later mental health problems) are reported at increased rates among those who have served in the military (Blosnich, Dichter, Cerulli, Batten, & Bossarte, 2014). Transition to and from military life creates many adjustment challenges, potentially disrupting identity and increasing risk for development of mental health problems. Military populations report higher rates of musculoskeletal conditions and chronic pain than civilian controls, and chronic physical disorders have been shown to precede depression and anxiety in many cases (Andersen, Wade, Possemato, & Ouimette, 2010; Thompson et al., 2016). This combination of mental and physical health conditions has a synergistic effect on functional impairment (especially in military roles) which, in turn, may significantly contribute to worsening of mental health problems in veterans (Thompson et al., 2015).

Taken together, those factors represent a unique risk profile for the development of mental health problems among military and veteran populations. Once problems develop, cultural factors may affect the person's willingness to acknowledge mental health issues, as well as how those problems are expressed (Sharp et al., 2015), highlighting the need for specialized understanding among practitioners about military service and the need to build trust with veterans in clinical settings. Those factors, of course, may also adversely affect engagement in, and response to, treatment. Without effective engagement, individuals with PTSD (whether military or civilian) are at risk of a chronic course and long duration of illness with significant negative consequences for themselves and their families. Regrettably, a detailed discussion of the impact on families is beyond the scope of this paper. Suffice to say at this point, however, that it is of the utmost importance to actively support families—both in their own right and as part of PTSD recovery for the service member (Fear et al., 2018).

Trauma exposure and prevalence of PTSD in military and veteran populations

Military-related PTSD can be the result of a diverse range of operational experiences including combat, peacekeeping, and humanitarian deployments, as well as non-deployment trauma. Traumatic exposures may include direct threat to the self or others, or witnessing significant human suffering and being prevented through rules of engagement from intervening to protect non-combatants. Many of these scenarios are characterized by moral ambiguity and complexity. There is increasing recognition of moral injury—the psychological, social, and spiritual impacts of exposure to traumatic events that transgress deeply held moral beliefs (Litz et al., 2009) or involve betrayal of 'what's right' (Shay, 2014). These exposures can occur repeatedly against a background of long periods spent in demanding operational contexts, high levels of threat, and hostile physical environments.

Military personnel operating in a combat role have an increased likelihood of developing PTSD (Prigerson, Maciejewski, & Rosenheck, 2001). However, not all military trauma is deployment related. Non-deployment stressors are part of everyday military life, including realistic training exercises conducted under extreme conditions, often with dangerous machinery and live ammunition, in order to prepare them for their roles in operational environments. Military sexual trauma (MST), which affects both men and women (although proportionately more women), is associated with increased risk of PTSD as well as other comorbidities (Kimerling et al.,

2010; Wilson, 2018). Inevitably, as a military career progresses, there is increased likelihood of experiencing multiple potentially traumatic events, putting individuals at greater risk of the effects of cumulative trauma exposures. A more sophisticated understanding of trauma exposures in military experiences beyond the warzone has been influential in informing treatment approaches to military-related PTSD.

Estimates of PTSD prevalence in veteran populations vary widely, depending, for example, on the era, the percentage of those who deployed, and the specific nature of the deployment. For the veteran population as a whole (i.e. across cohorts and including both deployed and non-deployed), the best estimates are usually around 8% lifetime and 5% current PTSD (Wisco et al., 2014). These prevalence rates are comparable to, or slightly higher than, those for civilian populations (Chapman et al., 2012; Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012; Woodhead et al., 2011). Specific deployments, however, can be associated with substantially higher rates, with estimates of lifetime PTSD prevalence varying up to 35% (O'Toole, Catts, Outram, Pierse, & Cockburn, 2009; Xue et al., 2015). Experiences on deployment, such as increased combat exposure, fear of being killed or seriously injured, discharging a weapon, and witnessing someone being wounded or killed, substantially increase the risk for PTSD (Xue et al., 2015). PTSD prevalence in military and veteran populations also varies across nations, a function of factors such as trauma-related exposure, deployment length, and rank (Kok, Herrell, Thomas, & Hoge, 2012; Sundin et al., 2014), as well as methodological variations in sampling strategy and psychometrics (Creamer & Forbes, 2004; Rischardson, Frueh, & Acierno, 2010; Sundin, Fear, Iversen, Rona, & Wessely, 2010). (We have avoided providing comparisons across nations due to interpretational challenges.)

Somewhat counterintuitively, PTSD prevalence is usually higher in ex-service populations than in currently serving cohorts (Stevelink et al., 2018; Van Hooff et al., 2018): since veterans are no longer exposed to military stressors, and should benefit from the effects of a natural recovery process, one might expect PTSD rates to be lower in veterans. The explanation may lie in the additional stress faced by veterans as they swap the structure and security of the military for civilian life (e.g. finding jobs and accommodation, budgeting, and forming civilian relationships), which may provide time and space for past experiences (including traumatic events) to dominate consciousness. It may also be that personnel who develop substantial PTSD symptomology in service are more likely to leave, resulting in higher rates of PTSD in the ex-service population. Research has also explored PTSD prevalence in specific military and veteran sub-populations, including peacekeepers (Souza et al., 2011) and military personnel (particularly women) who have experienced MST (Kimerling et al., 2010), with results showing significant levels of PTSD, even in the absence of combat exposure.

Notwithstanding the heterogeneity in PTSD prevalence research, there is sufficient consistency to conclude that, in the majority of Western countries: (a) PTSD remains one of the common mental disorders in both military and veteran populations; (b) PTSD rates increase in proportion to potentially traumatic event exposure (including combat); and (c) prevalence is higher among discharged veterans than among active duty military.

Questions of causality: risk indicators and risk factors for military-related PTSD

Risk factors are antecedents that contribute causally to the condition of interest, in this case PTSD, while risk indicators are characteristics of sub-groups in whom the condition of interest is more common but where evidence of causality remains uncertain (American Psychiatric Association, 2013). PTSD appears to arise in individuals owing to the interaction of multiple causal risk factors. While numerous risk indicators have been identified, PTSD causality is not yet fully explained. Exposure to a traumatic event is required as part of the diagnostic criteria for PTSD. Yet, while PTSD is a common cause of morbidity in military and veteran populations, the majority of those exposed to potentially traumatic events do not develop PTSD. Thus, exposure to a traumatic event is a necessary but not sufficient risk factor in understanding individual risk for developing PTSD. The onset of PTSD is influenced by a complex interaction of biological, cognitive, and psychosocial factors across various time points. Research suggests that, as with civilians, a whole life approach to understanding risk for PTSD is required, since risk indicators have been identified in pre-trauma, peri-trauma, and post-trauma time periods (Brewin, Andrews, & Valentine, 2000). The person's stage of life and developmental tasks at the time of trauma exposures and recovery feed into this complex mix. In addition, the risk factors for the development of PTSD are not necessarily the same as the risk factors for chronicity (Schnurr, Lunney, & Sengupta, 2004).

Commonly cited pre-trauma risk indicators in military and veteran populations include age, gender, race, education, and military status (Jones et al., 2013; Xue et al., 2015). Research has consistently shown that childhood trauma is a significant risk factor for later development of PTSD and, as noted above, military and veteran populations are more likely to report adverse childhood experiences. Sleep problems are also associated with, or potentially an early marker for, development of PTSD both at pre- and post-deployment (Gehrman et al., 2013; Wang et al., 2018).

Aspects of military service independent of deployment may influence the risk of developing PTSD, with factors such as service branch, rank, quality of leadership, social support, and unit cohesion proving relevant (Anderson et al. 2019; Jones et al., 2012; Wright, Kelsall, Sim, Clarke, & Creamer, 2013). Similarly, historical overviews addressing the issue of combat motivation and breakdown suggest that broader consideration should be given to the influence of the group and the key social connections between serving personnel as an important moderator of vulnerability within the military and following discharge (Janowitz & Shils, 1948; Wessely, 2006). Wessely argues that risk of psychological injury increases when the primary relationships of small fighting units are poor or fractured, or the unit is rendered ineffective, and individuals become isolated and lose their sense of connection to a powerful group. This possibility is supported by social network analyses in civilian contexts that fractured social networks following trauma increases risk for PTSD (Bryant et al., 2016). Indeed, given that unit cohesion and leadership are integral to occupational health in the military (Adler & Castro, 2013), they provide a potential avenue for reducing the risk of PTSD and enhancing adjustment following exposure to potentially traumatic events.

Trauma related risk factors in military and veteran populations include the extent of exposures, length of deployments, time between deployments, and (in most cases) the number of deployments (Bliese, Thomas, McGurk, McBride, & Castro, 2011; Rona et al., 2014), mirroring civilian research indicating the cumulative risk effects of repeated trauma exposure. Post-trauma risk factors include concurrent and subsequent life stressors and post-deployment support, both within and outside the military environment. This is particularly critical during the adaptation period during transition to civilian life.

PTSD is often associated with other health problems. Comorbidity of psychiatric disorders is common, particularly depression, anxiety disorders, and substance use disorders, with co-morbidity more the rule than the exception (Head et al., 2016; Smith, Goldstein, & Grant, 2016). Chronic physical health conditions, medically unexplained somatic symptoms, and chronic pain also are recognized PTSD risk indicators (NICE, 2018). However, the nature and direction of causal relationships between PTSD and physical health status remain largely unexplored (Gautam, Jain, Gautam, Vahia, & Grover, 2017; McFarlane, Lawrence-Wood, Van Hooff, Malhi, & Yehuda, 2017). Suicidal ideation and attempts, although not exclusively related to PTSD, have also been the focus of considerable attention in recent years (Naifeh et al., 2019; Naifeh et al., 2018). Significant functional impairment is common in the form of problematic relationships, reduced social networks, and poorer employment outcomes (Rona et al., 2009; Schnurr et al., 2009).

The current status of PTSD treatments

Earlier international PTSD treatment guidelines consistently found trauma-focused cognitive behavioural therapies, such as Cognitive Processing Therapy (CPT), Prolonged Exposure (PE), and Eye-Movement Desensitization and Reprocessing (EMDR) to be the gold standard for treatment (Australian Centre for Posttraumatic Mental Health, 2013). More recent guidelines expand the number of treatments with high levels of evidence. For example, the guideline jointly developed by the Department of Veterans Affairs and the Department of Defense (2017) in the US gave the strongest recommendation to trauma-focused psychotherapies such as PE, CPT, and EMDR, but also included a range of additional therapies in this recommendation (e.g. written narrative exposure, Brief Eclectic Therapy). The recent update of the UK National Institute for Clinical Excellence (NICE) PTSD Guideline differs slightly in endorsing PE and CPT with the strongest recommendations, but giving a slightly lower rating to EMDR specifically in relation to military veterans who have been traumatized as a result of combat, in view of the more limited evidence base for EMDR in this population (NICE, 2018). Taken together, the consistent findings across several guidelines from different countries recommend that trauma-focused psychological interventions should be the first line of treatment for PTSD.

PTSD guidelines and meta-analyses (e.g., Jones, Burdett, Green, & Greenberg, 2017; Lee et al., 2016) have generally reported smaller clinical effects in

pharmacotherapy than trauma-focused interventions. Increasing attention, however, is now being paid to the methodologies of studies included in those reviews. For example, the meta-analysis of these comparisons by Lee et al. (2016), while supporting the use of trauma focused interventions as first line, recommended the need for more direct head-to-head research with specific agents, as well as the need to prioritize studies utilizing active controls instead of waitlist or treatment-as-usual conditions (Lee et al., 2016). Consistent with this, new evidence indicating little difference between sertraline plus enhanced medication management, PE plus placebo, and PE plus sertraline (Rauch et al., 2019) suggests that, as the direct comparison evidence base confirms, more nuanced recommendations will emerge. Despite this, all current guidelines continue to emphasize the role of medication and recommend its use, where indicated, in stabilization or where first-line treatments are not available, not acceptable, or have not worked.

The intensive treatment outcome research efforts in recent years, using high-quality randomized controlled trials, is commendable. Regrettably, however, research suggests that military and veteran populations experience more modest treatment outcomes than civilians, with around two-thirds retaining their PTSD diagnosis after treatment with CPT or PE (Steenkamp, Litz, Hoge, & Marmar, 2015). In view of these modest outcomes, modifications to standardized treatment may be required in clinical practice to suit the specific presentation. Promising early results, for example, have been found in the treatment of moral injury with veterans (Litz, Lebowitz, Gray, & Nash, 2017). Similarly, although more research is required, it is reasonable to assume that the presence of significant dissociation would have implications for treatment (Frewen & Lanius, 2015). Interestingly, one study found that female veterans who met criteria for the dissociative sub-type of PTSD had reduced, but still meaningful, response to PE (Wolf, Lunney, & Schnurr, 2016).

Challenges in providing evidence-based treatments

Significant challenges exist in delivering evidence-based treatments to military and veteran populations. Pathways to care comprise multiple steps, including acknowledging the problem, making a decision to enter treatment, accessing care, and remaining in treatment. A multitude of potential barriers to care exist at each step (Forbes et al., 2018). Some of the key challenges in delivering evidence-based treatments to military and veteran populations with PTSD include: (a) engagement and retention in treatment; (b) absence of defined benchmarks for assessing treatment progress and non-response; and (c) clinician-related barriers including reluctance by some to work with veteran populations, capability, and willingness to use evidence-based treatments, and degree of treatment fidelity. The next section expands on these key barriers to effective care, of which stigma is a prominent one, before providing a framework for future research in order to best respond to these challenges.

Treatment engagement

Elements of military culture and organization, as well as individual factors, can make help-seeking and treatment engagement a challenge. Engaging in help-seeking behaviours, and the associated perceived vulnerability, can be experienced as antithetical to the warrior ethos universal to all militaries that prize self-reliance and strength in the face of adversity. Combined with a tendency to externalize, this may make it difficult for military personnel and veterans to acknowledge problems even to themselves and, if they do acknowledge them, to refuse mental health-care on the grounds that they would rather handle the problem on their own (Naifeh et al., 2016). Further research is needed to better untangle the complexity of this preference for self-management in order to increase help-seeking behaviours and modify the way in which services are delivered (Adler, Britt, Riviere, Kim, & Thomas, 2015).

A further concern for serving members (as well as some emergency responders) is that engaging in PTSD treatment may have a negative effect on career trajectory (Coleman, Stevelink, Hatch, Denny, & Greenberg, 2017; Iversen et al., 2011). Some of these concerns are well-founded, as certain mental health problems and medication use can result in being assessed as unfit to deploy. Other concerns, such as being treated differently by leadership or fellow unit members, may or may not be justified, yet the broad issue of stigma is clearly relevant (Sharp et al., 2015). Cultures, beliefs, and behaviours around help-seeking that develop in military service may become ingrained, remaining after transition out of the military (Sharp et al., 2015). There is some evidence that stigma is not a 'fixed' entity and, indeed, may be highest whilst service personnel are on deployment (Osório, Jones, Fertout, & Greenberg, 2013). This may be because deployed personnel develop an

adaptive strong 'operational mindset' which allows them to focus on the various challenging tasks they are required to undertake whilst deployed. Such a mindset is unlikely to include positive attitudes towards help-seeking. The concept of stigma relates both to 'self-stigma' (the individuals' own beliefs and agreement with stereotypes they perceive others apply to themselves), and 'anticipated public stigma' (the manner in which they believe they will be viewed by others) (Forbes et al., 2018; Hoge et al., 2004; McFarlane, Hodson, Van Hooff, & Davies, 2011). Both types may impede help-seeking behaviour.

The nature of PTSD itself may also impede engaging in treatment (Blais, Hoerster, Malte, Hunt, & Jakupcak, 2014). A cardinal feature of the disorder is avoidance, and it is not unusual for people with PTSD to go to extreme lengths in order to avoid reminders of their traumatic experience. Many treatments for PTSD, of course, require people to do the exact opposite and to confront the memory of their traumatic experiences repeatedly, and in rich sensory detail. Thus, avoidance may contribute to failure to engage in treatment, early drop out, and a delayed return to treatment. Finally, involvement in adversarial liability and compensation processes can contribute to delays and interruptions in treatment, potentially undermining recovery. Any process that prolongs symptoms and disability arising from PTSD will reduce opportunities for the individual to modify, re-focus, or substantially change their vocational goals. Movements internationally toward non-liability approaches to healthcare (i.e. automatic approval for treatment without going through a lengthy claims process) have helped to separate treatment seeking from compensation, hopefully reducing this potential barrier to care.

Primary care (in both military and civilian contexts) deserves special mention, since this will be the first point of contact for many people with PTSD or other mental health conditions. PTSD recognition, and patient engagement, can present major challenges for primary care providers. PTSD may present in a wide variety of ways. It could, for example, be just one of many differential diagnoses of non-specific symptoms or a masked factor complicating the care of physical health conditions. It could manifest as late onset, remote from psychologically traumatic events, or as complex PTSD in persons with ongoing psychologically traumatic stressors. As the health practitioner most likely to be delivering initial and ongoing care, as well as providing referrals for specialist mental healthcare, primary care providers need to find ways to recognize possible PTSD among a potentially complex array of clinical presentations.

Treatment non-response

'Head to head' comparisons of veterans and civilian patients have not been conducted, and conclusions, therefore, must be drawn with caution. Nevertheless, observation of clinical effect sizes in the treatment outcome literature from several countries (e.g. Australia, the US, Canada) suggests a poorer treatment response among military personnel and veterans compared to other trauma populations (Jones et al., 2017). High comorbidity may be a contributing factor, with military PTSD associated with high levels of problematic anger, substance abuse, sleep disturbance, and emotional numbing (Knowles, Sripada, Defever, & Rauch, 2018). Personality style and military training (good soldiers may not necessarily make good patients), trauma history, over-representation of males, and differences across service delivery systems may all play a part in these somewhat disappointing outcomes. Despite recognition of the complexity and poor treatment response in military and veteran PTSD, there is little evidence and guidance to support sound clinical decision-making when an individual: (a) has an atypical presentation; (b) has a complex presentation including several comorbidities and/or psycho-social problems that challenge considerations in how to sequence treatment; and/or (c) does not respond to first or second-line treatments.

One outstanding question in the field is how to correctly identify treatment-resistant PTSD. This contrasts with other disorders such as depression which have clearly developed heuristic definitions of treatment resistance (McFarlane, 2019) and have adopted clinical algorithms that guide clinicians through the decision-making process of 'next steps' when treatment is ineffective and a change of treatment plan is indicated (Gautam et al., 2017). Sippel, Holtzheimer, Friedman, and Schnurr (2018) have recently offered guidance on how to define treatment resistant PTSD, but evidence is needed to inform the appropriate action in the context of non-response to treatment. As noted below, recent moves towards personalized medicine may have relevance in this context.

Clinician-related barriers

The quality of the therapeutic relationship is a key factor in achieving positive outcomes. To work effectively with military and veteran populations,

practitioners need an understanding of military culture and have the capacity to tolerate details of traumatic experiences whilst maintaining unconditional positive regard (Australian Centre for Posttraumatic Mental Health, 2013). In addition to consideration of the therapeutic relationship, the skills needed to deliver trauma-focused treatments are time-intensive and expensive to obtain. Research suggests that, even after a clinician has been appropriately trained in trauma-focused treatment, the uptake and implementation with military and veteran populations with PTSD is poor (Rosen et al., 2016, 2017). There are several reasons why clinicians might be hesitant to use evidence-based interventions, including doubts about the effectiveness of trauma-focused treatments and concerns about distressing the patient with recounting and recalling the traumatic memory.

Maintaining the fidelity of PTSD treatment protocols in real world clinical settings is always a challenge, as practitioners adapt the protocols to suit specific clinical presentations, including the unique features of military and veteran populations (Cook, Dinnen, Thompson, Simiola, & Schnurr, 2014). Perhaps not unreasonably, when veterans do not respond to first-line treatments, and in the absence of evidence-based clinical decision algorithms for treatment resistant PTSD, clinicians may seek alternative approaches to treatment. While some of these options may be clinically appropriate, others may be of little therapeutic benefit, and there is a risk of long treatment episodes that achieve little. As a result, implementation of treatments that work, as well as maintaining patients in these treatments, is becoming an increasing focus and cause for concern, in addition to concerns regarding the quality and impact of the treatments themselves (Sippel et al., 2018; Stirman et al., 2017).

Innovative solutions to PTSD treatment challenges

The current challenges in PTSD treatment require development of scientifically robust innovations that are consistent with the priorities of military personnel and veterans, and accessible to them across nations. We will now explore possible research directions necessary to progress this agenda over the next decade.

Agreed terminology and definitions

A clear consensus on what constitutes PTSD treatment success, treatment failure and/or non-response, treatment resistance, and cure and/or remission, along with an agreed terminology, is essential. A fundamental problem at present is how to operationalize when a person has had sufficient treatment. Varying definitions exist and are not used systematically across studies (Schnurr & Lunney, 2016; Sippel et al., 2018). Operationalization of these constructs will facilitate development of clinical algorithms to guide decision-making and treatment planning in cases of treatment non-response, treatment resistance, or relapse.

Strategies to increase engagement

Strategies to enhance engagement include increasing individual awareness of the need for treatment, reducing stigma, alternative methods of healthcare delivery, enhancing treatment acceptability and accessibility, and involving families, military leaders, and communities in sustaining an environment supportive of care. A better understanding of the many steps in the pathway to care is needed in order to effectively target strategies to increase engagement at all levels. These improvements could be facilitated through leadership initiatives, unit-based bystander support, and family involvement, as well as through strategies designed to increase awareness of the benefits of PTSD treatment.

Systemic changes are required to improve the coordination and integration of healthcare services within and between military and veteran systems, as well as to improve accessibility, quality, and resourcing of those services. Such systemic improvements are particularly important during key transition periods. The organizational culture needs to actively promote engagement in treatment when required, from the highest levels of leadership through various command levels, to leveraging unit and 'buddy' support. Peers (i.e. 'buddies' and 'mates') can be particularly important in encouraging engagement in care. Emerging research examining the effectiveness of peer-led engagement and help promoting activities following exposures are demonstrating promise and warrant further investigation (Jones et al., 2017).

Identifying who will benefit from intervention is a key component of engagement. While population screening has been considered, large automated screening trials have demonstrated little impact on treatment seeking (Rona et al., 2017). Face-to-face engagement with healthcare professionals, often including education and some psychometric screening, is currently delivered in several Defence Forces, with the goal of facilitating early detection, case identification, and engagement in treatment if required.

Such approaches are commonly applied to cohorts at specific timepoints (e.g. following deployment, at the point of transition) and, when indicated, in primary care settings. Studies building on the work of Rona et al. (2017) to examine the effectiveness of different elements provided in current face-to-face engagement and screening practices are critical to ensure that scarce resources are devoted to where the gains will be most substantial (McFarlane et al., 2017). An integrated approach to identifying mental health problems, which may include screening across the deployment cycle, is needed to facilitate continuity of care from garrison to deployment and back again (Warner, Appenzeller, Parker, Warner, & Hoge, 2011).

On a related theme, it may be possible to go beyond screening based purely on self-report to explore other risk markers. While military personnel can develop PTSD after a single incident during service, there is increasing recognition that repeated deployments confer an incremental risk of developing PTSD (McFarlane et al., 2011). Conceptualizing PTSD within a staging model, whereby trauma exposed individuals have not developed symptoms but are at greater risk due to high likelihood of further exposure and are presenting with certain biomarkers, may provide opportunity for early engagement and avoid the complications, comorbidity, and psychosocial losses associated with chronicity and a prolonged recovery process (McFarlane et al., 2017). It is unclear, however, how effective these interventions might be in returning personnel to full function, and studies are required to properly understand the occupational prognosis of trauma-related adjustment disorders which develop during service, with or without early intervention.

Collaborative care models in primary care (e.g. a multidisciplinary team approach), which have a strong evidence base in mental health (Archer et al., 2012), may assist with increasing engagement in PTSD treatment, helping to efficiently identify PTSD patients and match care according to clinical complexity and patient characteristics (Engel et al., 2016). Emerging evidence around case management has significant promise for high risk and complex cases (Kehle-Forbes & Kimerling, 2017). However, trials of collaborative care for PTSD have yielded mixed results, and point to the importance of ensuring that collaborative care involves effective treatments (Schnurr, 2016; Schnurr et al., 2013).

Modifications to PTSD treatments or healthcare service structures also have the potential to increase military and veteran engagement with PTSD treatment. Massed treatment, for example, such as intensive PE (Foa et al., 2018) and CPT or CT (Ehlers et al., 2014), may be appealing to military personnel who may have limited availability for lengthy treatment periods. Another potential treatment modification, designed to improve maintenance of treatment gains, is booster sessions after treatment completion. Little evidence is available regarding the long-term benefits of treatment for PTSD, because most trials only assess outcomes in the short- and medium-term, but the few long-term follow-ups that exist suggest initial treatment gains may not be maintained over time (Resick, Williams, Suvak, Monson, & Gradus, 2012; Shalev et al., 2016). Booster sessions may provide beneficial refresher training of skills taught in therapy, and lead to greater symptom reduction in the long-term. In addition, continued expansion of telehealth and related modalities may assist in making evidence-based treatment, educational activities, and research participation more accessible.

Improved understanding of treatment outcome predictors

Research focused on uncovering predictors of treatment outcome, including active facilitators and inhibitors of change, is vital. Loss, shame, and problematic anger are particularly relevant to military and veteran populations, and have been demonstrated to be potentially important inhibitors of treatment outcomes (Forbes et al., 2005; Lloyd et al., 2014; Yehuda, Vermetten, McFarlane, & Lehrner, 2014). There is mixed evidence around the extent to which depression, guilt, anxiety, and dissociation at pre-treatment are associated with poorer treatment response (e.g. Richardson et al., 2014). Recent research has suggested that it may be a combination of co-occurring risk indicators that best predicts outcomes (e.g. severe PTSD, guilt and depression as a co-occurring triad) rather than single predictors considered independently (Phelps et al., 2018). Further work is needed in developing the evidence base around differential treatment response in individual PTSD profiles, with a view to evidence-based guidelines for treatment sequencing and the development of interventions for clusters of features such as the triad outlined above. The emerging concept of moral injury and its implications for PTSD interventions is also relevant here (Bryan, Bryan, Roberge, Leifker, & Rozek, 2018). Different approaches might be required when the impact of traumatic experiences manifests as recognizable symptoms of PTSD (e.g. arousal), but the

mechanism of action driving symptoms is markedly different (e.g. not fear of harm but beliefs about transgressions of core beliefs or perceived betrayals by self or others—moral injury; Williamson, Stevelink, & Greenberg, 2018).

Innovations in treatment

Now that the evidence base for first-line treatments of PTSD is established, increasing attention is being paid to related questions. The following are important areas for further research: (a) how to improve, complement, and augment current evidence-based treatments to maximize treatment response; (b) expanding knowledge about non-trauma focused treatments; (c) novel pharmacotherapy; (d) personalized medicine approaches; and (e) treatments that specifically aim to enhance functioning.

Enhancing existing treatments

Research must continue to focus on strategies designed to prepare an individual for treatment, better engage an individual in treatment or augment the effects of current treatments. Advances in neuroscience, cognitive psychology and pharmacology have produced several novel approaches to augmenting current PTSD treatments that can be used concurrently with trauma-focused treatments or in a preparatory fashion. Examples include pharmacological approaches such as MDMA, ketamine, and LSD, which, when used in conjunction with unstructured psychotherapy, may facilitate engagement with the traumatic memory (Mithoefer, Grob, & Brewerton, 2016). Further work is also underway in combining MDMA with evidence-based trauma-focused treatments. The use of propranolol, a noradrenergic beta-receptor blocker, as a putative reconsolidation blocker in conjunction with psychotherapy, also shows some promise in reducing PTSD symptoms (Brunet et al., 2018).

Recent developments in cognitive and neuroscientific interventions that aim to enhance working memory or improve attention control (McDermott et al., 2016), transcranial magnetic stimulation (TMS; Kozel et al., 2019) and new technologies such as virtual reality (Reger et al., 2016) have also shown promise as augmentation interventions.

Given the evidence indicating that anger inhibits treatment response in PTSD, using targeted anger interventions in a phased approach prior to trauma focused treatment may offer benefit (Cash et al., 2018). Experiential and physical treatments such as physical exercise or creative art therapies, and current second-line treatments such as acupuncture or mindfulness, may have a role to play in augmenting existing first line treatments (as well as potentially treatments in their own right). While these approaches may be more acceptable to some service members, their effects on improving PTSD are not well studied (Benedek & Wynn, 2016).

Non-trauma-focused treatments

Current promising non-trauma-focused treatments for PTSD include Interpersonal therapy (Markowitz et al., 2015), Mindfulness-Based Stress Reduction (Polusny et al., 2015), and Present-Centred Therapy (Schnurr et al., 2007), which was initially conceptualized as a control treatment. Emerging evidence in neurofeedback and biofeedback is also showing promise (Fisher, Lanius, & Frewen, 2016). As noted above, although it is not yet known whether these non-trauma focus interventions will improve outcomes for military personnel or veterans who do not respond to first-line treatments, they may be more acceptable to those who express a strong preference not to engage in trauma focused work. Similarly, in recognition that PTSD is often comorbid with other psychiatric disorders, transdiagnostic approaches are becoming increasingly considered as a useful approach for trauma-related pathology (Gutner, Galovski, Bovin, & Schnurr, 2016).

Novel pharmacotherapy

A common theme in recent literature is the disappointing lack of innovation in the development of effective pharmacotherapy for PTSD (Krystal et al., 2017). Antidepressants targeting traditional monaminergic systems, in particular selective serotonin reuptake inhibitors, remain the first line evidence-based treatments when considering medications. Given the limited effect size of agents like the SSRIs (Ipser & Stein, 2012) and the absence of a PTSD-specific agent, a range of agents predominantly designed for other mental health conditions have also been trialled or frequently utilized, including other antidepressant, anxiolytic, and antipsychotic medications. At this point, none have reached established high level evidence. Work is currently underway, however, focusing on non-monoaminergic transmitter systems that may be of specific relevance to the neurobiology of PTSD. A recent expert consensus identified a list of mechanisms that should be targeted for ongoing research, with the top three being NMDA receptor

antagonists, cannabinoid receptor modulators, and glucocorticoid receptor agonists (Krystal et al., 2017).

Personalized medicine

Personalized medicine in PTSD, where treatments are tailored to match the specific needs of an individual military member or veteran, holds considerable promise. This work now goes well beyond the traditional genomic focus of personalized medicine. Research is needed on how to improve treatment fit and effectiveness through better understanding of the typologies of PTSD phenotypes and across the biopsychosocial indicators. Advances in use of fMRI, EEG, biomarkers, and genetics hold some promise also for improved understanding of neurobiological profile variations and for the potential matching and tailoring interventions. In addition, large randomized controlled trial datasets using first-line treatments such as PE and CPT (Schnurr et al., 2015) could form a base for machine learning approaches to identify which interventions work for whom. This 'big data' research can then drive appropriate adaptations to the treatment protocols or the clinical setting and provide informed guidance for treatment selection through data-driven, continuous quality improvement (Cook et al., 2014). Machine learning approaches to large data may aid in moving PTSD to personalized medicine, matching the individual with the most likely successful treatment.

Approaches specifically designed to enhance functioning

Since PTSD is routinely associated with impaired social and occupational functioning, it is critical to develop and rigorously evaluate interventions designed to have a broader social-occupational focus on wellbeing and function (examples include not only occupational rehabilitation, but also support animals, equine therapy, and hiking). Such interventions have the potential to provide avenues to engagement in activity, positive social connections, and regaining a sense of self beyond the mental health problems. Indeed, such interventions may succeed where traditional approaches have been unsuccessful, including in preparatory phases prior to first line treatments. In the absence of robust evidence, however, it is important that these approaches are not considered as a substitute for evidence-based interventions. Psychological wellbeing is strongly influenced by participation in life roles, but ensuring role participation requires: (a) recognizing, diagnosing, and effectively treating the condition so as to minimize impairments; (b) enabling adaptive coping for those living with the condition; and (c) reducing barriers to role participation in their social and physical environments.

The role of family intervention and support

While the impact on families is beyond the scope of this paper, it is nevertheless important to recognize the difficulties faced by family members of military personnel and veterans with PTSD. How do we care for the wellbeing of families as an end goal in itself, and how do we improve their wellbeing in a way that supports the veteran's recovery? Research consistently finds that support and encouragement from loved ones increases treatment initiation and retention in military and veteran populations (Murphy, Palmer, Hill, Ashwick, & Busuttil, 2017). The burden of care shouldered by the families of those with PTSD is substantial, and the impact on their own mental health needs must be assessed in order to minimize long-term negative consequences for the PTSD sufferer and the family (Cramm, Mahar, MacLean, & Birtwhistle, 2019; Fear et al., 2018).

Attention to physical health

Specialist mental health providers and researchers are sometimes at risk of focusing exclusively on psychiatric conditions and ignoring the role of chronic physical health conditions, medically unexplained symptoms, and chronic pain. Those three types of problems are disproportionately prevalent in persons with PTSD (as, indeed, they are in persons with depression or anxiety disorders). Whole person management must include attention to comorbid/co-occurring physical health problems in addition to the psychiatric condition (Sharp, 2019).

Strengths and weaknesses

The author group of this paper was convened by the 5 Eyes Mental Health Research and Innovation Collaborative (5 Eyes MHRIC). The 5 Eyes MHRIC is a collaboration of mental health researchers in Canada, Australia, the US, the UK, and New Zealand working to improve mental health outcomes for past and present military personnel and their families. The paper reflects interpretations of the evidence base by a group of researchers working on military and veteran mental health in those countries, and might not represent the views of other researchers. However, the broad representation of disciplines, nationalities, and

military and veteran life course stages mitigates the risks of bias.

Summary and conclusions

Research over the past decade has demonstrated that evidence-based treatments, when used correctly, can be moderately effective for treating PTSD in military and veteran populations. Improvements in symptom reduction and quality-of-life for some individuals are modest, however, highlighting the need for improved PTSD treatment and chronic symptom management approaches.

This paper has provided an overview of key questions in each of several important areas for future research including: (a) developing a consensus on terminology and definitions around treatment success, failure and/or non-response, resistance, and cure/remission; (b) developing individual and systemic approaches to enhancing treatment engagement, including addressing stigma, improving early recognition, and modifying treatment; (c) improving our understanding of predictors of treatment outcome; (d) improving the efficacy of treatment through enhancing existing interventions, exploring new approaches, increasing personalized approaches to treatment, and increasing the focus on functional impairment and physical health.

We also do not under-estimate the scale of this important task. We also recognize that research directions will continue to be driven, in large part, by the individual interests of researchers, by the availability of targeted research funding, and by various social and government priorities. Nevertheless, we believe that the future directions outlined in this paper will inform key developments in each of the nominated areas. The authorship group are committed to ongoing international collaboration with a view to optimizing a consistent and coherent approach to research and policy in military and veteran mental health.

The agenda for future research needs to be ambitious, focusing on international cooperation and extending the focus beyond a 'one-size-fits-all' approach in order to tailor treatment to individual need. Only then will we ensure better mental health outcomes for serving personnel, veterans, and their families.

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Disclosure statement

The authors report no conflicts of interest.

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