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DISASTER PSYCHIATRY: TRAUMA, PTSD, AND RELATED DISORDERS (MJ FRIEDMAN, SECTION EDITOR)

PTSD as a Public Mental Health Priority

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Abstract
Purpose of Review This article reviews recent evidence related to public health epidemiology and intervention for traumatic stress and PTSD. Recent evidence is presented regarding incidence of traumatic stress worldwide, as well as most frequent types of traumas, indicators of the public health burden of PTSD, and prevalence, predictors, and correlates of PTSD. Public health perspectives on intervention and treatment are delineated, and innovations in both psychosocial and psychopharmacological interventions are highlighted.
Recent Findings PTSD has been associated with substantial medical and economic burden. Recent public health preventive innovations include integrated medical/behavioral health care, acute CBT and attention interventions, modifications to CBT protocols, use of novel and augmentative psychopharmacological agents, and use of technology.
Summary Recent research regarding the scope and impact of traumatic stress, as well as prevention strategies for PTSD, have resulted in an improved understanding of its impact and more effective public health interventions.

Keywords Traumatic stress · Public health · PTSD · Primary prevention · Secondary prevention · Tertiary prevention · Treatment

Introduction

Public health measures are called for when a disease (a) is widespread, creates suffering and loss of function in affected populations, (b) has an impact on wider society (i.e., cost of health services, loss of man power, loss of productivity and economic performance), and (c) is preventable, with effective treatments available [1].

PTSD meets these public health criteria because (a) exposure to potentially traumatic events occurs frequently across the world, and epidemiological research has drawn a clear link between exposure to traumatic stress and PTSD; (b) traumatic events occur commonly across the lifespan, often with major consequences for mental and physical health, and risk and protective factors related to development of PTSD have been elucidated; and (c) commensurate with these findings, there has been a corresponding focus on public health and early intervention strategies designed to reduce the toll of PTSD, with promising progress reported [2].

This article highlights some of the recent epidemiological findings on incidence of traumatic stress exposure, prevalence, predictors and correlates of PTSD, the public health burden of PTSD, and the findings on early intervention and innovative treatment strategies for PTSD from a public mental health perspective.

Incidence of Traumatic Stress Exposure

Epidemiological studies in various countries indicate that a majority of adults will experience a traumatic event at some point in their lives, despite variation in the prevalence of specific types of traumatic events across countries [3••, 4, 5]. The recent World Mental Health Surveys on Trauma and PTSD have been a major contribution to understanding the global public health burden of PTSD. The project combined general population surveys in 24 countries with a combined sample of 68,894 adult respondents across six continents. The authors concluded that nearly 70% of respondents reported a traumatic

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event, and a third were exposed to three or more events [6••]. Nearly 75% of respondents reported experiencing more than a single type of traumatic event. The average number of traumas reported was 3.2, and the average among respondents with at least one exposure was 4.6. Prior exposure itself has been shown to be a significant risk factor for future traumas in all countries. Other consistent risk factors for trauma exposure included experiencing childhood adversities, and having a history of psychopathology, which are both strongly associated with subsequent exposure to traumas, particularly involving physical and sexual violence [3••].

Overall, the most frequently reported traumas were accidents/injuries (36.3%) and serious automobile accident, interpersonal violence, and experiencing a life-threatening illness or injury. These accounted for over half of all exposures [3••]. In the USA, physical and sexual assaults (52% lifetime prevalence) and accidents or fires (50% lifetime prevalence) are the most frequently reported traumatic events [4]. Internationally, in a large-scale study of 21 countries, 21.8% witnessed violence, 18.8% experienced interpersonal violence, 17.7% witnessed accidents, 16.2% were exposed to war, and 12.5% were exposed to trauma to a loved one. In countries affected by pervasive conflict, 15.4% of participants reported PTSD, and 21% reported personal experiences of torture [7].

Globally, a substantial proportion of children are exposed to trauma as a result of armed conflict, natural disasters, and other humanitarian emergencies [8]. In the WMH surveys, most traumas occurred early in life [3••]. For instance, 90% of surveyed orphaned and separated adolescents living in lower-middle-income countries reported experiencing at least one lifetime PTE [9].

Prevalence, Predictors, and Correlates of PTSD

The overall lifetime prevalence of PTSD reported in the WMH studies was 3.9% for a randomly selected trauma. Prevalence was higher in high-income countries, at 5.0%, compared to 2.3% in upper-middle-income countries and 2.1% in low- and lower-middle-income countries. Among the trauma-exposed subgroup, lifetime prevalence was 5.6% overall. The rates were 6.9% in high-income countries, compared to 3.6% in upper-middle-countries and 3.0% in low- and lower-middle-income countries. 50.5% of respondents with PTSD developed persistent symptoms (varying from 31. 7% in Africa to 60.7% in Eastern Europe), consistent with findings in prior studies.

The probability that PTSD will develop after exposure to traumatic stress varies according to the type of trauma and according to sex [10••]. Trauma involving victimization through sexual violence has been associated with the greatest risk of PTSD. After rape, the respective probabilities for developing PTSD in men and women are 65% and 46%. Exposure to death, injury, torture, or bodily disfigurement; traumatic brain injury; or unexpected, inescapable, or uncontrollable traumatic stress is also associated with increased risk for PTSD [10••, 11]. There are many biological abnormalities associated with PTSD [12]. Onset has also consistently been associated with female sex, being unmarried, unemployment, low education, exposure to four or more traumatic events, prior mental disorders, and low household income [13]. The probability is also higher in high-income countries than in lower-income countries [3••].

Prevalence rates of PTSD in children range from 10 to 25% in studies from high-income countries to as high as 75% in studies from low- and middle-income countries [14]. Childhood adversities and prior psychopathology (especially prior PTSD) have typically been the most robust risk factors for the development of PTSD. These risk factors also significantly predict PTSD after sexual assault, life-threatening motor vehicle collisions, unexpected death of a loved one, and disasters, even when adjusting for trauma severity [3••].

Public Health Burden of PTSD

While 25–40% of PTSD cases can be expected to remit within 1 year, recovery among the majority of persons can be expected to require longer than this [3••]. Mean duration of symptoms in the WMH surveys was typically 6 years across trauma types, with combat-related PTSD, associated with a longer mean duration of over 13 years. The authors of the WMH studies concluded that because of the chronic nature of PTSD symptoms, in a large population sample, if 100 people were assessed, a total of 78 person-years of experiencing PTSD symptoms would be spread out among those individuals. Taking into account that trauma exposure rates vary by trauma type, the authors note that intimate partner-sexual violence would account for approximately 43% of the years of experiencing PTSD (their measure of cumulative burden), and the unexpected death of a loved one would account for nearly 12% of the cumulative burden. Several factors contributed to the lifetime burden of trauma: high prevalence of traumas; PTSD after trauma exposure; an early age of onset of PTSD; high PTSD persistence, with associated impairment in personal and vocational domains; and associated suicidal ideation, mental, and physical health conditions. Twenty percent of the respondents with PTSD reported more than one trauma. Compared to respondents whose PTSD was associated with a single trauma, those reporting four or more traumas were six times more likely to exhibit global impairment, independent of type of trauma and comorbidity [3••].

PTSD has been shown to have a high level of comorbidity, frequently co-occurring with mood, anxiety, or substance use disorders [10••]. It is associated with serious disability, medical illness, and premature death. For instance, in a nationally representative sample of Vietnam veterans, PTSD was associated with a twofold increase in age-related mortality [15•]. PTSD has been implicated in the onset and course of many medical conditions, such as type 2 diabetes, respiratory conditions, and cardiovascular disease [10••]. The most frequently studied links between PTSD and these disorders have been shared lifestyle risk factors such as drug and alcohol use; physiological factors such as inflammation, gene expression, or dysregulation of the HPA axis; and biomedical indices such as heart rate variability or infectious disease history [10••]. For example, both large, population-based cohort studies and more in depth clinical studies provide strong evidence that patients with PTSD have a greater burden of atherosclerotic plaque and reduced myocardial blood flow that can lead to clinical cardiovascular disease events. These findings appear to be independent of traditional risk factors, such as high blood pressure, smoking, and obesity, and have been linked to mechanisms such as inflammation, altered autonomic nervous system and neurochemical function, genetics, and health behaviors [16]. Large and clinically targeted case groups, appropriate controls, and data on the time interval from onset of PTSD to the point of data collection are recommended to further clarify these relationships [3••, 17].

Exposure to trauma in childhood or adolescence is particularly detrimental, affecting development in cognitive, emotional, and social domains, leading to adverse mental health and educational outcomes, negative impact on learning and memory, emotional functioning, and social relationships [18•].

The economic costs of PTSD are potentially substantial. For instance, work impairment associated with PTSD has been estimated at 3.6 days per month per person with PTSD [19]. Annual economic burden of sexual assault in the USA has been reported to be $122,461 per person, or $263 billion nationally [20]. The average lifetime costs derived from childhood interpersonal violence (IPV) exposure have been estimated to be over $50,000 per person, or over $55 billion nationwide [21].

Public Health Perspectives on Intervention and Treatment

The magnitude of trauma exposure and PTSD has been described as a "truly global public health problem" [3••]. The foundational public health approaches for this problem are aimed at prevention of the occurrence and sequelae of traumatic stress itself. The focus at this level would be on preventing disease onset at multiple levels of influence, such as attempting to influence the trauma itself, those who are exposed to trauma, their relationships, the variety of environmental factors playing a role in shaping the likelihood of both trauma exposure and outcome, and societal factors that influence trauma likelihood and intervention [18•, 22, 23].

Primary prevention efforts aim to prevent the actual occurrence of a disease or illness. See Fig. 1 for typical strategies that have aimed at reducing the likelihood of trauma exposure, as delineated by the US centers for disease control and prevention *levels of intervention* framework [18•, 22].

Secondary prevention efforts generally intervene early for cure or better outcomes. Table 1 lists a summary of secondary prevention efforts. Because of the higher likelihood of traumatic exposure and access to early contact, secondary prevention efforts are often based in emergency medical settings. For instance, primary care behavioral health integration has been shown to improve access to and utilization of mental health care, along with positive preliminary evidence of improved patient health outcomes and satisfaction, without increasing acute care or total costs [49, 50••].

Recommended Evidence-Based Secondary Prevention Efforts

For those who are identified as needing more intensive early interventions, cognitive behavioral treatment (CBT) has received the most empirical support for those requiring early mental health intervention [45, 46, 51••]. Early CBT has been tested in many settings, with significantly more effective results in preventing PTSD and in decreasing depressive symptoms than education and support [52]. While it has proved ineffective in some individuals, it is most effective in those who meet the diagnostic criteria for ASD or PTSD, and is equally effective when administered 1 month or 6 months after a traumatic event [10••]. In fact, evidence-based clinical practice guidelines have recommended that while there is insufficient evidence to recommend the use of trauma-focused psychotherapy in the immediate post-trauma period, there is sufficient evidence to recommend individual trauma-focused psychotherapy that includes a primary component of exposure and/or cognitive restructuring in patients with acute stress disorder (ASD) [24••].

Innovative use of statistical procedures has been aimed at determining ideal candidates for this treatment approach. In one study using latent growth mixture modeling statistics, early CBT was shown to be effective only with those who would otherwise be slow remitters of PTSD symptoms (27%), those whose symptoms remit over 15 months, versus fast remitters (56%) whose symptoms drop off over 5 months and non-remitters (17%) who continue to have symptoms at 15 months and beyond [46]. From a public health perspective, this finding is important because it highlights the importance of identifying pertinent subpopulations for study of recovery mechanisms that may not exist in the other two groups, as well

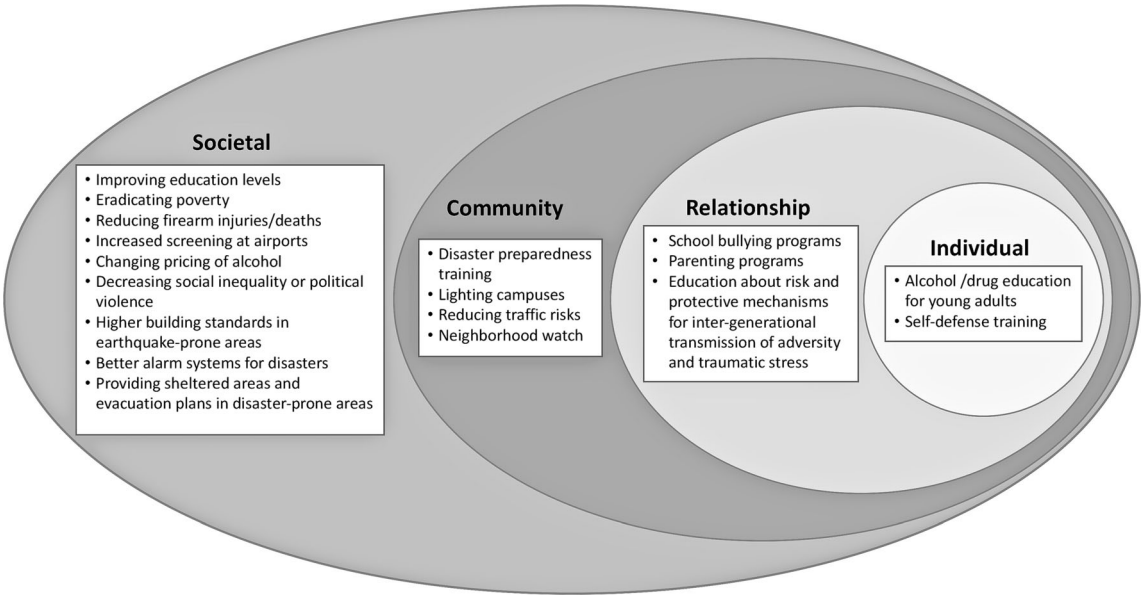

Fig. 1 Types of primary prevention [18•, 22]

as allocating treatment resources to those who will maximally benefit from early intervention. Importantly, the results are maintained for years, and recent evidence suggests that resilience and post-traumatic growth can be experienced independently of whether CBT interventions specifically address them [22, 53•, 54]. It has also been shown to be effective in preventing PTSD in youths [47•, 48].

Innovative Secondary Prevention Efforts with Preliminary/Speculative Evidence

While tertiary treatment interventions for PTSD have much stronger empirical support, many of the secondary prevention efforts for traumatic stress have received much more preliminary, speculative support. Most acute/emergency interventions, while promising, have not yet been approved as evidence-based treatments. However, many approaches are currently being tested in post-traumatic settings with the understanding that much more research is needed before any of them can be recommended. See Table 1 for a summary of these efforts. For example, in primary care and emergency room settings, a collaborative care approach with behavioral health has been associated with a more significant reduction of PTSD symptoms over the course of a year of intervention in both underserved patients and injury survivors [35, 37]. Similarly, a three-session modified prolonged exposure (PE) intervention applied within 11–12 h after exposure to a severe traumatic event has shown promising results in reducing PTSD and depression severity at 1- and 3-month follow-up [38].

Table 1 Examples of secondary prevention efforts

Types of efforts	Examples
Recommended evidence-based interventions [24••, 25]	
CBT	• Cognitive behavioral treatment for ASD
Innovative secondary prevention efforts with preliminary/speculative evidence	
First responder settings	• Stress First Aid [26, 27]
Post-disaster	• Psychological First Aid (PFA) [25, 28–33] • Five Essential Elements [34]
Evidence-informed interventions	
Emergency/medical setting interventions	• Primary care behavioral health integration [35, 36] • Emergency room collaborative care [37] • Three-session modified prolonged exposure (PE) intervention [38–40] • Game-based distraction intervention [41, 42•, 43, 44]
Stepped care	• Cognitive behavioral treatment outreach [45, 46, 47•, 48]

The intervention was least successful in those with dissociation after trauma [39], and most successful in those at highest risk for PTSD based on particular genetic polymorphisms [40]. Preliminary positive effects on intrusive memories via 20 min of visual distraction delivered via video games within 3 h after a motor vehicle accident [41, 42•], while not replicated with mobile app games [43], have received attention as a potential innovation that holds promise for improved prevention efforts [44].

Evidence-based clinical practice guidelines have noted that there is insufficient evidence to recommend the use of pharmacotherapy in the immediate post-trauma period [24••]. However, psychopharmacological early interventions have been tested in a number of settings, and have shown some promise in acute reduction of PTSD symptoms. Hydrocortisone is the intervention with the most RCT evidence in adult trauma survivors as well as in patients who were critically ill or undergoing major surgery [55]. Escitalopram has mixed results, and opioids such as morphine administered shortly after exposure to trauma have shown some promise in reducing subsequent PTSD symptoms [56•, 57]. Intranasal oxytocin has reduced anxiety, irritability, and intrusive recollections in trauma survivors [58•, 59]. Propranolol, temazepam, and gabapentin have proven disappointing as a pharmacologic prevention for PTSD [60–63]. Experts have advised against prescribing benzodiazepines in the early aftermath of a traumatic event [10••]. While many of these preventive interventions show promise, no pharmacologic interventions to prevent PTSD currently have enough evidence to justify clinical use, and further study with clinical samples is needed to resolve inconsistent findings before a causal link can be confirmed [64••].

Evidence-Informed Secondary Prevention Efforts

Evidence-based and evidence-informed secondary prevention efforts have emerged as a way to provide preventive efforts where gathering empirical evidence is difficult. In emergency settings, evidence informed efforts have included the Stress First Aid (SFA) and Curbside Manner (CM: SFA for the Streets) interventions, which comprise a peer support framework that maps onto a public-facing behavioral health response for first responders [26, 27]. In the immediate aftermath of disasters and mass violence, evidence-informed secondary prevention efforts, such as psychological first aid (PFA), aim to promote safety, attend to practical needs, enhance coping, stabilize, and connect survivors with additional resources, as well as identifying those at-risk for psychopathology and referring them for more intensive specialized services [28]. Most of these acute intervention models are informed by a flexible evidence-informed framework of five essential elements related to early and mid-term recovery after adversity, which aims to re-establish a psychological sense of safety, promoting calming, promoting a sense of self- and community-efficacy, promoting social connectedness, and instilling hope [34]. Following disasters or mass violence, a flexible, resilience-based practical approach is important because most of those affected will not seek formal mental health treatment. It is difficult to conduct controlled studies on interventions like PFA because of the chaotic environment immediately following disasters, as well as its responsive, flexible approach. However, the few uncontrolled PFA studies suggest that providers of PFA consider it a good first step for engaging and supporting disaster-affected individuals, and recipients have reported a heightened ability to be calm and to help themselves and others, a greater sense of emotional control, improved functioning, and strengthened family relationships [29–31]. While generally regarded as an evidence-informed, acceptable, and benign intervention, there remains a great need for more rigorous field research to evaluate the delivery and effectiveness of PFA in a variety of post-disaster contexts [25, 32, 33]. Approaches informed by this framework may additionally be further shaped by ongoing efforts to specify the most effective early coping strategies, such as emotion regulation, emotional support, and problem solving [65•, 66, 67••, 68].

Evidence Based Tertiary Prevention Efforts

Tertiary prevention efforts are aimed at preventing the disability that accompanies an illness or disease. For instance, PTSD treatment may prevent the development of comorbidities (e.g., depression and substance use disorders) and improve functioning [10••]. Evidence-based clinical practice guidelines recommend that the evidence is strong for individual, manualized trauma-focused psychotherapies that have a primary component of exposure and/or cognitive restructuring (see Table 2) [24••, 69••]. They note that evidence is also strong for the innovative use of a secure video teleconferencing (VTC) modality to deliver PTSD treatment [24••, 70].

Experts have also recommended that the presence of co-occurring disorder(s) not prevent patients from receiving other guideline-recommended treatments for PTSD, particularly for co-occurring substance use disorders (SUD) [24••, 69••]. CBT-I for insomnia in patients with PTSD has also been endorsed, unless the immediate use of medication can prevent harm from severe sleep deprivation, or an underlying medical or environmental etiology is identified [24••, 69••]. Finally, the development of personalized biopsychosocial medicine approaches has also been recommended, with the use of decision guides and predictive algorithms to optimize the choice of care trauma-informed care [2, 17, 24••, 44, 69••, 71••].

While evidence-based clinical practice guidelines have recommended psychotherapy as the first-line treatment for PTSD, they have also recommended the use of sertraline, paroxetine, fluoxetine, or venlafaxine as monotherapy for PTSD for those diagnosed with PTSD who choose not to engage in or are unable to access trauma-focused psychotherapy [24••, 69••].

Innovative Tertiary Interventions with Preliminary/Speculative Evidence

Innovative technological approaches that are being explored include use of mobile apps and device-guided slow-breathing devices (see Table 2). These have shown some promise in reducing signs of PTSD and may provide prevention of the long-term burden of PTSD, as well as the associated common comorbid conditions, particularly with treatment-resistant PTSD [72, 73]. From a public health perspective, technological application of telehealth, mobile apps, and online treatment can be designed to increase engagement in early intervention, meet the specific needs of populations, used at low or no cost by large numbers of people, and used at the exact moment they are needed [74].

Additionally, recent research on applying CBT differently has proven to show some success. For instance, offering CBT in more intensive, frequent sessions has been found to be as efficacious as normal cognitive therapy (over 10–12 weeks), thus achieving the same symptom reduction in a shorter period of time [75]. Use of virtual reality technology to augment CBT has also been associated with a medium effect size compared to controls and has been deemed an alternative to in vivo exposure [76]. Research to improve treatment by determining the key treatment components of CPT and symptom change is also yielding positive results. For instance, one study found that greater improvement in PTSD severity was related to high therapist competence in Socratic questioning and to prioritizing attention to inaccurate beliefs about why the trauma occurred (to prevent continued avoidance of the trauma) before turning attention to current worldviews that are affected by the traumatic experience [85].

Researchers are also exploring application of novel psychopharmacological interventions, such as cycloserine, a partial agonist of the glutamatergic N-methyl-d-aspartate (NMDA) receptor, to enhance extinction learning during cognitive behavioral therapy [86]; adenosine to decrease activity in the amygdala and noradrenergic system [87]; cannabinoids to decrease PTSD-related insomnia, nightmares, and hyperarousal [88]; and intravenous ketamine, a glutamate NMDA receptor antagonist, to rapidly reduce the severity of PTSD symptoms [89, 90]. At this point in time, however, evidence-based clinical practice guidelines have recommended against treating PTSD with divalproex, tiagabine, guanfacine, risperidone, benzodiazepines, ketamine, hydrocortisone, D-cycloserine, or cannabis/cannabis derivatives

Table 2 Examples of tertiary prevention efforts

Types of Efforts	Examples
Recommended evidence-based interventions [24••, 25]	
CBT	• Prolonged exposure (PE) • Narrative exposure therapy (NET) • Written exposure therapy (WET) • Cognitive processing therapy (CPT) • Eye movement desensitization and reprocessing (EMDR) • Specific cognitive behavioral therapies for PTSD • Brief eclectic psychotherapy (BEP) • CBT-I for insomnia in patients with PTSD • Personalized biopsychosocial medicine approaches • Use of secure video teleconferencing (VTC) • Personalized biopsychosocial approaches
Psychopharmacology	• Sertraline • Paroxetine • Fluoxetine • Venlafaxine
Innovative interventions with preliminary/speculative evidence	
CBT innovations	• Mobile apps [72] • Device-guided slow-breathing devices [73] • Online treatment [36, 74] • Applying CBT in more intensive, frequent sessions [75] • Virtual Reality CBT [76]
Post-disaster	• Problem Management Plus (PM+) [77, 78•, 79]
Evidence-informed interventions	
Post-disaster	• Skills for Life Adjustment and Resilience Program (SOLAR) [80, 81] • Skills for Psychological Recovery (SPR) [82, 83] • Child–Adult Relationship Enhancement (CARE) [84]

as monotherapy or adjunctive therapy for PTSD, due to the lack of strong evidence for their efficacy and/or known adverse effect profiles and associated risks [24••, 69••].

Post-disaster, conflict, or mass violence settings often tax the capacity of a community to provide psychosocial support or formal mental health treatment. Another challenge in this circumstance is that although a portion of those most affected might experience distress and reduced functioning, they are unlikely to seek mental health treatment. Low-intensity, evidence-informed skill-building models that can be delivered by lay professionals try to ameliorate these challenges. For instance, Problem Management Plus (PM+), a low-intensity intervention for adults with symptoms of common mental health problems, uses lay helpers supervised by skilled mental health professionals in communities exposed to adversity [77, 78•, 79]. Similar programs, such as Skills for Psychological Recovery (SPR), Child–Adult Relationship Enhancement (CARE), and the Skills for Life Adjustment and Resilience Program (SOLAR), are also evidence-informed, skill-building interventions that can be delivered by paraprofessionals, but they have added a trauma-focused component for post-disaster settings [80–82, 84]. Besides improving reach via provision by lay professionals, the low-intensity, collaborative, and skill-building nature of these interventions may have a better acceptance by those affected by adversity and traumatic stress. As with PFA, conducting controlled research with these interventions is challenging because of the chaotic nature of post-conflict and post-disaster settings. Empirical findings for these types of interventions have primarily been with providers, case studies, or have been qualitative in nature [77, 79, 80, 82, 83]. However, one randomized controlled trial with PM+ has found promising results with reduction of PTSD symptoms, and further controlled research is underway with both PM+ and SOLAR to gather more support [78•].

Challenges to Providing Early Intervention

Determining when early intervention is indicated can be complicated [91]. One of the challenges to offering more intensive early interventions is identifying those who might be at risk for long-term psychopathology. There have been some recent improvements in the ability to predict PTSD in early phases post-trauma using machine-learning methods, which may facilitate close-in screening of disaster-affected populations as these methods are better studied and applied to disaster settings [92, 93••]. A family of risk prediction algorithms or a consolidated master algorithm that allows for complex interactions across populations, traumas, and screening settings might help pinpoint those trauma-exposed individuals who account for most subsequent cases of PTSD.

Multiple barriers to entry into early CBT have been reported [3••, 94]. For instance, in one study of injury survivors in an emergency department, 96% accepted early telephone-based assessments (at 10 days and 1 month) versus 50% accepting in-person clinical assessments, and 25% of those with post-traumatic symptoms declined an offer of treatment after seeing a clinician. Even with these barriers to early CBT, experts assert that it should be offered because it is safe and effective, and it shortens duration of suffering, yields improvement in those who complete treatment, and results in marked gains in overall population impact [46, 62, 71••, 95]. Therefore, reducing barriers that impede access to services and introducing evidence-based treatments early and in acceptable ways are recommended as a way to prevent or attenuate suffering, where possible [71••, 96]. For instance, affected individuals often resist more formal treatment because of fear of stigma, lack of time, money, or energy, and a sense that they will get better in time on their own, so it is recommended that providers inform them about any risks, help them make well-informed decisions about next steps, and advise them about coping strategies which foster recovery and prevent future maladaptive behaviors.

Training mental health providers in effective early interventions can be challenging, but many efforts are underway to train providers in more trauma-focused care. For instance, a recent World Health Organization (WHO) Global Action Plan for the Prevention and Control of non-communicable diseases (NCDs) has incorporated a focus on improving global mental health. This effort includes recommendations to more adequately train researchers and practitioners around the world, as well as recommending redistributing tasks from highly qualified health workers to health workers with less training and fewer qualifications, as promoted by programs like PM+, SOLAR, CARE, and SPR [77, 78•, 79, 80, 81–83, 84, 97, 98••].

Other programs that have resulted in large increases in trauma-trained providers across the USA are the Veterans Health Administration (VHA) dissemination and training program in evidence-based treatments (EBTs) for mental health disorders [98••] and the NCTSN Core Curriculum on Childhood Trauma to improve delivery of evidence-based treatments for child trauma [99]. Development of trauma-focused competencies to help mental health professionals build foundational trauma knowledge and skills [100], as well as online and mobile app training and facilitation of trauma-focused CBT, will also improve provider knowledge and skill level in delivering effective care for trauma survivors [36, 98••, 101, 102, 103].

Conclusions

The global burden of trauma exposure for mental and physical health has been shown to be substantial. A public health framework in response to traumatic stress exposure is not only necessary for understanding risk and protective factors, but for

generating opportunities for prevention at multiple levels. Adopting a public health approach to traumatic stress and PTSD aims to improve information, activation, and support for individuals, families, communities, and policymakers. It calls for early interventions to be incorporated within a multidisciplinary, multi-layered stepped-care approach that is integrated across health structures. Any models should anticipate a variety of associated medical and psychosocial needs, screen affected individuals as accurately as possible, and provide personalized early interventions. Many of the commendable approaches described in this review fit within these recommendations, with collaborative efforts and treatment innovations aimed at reaching larger numbers of affected individuals and communities, as well as improving treatment effectiveness via more timely and effective interventions. In addition to these approaches, effort should be made to allocate appropriate attention to high-risk or vulnerable populations and integrate treatment for medical and mental health comorbidities. Finally, resources should be allotted towards more effective provider training, as well as increasing mental health resources in high-risk locations.

Preventive efforts related to traumatic stress and PTSD should be tailored for different traumas, cultures, and available resources, so partnerships and innovation of interventions will continue to bring the field forward [17, 18•, 104]. Every effort should be made to evaluate the services that are provided, with an eye towards determining optimal timing and optimal components to use, as well as which strategies will better persuade affected individuals to accept the resources and treatment which might help them recover more quickly and thoroughly [51••, 74, 94, 105]. There is a clear need for further understanding of resilience factors, mechanisms underlying the onset and maintenance of PTSD, as well as innovative and more efficacious treatments that can reduce the burden of PTSD worldwide. For instance, widespread adoption of developmental systems theory as a conceptual framework for understanding response and adaptation to traumatic stress has resulted in research promoting resilience for individuals, families, systems, and communities [106–108]. The researchers involved in the WMH studies have concluded that a complex set of interacting environmental, biopsychosocial, and genetic variables seem to play a determinative role in predicting resilience, onset of PTSD, and remission [3••]. They recommend that future studies provide multi-faceted prospective data which identify a variety of risk and resilience factors related to exposure to traumatic stress. One example of this strategy is the AURORA study, which is following 5000 trauma-exposed Americans for 1 year after an initial emergency department screening. This study is gathering blood and urine specimens, mood and activity levels, and sleep measures from mobile apps, as well as in-depth psychological and neuropsychological examinations, and neuroimaging [109]. If more studies are planned with this level of care regarding multiple factors, all levels of public health intervention will be able to incorporate the findings to more successfully reduce the global impact of PTSD.

Compliance with Ethical Standards

Conflict of Interest The author declares that there is no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- •• Of major importance

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