Toxic Stress, Behavioral Health, and the Next Major Era in Public Health

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Executive Summary

America's health and well-being are dangerously in decline. Our longevity has dropped from 28th to 36th in the world since 1990. Compared to 16 similar high income countries, the U.S. consistently has the worst health outcomes. Our academic achievement is lagging, with U.S. scores on reading, science, and math dropping during the last 15 years to near the bottom of the Organization for Economic Cooperation and Development (OECD) nations. Among comparable nations we score poorly on 25 of 54 indicators of well-being, including primary and secondary school enrollment and inequality of educational attainment. We have the highest incarceration rate in the world, and the highest rate of diagnosed mental illnesses. Relative to our wealth and international prominence, we appear to be in the midst of a public health crisis.

At one time epidemics of infectious illness were the greatest threat to the public's health. This changed with the broad adoption of the germ theory of disease. Although fully implementing the germ theory required massive investments in public health infrastructure (water and sewage systems, mass vaccinations, new treatments, policy and standard setting), the strong science that supported the germ theory provided a compelling rationale for these investments. In this paper we argue that the science regarding our current public health crisis is as convincing as the germ theory was when the public hygiene movement began. This paper details the rationale for an action agenda to usher in a new era of public health that focuses on reducing the impact of toxic stress and trauma on our health, productivity and well-being.

We argue that behavioral health is the linchpin for the next era in public health.   The argument is based, in part, on our increasing understanding of the role of toxic stress and trauma, in combination with genetic vulnerability, as antecedents to our declining health and well-being.   A review of relevant literature demonstrates the pathways through which these problems develop by mapping the effects of stress and trauma on neural, endocrine and immunological systems. These effects, in turn, cause problems in cognition and executive and emotional control which lead to further developmental problems. A subsequent cascade of consequences ultimately results in increased rates of chronic illnesses and disability.

Behavioral health problems, whether initially displayed in childhood or adulthood, are often the first visible consequences of stress and trauma. Without identification and treatment, children who are exposed to toxic stress and trauma are at increased risk for mental and addictive disorders as well as learning deficits, which in turn predict academic failure, compromised occupational achievement, lower socioeconomic status, and health problems. Adults who experience violence and trauma are also at increased risk for a variety of poor health and social outcomes. Without effective support and intervention, the risk increases for inter-generational exposure to toxic stress and trauma, creating a 'vicious circle' of self-reinforcing mechanisms that undermine population health and well-being.

Although the exposure to toxic stress and trauma is nearly universal, not everyone exposed is adversely affected. Resilience is key to understanding this differential response. Resilience is a characteristic of both people and environments that can be purposely developed. Many prevention and promotion strategies strengthen resilience and reduce environmental risk factors. Child abuse and neglect, for example, are powerful predictors of later life difficulties. The Triple P program and the Nurse Family Partnership both demonstrate significant reductions in child maltreatment and produce positive behavioral and social outcomes. Other programs increase personal skills and social supports associated with resilience.

A public health approach to reducing toxic stress will include strategies for preventing or reducing extreme stress and trauma, building resilience, and providing effective care and treatment. Just as the sanitarians needed infrastructure to reduce and treat infectious illness, we need infrastructure to realize the promise of our science. Infrastructure needs to be developed at the individual/family, community and societal levels. Public education targeted to individuals and families can help to create safer, healthier environments, address the impact of toxic stress and trauma on overall health, and present effective strategies for building resilience. Parental education

and support can increase skills-based parenting and create a sense of urgency regarding children's well-being. Interventions that reduce abuse and neglect need to be universally available, as well as other parental support mechanisms including treatment for mental health and substance abuse problems. Clearly, early identification and treatment of problems for all age groups is essential. Safer, less toxic communities are environments in which stress and trauma are prevented whenever possible, risk factors are identified and addressed, and people who are affected receive immediate support and treatment. It is 'on the ground' in communities where existing resources in education, housing, health, juvenile justice, child welfare, etc. can be coordinated and focused on common goals. Community coalitions are an essential ingredient, and can provide a platform for evaluating the effectiveness of preventive and treatment interventions and monitoring overall community health. Several communities have found that using the trauma and developmental lens discussed here greatly helps to identify common interests across divergent sectors, and provides a template for community action.

At the societal level, state and national leadership is critical. Current service systems can be reshaped to emphasize public health goals and functions. Policy interventions like criminalizing domestic abuse and increasing alcohol taxes can reduce exposure to the toxic stress and trauma. Developing common language can facilitate greater coordination among sectors. Collaborative workgroups can help to inform processes such as the Healthy People national public health goals. Population based measurement systems can help us to track progress over time. Federal legislation enabling greater coordination and accountability for population health and well-being could further facilitate progress. A national action agenda is needed to usher in this next great era in public health.   The agenda will operationalize the elements of public health infrastructure needed to address these issues. Perhaps most importantly, it will create broad-based coalitions across the public, private and voluntary sectors that can help create the political will required at local, state and national levels. Given the centrality of behavioral health, SAMHSA has a unique opportunity to provide strategic leadership to the field by facilitating the interaction of the various government components and systematically implementing a change strategy informed by research and past public health successes.

As a nation, we are confronted with serious challenges to our health, well-being and competitiveness. These challenges are not broadly understood or appreciated by the nation's population. Individuals were once resigned to early mortality and morbidity from infectious illnesses. After understanding the germ theory and building public health infrastructure, expectations changed. The resignation changed to action. We now must address our contemporary resignation to the inevitability of the effects of toxic stress and trauma and mobilize for action. We have the opportunity to usher in a new era in public health. The need is compelling. The role of behavioral health is central. While more science will be developed and our insights enhanced, our knowledge is clearly adequate for action. It is in our enlightened self-interest to act now.

Introduction

The U.S. population is sick, and we are only now beginning to recognize it. We are the most obese population in the world. We have the highest rates of mental illness in the world. Our life expectancy is decreasing relative to other developed nations. All of this is in the context of the wealthiest nation and most expensive medical care system in the world. What's wrong?

While our health was once threatened primarily by infectious illnesses, our contemporary public health challenges have different causes. As with infectious illnesses, it is the interaction of our biological vulnerabilities with environmental toxins that undermines our health. The contemporary toxins, however, are not microorganisms but the effects of toxic stress and trauma.[1] [1] Just like John Snow's careful study led to a cholera control strategy prior to the full elaboration of the germ theory, we now have compelling evidence for the long term impact of toxic stress and trauma on the development of behavioral and general health problems. In fact, our knowledge of the mechanisms that undermine our health is much better than what Snow had available.

We also know a lot about what can be done to address these effects – both by reducing exposure and by increasing resilience. Addressing these problems is not easy, but it is not an impossible task. When the early sanitarians proposed installing pipes in every household to bring in clean water and separate pipes to remove waste, it must have seemed impossibly complex and expensive. However, armed with a convincing theory about epidemic infections, the infrastructure was conceptualized and implemented. Fully implementing the proposed public health infrastructure will also be a challenge. However, many individual interventions are already in place, and we have the knowledge necessary to implement others. We already have a sufficient platform to build a coordinated strategy and approach. It is our hope that the data and integrative theory presented here will create the political will to develop a coordinated public health infrastructure to address these contemporary challenges. From our perspective, this is the next great challenge in public health.

Today's Public Health Crises - Indicators of Health and Wellbeing

Despite the common belief that U.S. citizens enjoy the best health and living conditions in the world, we lag behind other nations on many measures of health and wellbeing. In 2012, the U.S. ranked 36th out of 194 countries in life expectancy, dropping from 28th in 1990.[2] The U.S. ranks 38th in disability adjusted life years. The Institute of Medicine (IOM) recently compared the U.S. to 16 similar high income countries. The U.S. consistently has the worst health outcomes, with the highest 0-5 child mortality rate, maternal mortality rate, and rate of obesity. The U.S. has the second highest rates of death due to coronary heart disease, lung disease, and non-communicable diseases.[3] Moreover, U.S. health is deteriorating, with increasing rates of multiple chronic illnesses during the last decade.[4] Diabetes rates nearly doubled between 1997 and 2013.[5] The U.S. consistently has the most expensive and poorest performing health care system - ranked last among 11 comparable nations in each year since 2004, and 9th on measures of access.[6]

The U.S. has the highest rates of mental illnesses and second highest rate of substance abuse problems in the world.[7] Almost half of Americans, 47.4%, will develop a mental health or addiction condition in their lifetime.[8] Individuals who migrate to the U.S. from Mexico have rates of mental illness like the Mexican general population. However, over 13 years these immigrants' rates increase to equal those of the U.S. population[9] [10]. Compared to 16 similar countries, the U.S. has the highest rate of death by violence, almost three times higher than the next country.[11] The U.S. accounts for 80 percent of all firearm deaths among the Organization for Economic Cooperation and Development (OECD) nations – which greatly exceeds our proportion of the OECD population.[12] We incarcerate far more individuals than any other country, with a rate of 707/100,000 population, dramatically higher than similar nations (e.g., Canada's rate is 118/100,000).[13] Many American children end up in the child welfare system, victims of child abuse and neglect. In 2012, 678,810 children were abused or neglected, a rate of 9.2/1,000. Children under 1 year of age had the highest rate of abuse, at 21.9/1,000. Child abuse impacts healthy development, and also resulted in 1,640 deaths in 2012. Over 70% of these were of children under the

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[1] Not to minimize other chemical environmental toxins, which are important but not the focus of this work.

age of 3. Eighty percent of the fatalities were caused by one or both parents.[14] We have the second highest rate of intentional child death of the OECD nations exceeded only by Brazil.[15] More U.S. teenage girls become pregnant than those in the 16 comparable countries. Our teen pregnancy rate is almost 10 times higher than that of Switzerland, the country with the lowest rate. [16]

The U.S. lags other countries in the economic health of the population. Of the 34 OECD countries, the U.S. had the sixth highest child poverty rate (21.8%).[17] [18] In 2012, 15.0% of the population lived in poverty,[19] significantly higher than 12.2% in 2000.[20] The U.S. has the highest rates of income inequality of comparable OECD countries.[21] Lagging academic performance helps to limit mobility and exacerbates inequality. We rank 20th in reading, down from 10th in 2009; 30th in math, compared with 24th in 2009; and 23rd in science, slipping from 19th in 2009.[22] In 2011, the World Economic Forum ranked the U.S.'s education system 26th in its ability to prepare students for a competitive economy.[23]

Several measures have been developed to assess overall performance in health, opportunity, and sustainability. Each indicates that the U.S. lags behind similar countries. The Social Progress Index utilizes 54 social and environmental outcomes across three dimensions – basic human needs, foundations of wellbeing, and opportunity. Of 132 countries, the U.S. ranks 16th overall. We rank higher than similar countries on just four indicators (freedom of speech, affordable housing, tertiary schooling, and number of ranked universities). Compared with similar countries, the U.S. performs worse on 25 indicators, including several of the health and injury measures cited above (e.g., life expectancy), primary and secondary school enrollment, freedom over life choices, and inequality in educational attainment.[24] The Social Sustainability Index measures the sustainability of each country on three dimensions – human well-being, environmental well-being, and economic well-being. In 2012, the U.S. ranked 116 out of 151 countries for overall sustainability, a drop from 93rd in 2006. In the human well-being dimension, the U.S. ranks 32nd, about on par with its ranking in 2006. The U.S. ranks 125th in environmental well-being, demonstrating poor performance in our ability to take care of the environment. The U.S. also scores low on economic well-being at 102nd, down significantly from 45th in 2006.[25]

It is clear from this review that U.S. health and well-being are in significant decline. Our human capital is deteriorating. A nation's human capital is defined as the overall ability of its population to be economically productive. Human capital is like financial capital in that it represents the human resources necessary for economic activity. When our human capital is weakened, it decreases our competitive strength and our ability to have productive individuals, communities and a successful nation.[26] These indicators portray a decline in our human capital that may have profound long term impact on our status as a world leader. These are our contemporary public health crises, comparable to infectious epidemics during the 1800s. However, like infectious illnesses, these problems are not intractable or inevitable. In areas where we have developed and implemented social policies – such as child abuse – we've seen improvements. These improvements demonstrate that we can successfully address these problems if we understand their roots. A science base is emerging that both helps to explain our current crises and demonstrates effective approaches to our current challenges.

How Did We Get Here – The Effects of Toxic Stress and Trauma on Human Development

An understanding of infectious disease helped to shape an organized public health response in the 19th century. In the same way, emerging science about the underpinnings of our current public health crises suggests strategies for a public health response. Here, we review the evolving science concerning the interaction of biology and environment in the production of health.

Individuals' health and well-being is a product of their genetic make-up and the environments in which they live and grow. It is now well documented that the exposure to toxic stress and trauma is associated with a large variety of problems in human health and functioning.[27] [28] Toxic stress is contrasted with positive or tolerable stress (both which may promote healthy development), and is defined as:

> "…strong, frequent, and/or prolonged adversity—such as physical or emotional abuse, chronic neglect, caregiver substance abuse or mental illness, exposure to violence, and/or the accumulated burdens of family economic hardship—without adequate adult support. This kind of prolonged activation of the stress response systems can disrupt the development of brain architecture and other organ systems, and increase the risk for stress-related disease and cognitive impairment, well into the adult years."[29]

While a stress response is adaptive when reacting to immediate, acute danger, exposure to toxic stress can result in the persistent activation of the stress response and subsequent exposure to stress hormones. Chronic activation impacts brain structures and affects energy metabolism, causing a 'dysregulation' of the stress response system.[30] This process is referred to as the 'biological embedding' of experience.[31] [32]

The specific biological changes associated with toxic stress are, in part, dependent on when they occur. Prenatal and early life stress has the broadest impact, since all aspects of the brain are undergoing rapid development at that time. Toxic stress early in life is associated with brain changes that affect memory and the ability to learn. Toxic stress later in childhood and adolescence can result in difficulty in attention as well as impulse and emotional control. Exposure in late adolescence or early adulthood affects brain development, resulting in a heightened fear response and hyper-reactivity to stressful stimuli.[33] During the older adult years, the effects of stress amplify the aging process, affecting memory, cognition and emotion in an age-related way.[34]

We increasingly understand the ways these processes work, including their influence on the functioning of genes[35] (epigenetic influence) and on metabolic function at the cellular level.[36] We also have increasing evidence that individuals with a particular genotype who are exposed to adversity are more likely to develop antisocial behavior or depression.[37] Other research indicates that family support can ameliorate these increased genetic risks effects.[38] While much is yet to be clarified in this research,[39] understanding these biological processes will strengthen and elaborate the linkage between toxic stress, health and illness.

Summary. Early childhood adversity and exposure to toxic stress over the life span are associated with important changes in the structure of neural, endocrine and immune systems. These changes are, in turn, related to functional changes in behavior and metabolism that ultimately increase the likelihood behavioral health disorders and, subsequently, of other chronic illnesses. Effects on brain structures are associated with poor stress regulation as well as deficits in memory, emotion and executive control. These disruptions in development, as we will discuss below, provide the foundation for the behavioral health and general health problems that underlie our current public health crises.

The science exploring how adversity interacts with genetic vulnerability is progressing rapidly. Stress hormone regulation may be central to the molecular mechanisms through which adversity impacts development and behavior. Given what we know now about the multiple effects of adversity and associated risk and protective factors, we can begin to outline a public health response to both prevention and treatment.

Impact of Toxic Stress across the Lifespan

Traumatic events and toxic stress are common across the lifespan, with estimates of lifetime prevalence of 60.7% for men and 51.2% for women.[40] Almost 90% of respondents to the National Stressful Events Survey reported exposure to at least one traumatic event; 30% reported six event types.[41] When other sources of toxic stress are considered, it seems clear that these experiences are near-universal.

It has long been accepted that social factors affect health and productivity.[42] Research strongly suggests that toxic stress in childhood mediates this relationship. The Adverse Childhood Experiences (ACE) Study[43] demonstrates a strong relationship between ten categories of childhood adversity and poor health and social outcomes in a group of 17,000 middle class adults. The relationships are statistically powerful and "graded" – the more adverse events, the worse the outcome. The ACE study is an example of "life course epidemiology." This approach examines the impact of early life events on later development of disease, integrating biological and social risk processes.[44] To date, the ACE study has resulted in over 80 scientific articles and has generated

substantial interest among policymakers, researchers and the general public. A growing number of studies show similar relationships using different methodologies, populations, sources of toxic stress, and outcome measures.

Research has documented the negative impact of a wide variety of stressors, including preterm birth, child maltreatment, bullying, interpersonal and community violence, disasters, accidents, life-threatening illnesses, socioeconomic status (SES) and racism. The relationship between SES and outcomes has been especially well-replicated,[45] probably because living in poverty exposes people to unpredictable environments, lack of resource buffers, and social stigma.[46][47][48] As in the ACE study, the impact of different stressors appears to be cumulative; children exposed to multiple traumatic events show significantly more symptoms and problems than those without multiple traumas.[49] There is a very strong relationship between childhood adversity and the development of emotional and behavioral problems in children. One literature review found "overwhelming" evidence that maltreatment affects the development of mood and anxiety disorders, aggression, social skills deficits, peer relations and substance abuse in children and youth.[50] Children exposed to adverse events start using substances earlier and have higher lifetime rates of substance use.[51][52] The relationship also holds for the most serious mental illnesses. Children who are bullied and abused are nearly six times more likely to have psychotic symptoms.[53] A meta-analysis found that exposure to childhood adversities nearly doubles the risk of developing psychosis.[54]

Childhood adversity also affects educational achievement, including special education placements, grade retention, achievement test scores and attendance. Children from lower SES groups perform more poorly on measures of language, long term memory, working memory and executive control, confirming the impact of stressors associated with poverty and their effects on specific areas of brain development.[55] Longitudinal data suggest a developmental cascade, with toxic stressors leading to developmental and psychological problems which in turn affect academic performance and lead to additional problems over the lifespan.[56][57][58]

Finally, exposure to toxic stress has been shown to impact measures of general health in children, including asthma, obesity and less conclusively, cardiovascular disease.[59][60][61] Risk factors for obesity include adverse childhood experiences, mothers who experience repeated interpersonal violence, and living in unsafe neighborhoods. The relationship is mediated by gender; girls' weight appears to be more affected than boys'.[62]

The effects of toxic stress are highly interrelated. The structural remodeling of the brain caused by stress affects learning and memory as well as cognitive and emotional control systems, which leads to educational problems. Poor educational achievement may, in turn, increase environmental stress and maladaptive coping strategies (e.g., dropping out, substance use) that further impair educational achievement – establishing a 'vicious circle.' Impaired educational achievement predicts poor occupational achievement. Together educational and occupational achievement define socioeconomic status, which is known to be strongly associated with overall health and wellbeing. Endocrine and immune system changes likely underwrite later health conditions, which may also be affected by the use of substances. Without effective intervention, this developmental cascade continues into adulthood.

There is also a very strong relationship between childhood adversity and adult mental health disorders. In the ACE study, 54% of depression in women could be attributed to adverse childhood experiences,[63] and people with 7 or more ACEs were five times more likely to experience hallucinations.[64] A significant body of subsequent research links childhood trauma to a long list of mental conditions, including psychosis.[65][66][67] A recent meta-analysis shows that if six types of childhood adversity were eliminated, a third of new cases of psychosis could be prevented.[68] A significant body of research now supports the theory that changes in the brain caused by childhood trauma result in the heightened sensitivity to stress often found in people diagnosed with psychotic disorders, including schizophrenia. This is consistent with findings on toxic stress reviewed earlier. While genetic factors underwriting vulnerability are important,[69] it seems increasingly likely that adverse life events play a significant causal role in the development of mental disorders.[70]

Research has also confirmed strong links between childhood adversity and alcohol use, [71] [72] [73] [74] tobacco use,[75] [76] [77] and illicit drug use. [78] [79] In some studies, exposure to trauma in adulthood also increases risk for substance use.[80] These findings leave little doubt that severe childhood adversity places an individual at life-long risk of substance abuse, and that addictions are experience-dependent as well as substance-dependent, with implications for prevention and treatment.

A link between childhood adversity and adult general health was established by the ACE study[81] and has subsequently been replicated numerous times. A recent meta-analysis of 24 studies found that child abuse was most closely associated with adult neurological and musculoskeletal problems, followed by respiratory problems, cardiovascular disease, gastrointestinal and metabolic disorders.[82] Type 2 diabetes, Crohn's disease, Alzheimer's disease, hypertension, irritable bowel syndrome, obesity, arthritis, fibromyalgia, chronic fatigue syndrome, chronic pain syndrome, osteoporosis, colitis, and some forms of cancer all have some links to toxic stress.[83] Even a small reduction in childhood trauma would likely result in significant improvements in overall public health, as well as substantial healthcare savings.

The relationship between adversity and suicide is equally strong.[84] [85] [86] [87] [88] All forms of adversity appear to increase risk, but childhood sexual abuse is particularly predictive.[89] Stressful life events and trauma in adulthood also increase the likelihood of suicide. Many questions remain about the interaction of risk factors, but several recent studies demonstrate childhood adversity and adult trauma interacting to further increase risk.[90] [91] While there is clearly more work to do, the research evidence linking suicide to traumatic experiences is strong and has significant policy implications.[92]

Evidence is growing that "chains of risk" are at play, with one risk factor increasing the likelihood of additional factors. For example, female veterans with histories of childhood trauma have increased risk for military sexual assault and intimate partner violence.[93] [94] [95] Several studies have confirmed that multiple adverse childhood experiences increase the likelihood of PTSD in combat veterans over and above the level of combat exposure.[96] [97] These results support the developmental cascade or chain of risk model described earlier and highlight the importance of considering pre-enlistment traumatic experiences as well as combat exposure in the treatment of military personnel. Being a victim of violence is also closely linked to prior trauma and childhood adversity. Research has consistently shown that childhood trauma significantly increases the likelihood of adult intimate partner violence.[98] [99] Similarly, sexual assault in childhood or adolescence increases risk of sexual assault as an adult. Estimates of increased risk range from 2 to 13.7-fold, depending on gender, use of physical force, type of assault, and age at assault.[100] [101] There are many possible psychological explanations for this re-victimization.[102] Several of these, including changes in affect regulation and ability to identify danger, may relate directly to the neurobiological impact of toxic stress. Other trauma-related problems, such as substance abuse or psychiatric disorders, may also increase vulnerability.[103] [104] Violent experiences in childhood significantly increase the risk of perpetrating violence as an adult. The ACE study [105] [106] and others have shown a strong relationship between child abuse (including witnessing domestic violence) and perpetration of adult interpersonal violence (IPV), although not on all measures[107] and sometimes differing by gender.[108] [109] Researchers have begun to explore a number of potential mediating factors.[110] [111] [112] [113] [114] One study found that child abuse increases the risk of criminality by 50%.[115] Understanding the neurophysiological impact of trauma and toxic stress can help us to develop better models of violent behavior and ultimately to improve our capacity to prevent and respond effectively to violence.[116] [117]

Toxic stress and trauma also appear to be related to economic outcomes. The ACE study found that childhood adversity was strongly related to impaired job performance, absenteeism, and serious financial problems in an employed population.[118] Several more recent studies, including two using very large databases, have found a strong and significant relationship between ACEs and unemployment.[119] [120] [121] Several studies have also demonstrated a link between childhood adversity and homelessness, particularly with multiple sources of trauma.[122] [123]

In Figure 1 we display the proposed influences of genetic vulnerability and exposure to toxic stress and trauma that maps the major findings summarized here. As can be seen from the figure, genetic vulnerability interacts with toxic stress and trauma to produce neural changes. The earliest manifestations of these changes are likely
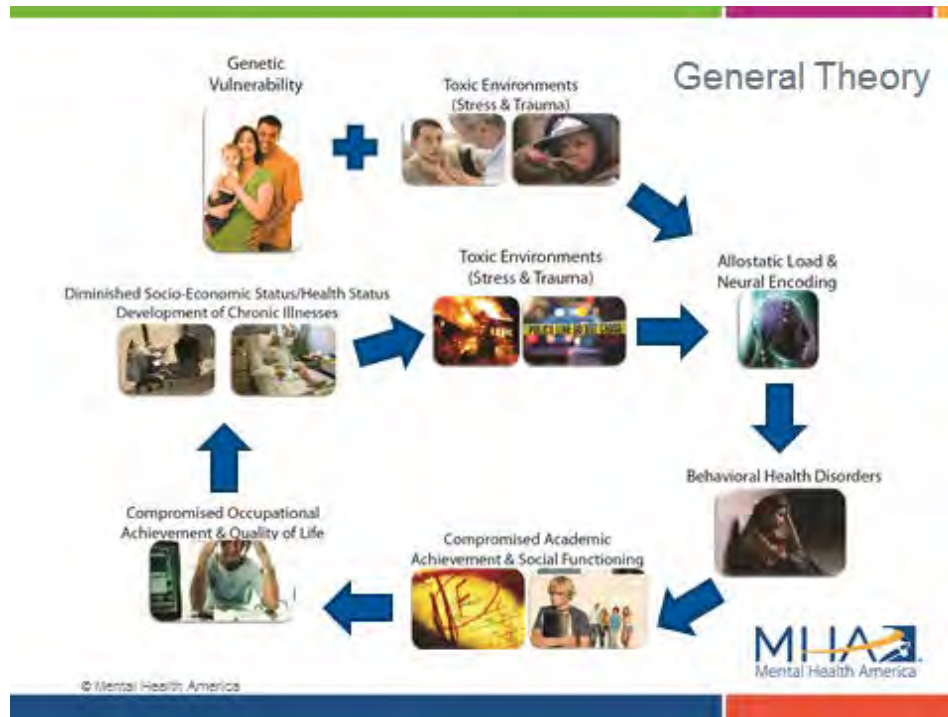

Figure 1. A General Theory of the Impacts of Genetic Vulnerability and Toxic Stress and Trauma on the Development of Behavioral Health Disorders and Associated Academic, Occupational and Health Outcomes

to be seen in behavioral health conditions. The appearance of these conditions and their associated emotional and cognitive effects result in academic and other problems in functioning that compromise academic achievement and later are associated with a reduction in occupational achievement. The subsequent reduction is socioeconomic status is further associated with the development of other chronic illnesses and places the individuals at increased risk for additional stress and trauma, which can help to underwrite multigenerational effects.

Summary. It is clear that for both adults and children, exposure to toxic stressors has profound and wide ranging impacts on all important aspects of life. For children, toxic stress leads to developmental problems in learning and language, which are followed by predictable problems in school. Failure in school, coupled with emotional and regulatory problems, increases risk for behavioral health disorders, including the use of substances. Educational difficulties foreshadow occupational difficulties, which in turn depress socio-economic status and increase stress in adults and in their children. If unaddressed, this developmental cascade continues throughout adulthood. Childhood adversity increases the likelihood of violence and trauma in adulthood, which further compromises health and social outcomes. Poor health and social outcomes, in turn, create conditions which put the next generation at risk.

This brief review makes a compelling case for the developmental antecedents of our current major health and social problems. The implications for policy and practice are profound. Preventing or reducing sources of toxic stress in both childhood and adulthood would have widespread ripple effects across society. Public health,

safety and economic security would likely all be affected. Increasing resilience in children and adults would lessen the impact of trauma and toxic stress and could help to break the chains of risk. Intervening in ways that address the underlying causes of health and behavioral health problems would not only help people regain their lives, but might well help to break intergenerational cycles of stress-related problems. Fortunately, we've learned much about what can be done to prevent the cascade and improve population health.

Resilience and Post-traumatic Growth

Although nearly everyone is exposed to some form of toxic stress and trauma in their lifetime,[124] most individuals overcome the adversity and do not develop health or behavioral health problems.[125][126] In fact, there is a growing body of evidence documenting the positive psychological changes that can, under some circumstances, result from people's struggle with stressful and traumatic life experiences. These positive changes have been referred to as posttraumatic growth, stress-related growth, perceived benefits, and thriving.[127]

Resilience is defined as the capacity to maintain positive mental health and avoid behavioral health problems despite the presence of toxic stress and adversity.[128][129] Once thought of as an innate capacity that people either had or lacked, we now consider resilience as a basic human competency that can be developed and strengthened.[130] It is influenced by genetic factors, resources in the environment, and the attitudes and skills that are acquired at various stages of development.[131] The earlier individuals develop these competencies the more successful they will be, since successfully addressing one challenge increases the likelihood of future success.[132][133][134][135] However, resilience is not solely a coping mechanism to deal with adversity but also a positive trait, helping an individual experience positive mental health.[136][137]

A number of individual and family characteristics promote resilience, including healthy attachment to caring adults, effective parenting, acquiring problem solving and self-regulation skills, and having friends/partners, hope, autonomy, belief that life has meaning or purpose, and effective teachers.[138][139] Positive relationships between parents, family cohesion, stimulating environments, social support, and adequate income also help provide an environment where individuals thrive and resilience develops.[140] Community factors that optimize resilience include safe neighborhoods, support services, prevention programs, access to health services, economic opportunities, and civic, religious and spiritual organizations.[141][142]

For individuals, resilience is the ability to adapt under varying circumstances and the ability to return to equilibrium after a challenge or traumatic event. For communities, resilience is demonstrated by the ability to come together to address problems and then return to business as usual. At the societal level, resilience is the ability for the social infrastructure to withstand stress. Resilient systems attempt to identify and understand the threat, respond effectively, and return to healthy functioning.[143] This definition of resilience at the individual, community or societal level is nearly the exact opposite of the dysregulated stress system response discussed earlier. Resilience is the appropriate response and leads to a desired re-balance.

Understanding the mechanisms and processes that create resilience in individuals and communities, and that help some individuals to thrive after adversity, is key to developing preventive and restorative interventions. Resilience is enhanced by personal characteristics but can also be strengthened or damaged by experiences. It is developed through successful negotiation of stressful situations and is most clearly exhibited in the presence of stressors. Environments which permit experimentation and reinforce effort as well as accomplishment promote resilience. So do environments which promote flexible emotional responses to adversity. Several of the preventive interventions to be discussed below capitalize on these strategies.

Preventive and Resiliency-Building Strategies

It is clear from our review of the effects of toxic stress that prevention programming should begin before birth and continue through the life course. Specific strategies should target risk factors and developmental

challenges encountered at each life phase. Successfully negotiating these situations builds resilience and increases the likelihood of successful navigation of the next challenge.

The work of Shonkoff and his colleagues is particularly helpful in identifying the needs of developing infants and their families.[144] They highlight interventions that are principally targeted at vulnerable populations, but that should be available to everyone, including basic medical care, early and intensive support for families, high quality center-based education programs, work-based income supplements, and others. A variety of evidence-based programs can provide these needed services and supports. Perhaps best known and most extensively studied is the Nurse Family Partnership– a home visiting program that has been shown to have long term beneficial effects including the reduction of child abuse.[145] Quality, early childhood educational programs can have long term benefits, with recent results indicating significantly lower risk factors for heart and metabolic disorders in mid-30s adults who had participated in the Abecedarian Project.[146] The strength of effects is dependent on the quality of the programs.[147]   A recent Cochrane review found that parent education programs improved parental mental health and parenting skills, and were associated with a significant reduction in childhood conduct problems.[148] The review included programs like the Positive Parenting Program (Triple P),[149] the Strengthening Parents intervention,[150] and the Incredible Years program.[151] Treatment of parents who have addiction or mental illness is a preventive intervention for their children.[152]

School based interventions have been extensively studied. A recent meta-analysis indicated that these programs improve youth development and decrease problem behaviors.[153] Two of these interventions, The Good Behavior Game (GBG)[154] and the Seattle Social Development project (SSDP) have extensive longitudinal data that demonstrate benefits 13 – 15 years following the intervention including several aspects of personal, educational and social functioning. [155] [156] Given these long term effects, these interventions act like vaccinations promoting long term resilience and good health. Other school based programs such as the Positive Behavior Intervention and Supports Program have documented positive effects similar to the shorter term effects of GBG and SSDP. They may portend similar long term benefits and are often welcomed into school settings. [157] [158] [159]

Community-wide interventions are intended to respond to local risk factors through organized community-based efforts. Communities that Care (CTC) and PROSPER are two excellent examples, with experimental evidence demonstrating their effectiveness in reducing rates of problem behaviors.[160] [161] Both use coalitions involving community partners and models quite similar to the SAMHSA Strategic Prevention Framework (SPF).[162] Anti-drug coalitions funded by the Office of National Drug Control Policy (ONDCP) and managed by SAMHSA can provide excellent community infrastructure for broad scale preventive interventions as can other SAMHSA funded programs.[163] Other targeted community interventions can reduce levels of violence,[164] [165] reduce substance abuse and depressive symptoms and improve educational achievement through improving housing conditions,[166] [167] [168] although some evidence indicates that the disruption of moving can be associated with deteriorating health and mental health.[169]

Social and community policies are also important preventive strategies. Tax policies have been estimated to reduce the levels of alcohol consumption,[170] traffic deaths (by 11%), alcohol related deaths (by 35%), sexually transmitted disease (by 6%), as well as violence and crime.[171] Policies that help to assure a basic standard of living and access to health care will improve overall health.[172] Business improvement districts have been associated with a 12% decrease in robbery, 8% drop in violent crime and a 32% drop in arrests.[173] As the World Health Organization notes, mental health promotion is largely socio-political. Activities that can make an impact include reducing unemployment, improving schooling and housing, and reducing stigma and discrimination.[174]

This brief and selective review builds on the important 2009 work of the Institute of Medicine.[175] Research clearly demonstrates that we have a wide variety of evidence-based prevention programs and policy initiatives. These interventions have been shown to reduce exposure to toxic stressors and increase protective factors and are associated with improved health, mental health, productivity and overall wellbeing. Given our contemporary public health crises, the strength of the science is encouraging.

Additionally, work completed by the Washington State Institute of Public Policy (WSIPP) indicates that these preventive interventions are often excellent investments. WSIPP was established by the Washington state legislature to assist them in evaluating the overall costs and benefits of various social interventions. They have rigorously evaluated the literature on multiple interventions and, as illustrated in Table 1 below, estimate very favorable benefit/cost ratios for investment when considering the overall impact of interventions on a range of social outcomes.

Intervention	Total Benefit	Taxpayer Benefit	Cost	Net Value	Benefit to Cost Ratio
Seattle Social Development	$15,238	$4,591	$3,081	$12,157	$4.94
Good Behavior Game	$8,890	$2,655	$158	$8,732	$56.34
Strengthening Families (10-14)	$4,259	$1,061	$1,098	$3,160	$3.89
Communities that Care	$2,079	$626	$574	$1,505	$3.70

Table 1. Illustrative Benefit/Cost Ratios for Preventive Interventions[176]

Treatment and Supportive Interventions

SAMHSA's National Registry of Evidence-based Programs and Practices (NREPP) lists 339 evidence-based programs for treating mental health and substance abuse conditions in adults and children.   Searches of NREPP using the keywords PTSD, PTSS, Complex Trauma or trauma/injuries yield a total of 31 evidence-based, trauma-related programs, less than 10% of the total number of interventions available.

Clinicians and researchers have long recognized that people with behavioral health disorders often come from traumatic backgrounds and have multiple problems.[177] Several reviews find that individuals with co-occurring substance abuse and trauma disorders show more severe symptoms and may be more likely to relapse than persons without trauma.[178] [179] NREPP lists a number of interventions addressing individuals with complex histories. Well-known models included in NREPP include Trauma Recovery and Empowerment Model (TREM), Target, Trauma Incident Reduction, Seeking Safety, the Boston Consortium Model, and Risking Connection. These approaches often involve teaching participants about the relationship between their experiences of trauma and their current problems. They also teach strategies for coping with symptoms and provide concrete assistance with housing, vocational and social goals. A five-year outcome study in ten sites showed that approaches that integrate trauma, mental health and substance abuse services are more effective than programs that treat them separately, and that educational and group components are also important.[180] One recent review of treatments for co-occurring substance abuse disorders and PTSD shows positive outcomes on multiple domains. In this review, Seeking Safety was the only treatment model to outperform a control on both PTSD and SUD.[181]

PTSD therapies, in general, are effective in symptom reduction. A meta-analysis found that on average, the approaches tested produced improvements. However, the majority of patients continued to have residual symptoms.[182] Another review concluded that evidence is strongest for Eye Movement Desensitization and Reprocessing (EMDR) and variations of Trauma Focused Cognitive Behavior Therapy (TFCBT). Non-trauma-focused psychological therapies did not reduce symptoms as significantly.[183] The use of medication for PTSD treatment has also been explored. One review found that significantly more patients responded to medication (59.1%) than to placebo (38.5%). However, no comparisons were made with other forms of treatment.[184] Clinical guidelines often suggest using a combination of medication and therapy, but there are too few studies to draw conclusions.[185] Research on the treatment of acute traumatic stress symptoms suggests that TFCBT may be helpful, but the findings are inconclusive.[186]

Peer support (including both grassroots mutual aid and peer staff models) is another modality that shows promise for trauma-related conditions. A recent Cochrane review found that mental health peer services are as effective as professionally run services.[187] Other reviews reach similar and sometimes more positive conclusions, with peer models at times outperforming traditional services on measures of engaging hard-to-reach clients, reducing hospitalizations, and decreasing substance abuse.[188] Peer support also has a long history in substance abuse treatment. A recent pilot outcome study of a peer-led Seeking Safety program found significant positive outcomes in trauma-related problems, functioning, self-compassion, and coping skills.[189] While the direct application of trauma theory to peer support is relatively new,[190] the public health benefits could be substantial. Peer efforts are also consistent with national efforts to implement recovery-oriented systems of care and cost-effective methods of support.[191]

The NREPP database also lists a number of evidence-based trauma treatments for children and adolescents. There is no clear evidence that children with particular types of trauma are more or less likely to respond to different therapies.[192] A number of studies suggest that Trauma Focused Cognitive Behavioral Therapy (TFCBT) is the best-supported treatment for reducing symptoms of PTSD in children and adolescents, although the evidence concerning behavior problems and depression is less clear.[193] Modifications of TFCBT can enhance access and engagement in services and reduce drop-out rates. [194] Therapeutic interventions developed specifically for children with complex trauma, such as the Attachment, Regulation and Competency (ARC) model, have also demonstrated positive outcomes.[195]

One of the most intriguing new developments in treating the consequences of trauma is the application of developmental neurobiology to the therapy process.[196] The Neurosequential Model of Therapeutics (NMT) developed by Bruce Perry identifies key systems and areas of the brain which have been impacted by adverse experiences. It is designed to help the clinician select and sequence appropriate activities based on the specific needs of the client[197] corresponding to different areas of the brain that have been affected. Initial applications of the model are promising.[198] To date this approach has been used only with children and adolescents, but it has clear implications for intervening with both children and adults.

Summary. A public health approach to the epidemics of today requires the integration of prevention and treatment approaches. Effective treatments will not only assist individuals who have already developed problems, but may help to interrupt the chains of risk discussed earlier. Even more importantly, effective treatment has the potential to intervene in intergenerational cycles of violence and trauma by reducing risk factors for the next generation. This brief summary of treatment interventions indicates that there is a growing science base related to trauma treatment. This literature continues to mature as the field realizes the importance of trauma and toxic stress in the development of behavioral health conditions. Our hope is that by summarizing this literature and presenting a life course developmental epidemiology we will stimulate the development of strategies at the federal, state and local level to implement effective solutions as they are discovered and validated.

A Public Health Framework

This paper suggests that investing in a comprehensive public health response to toxic stress and trauma could have a profound impact on the public's health, much as the "germ theory revolution" did in the 19th early 20th centuries. The World Health Organization defines public health as: "All organized measures to prevent disease, promote health, and prolong life among the population as a whole."[199] While descriptions of the scope of public health activities vary, critical elements include:

- A population focus;
- Assessment and monitoring of communities and populations at risk;
- Public policies to address local and national health problems;
- A focus on health promotion and prevention as well as treatment; and
- Research on public health problems and solutions.[200] [201]

Treating toxic stress and trauma as a public health issue will involve all of these functions.

The scope of our current health and social problems can at times seem overwhelming. However, the arguments advanced in this paper provide an organizing framework for action. When the role of toxic stress is considered, seemingly disparate problems are seen to be related, and it becomes possible to align resources toward common goals. The research reviewed in this paper argues that we should be organizing our public health efforts to ensure:

1. A safe, nurturing early childhood environment for all;
2. Maximum possible freedom over the lifespan from all forms of violence, including economic inequality and discrimination;
3. Opportunities to learn skills and access supports to increase resilience; and
4. Effective treatment and supports to reduce the impact of exposure to toxic stress and trauma.

Research shows that we already have many effective tools for promotion, prevention and treatment. Our task now is to deploy these tools strategically and monitor their overall effects on population health and well-being.

The first "public health revolution" involved actions at all levels of society. The germ theory helped to convince the general public that epidemics previously seen as inevitable could be avoided.[202] Individual personal hygiene practices changed as people realized they could help control the spread of germs through daily bathing, not spitting in the streets, and using antiseptic cleansers.[203] Community coalitions of business, civic leaders, and philanthropists mobilized to organize prevention efforts. Municipal authorities initiated massive sanitary campaigns and monitored food and water supplies. Researchers developed and tested new intervention strategies, entrepreneurs marketed new products, and professional associations adopted new practices. State and federal governments established standards for clean water and created the Public Health Service.[204] A comprehensive public health response to toxic stress and trauma will likewise involve all levels and sectors of society. In this section, we will outline some key steps to be taken, and cite examples of innovations that are already moving us in this direction.

Individual/Family

Individual beliefs and actions are at the core of public health improvements. In the 19th and 20th centuries, a new consciousness about the role of unsanitary conditions in the development of disease created political demand for new community infrastructure. It also led to profound changes in individual behavior.[205] In this section, we outline public health interventions designed to have an impact on the knowledge and behaviors of individuals and families.

Public education and social marketing. Educating the public about the impact of toxic stress and trauma could have a similar impact to that of education regarding the germ theory of illness. Public awareness campaigns, tools, and resources on trauma and toxic stress have proliferated in the past decade. SAMHSA's national centers on child traumatic stress, disasters, and trauma-informed care play a major role in highlighting the problem and

potential solutions. The Departments of Defense and Veterans Affairs have developed educational resources about military trauma and its impact on families. In 2011, the U.S. Senate declared June 27th as "National PTSD Awareness Day." Web-based resources such as the ACEsConnection and ACEsTooHigh news site and social networking platform are an ongoing source of information for an increasing number of users. In the past three years, major mainstream media outlets such as NPR, the New York Times and New Yorker have featured opinion pieces and in-depth analyses of the issue. While we know of no research on the social impact of this information explosion, it seems clear that an increasing number of individuals are being exposed to basic information about the impact of toxic stress and trauma.

Given the importance of early childhood, educating new parents should be a priority. Several evidence-based parent education programs have already been noted. Social marketing campaigns can also be effective.[206] For example, providing information to parents about the dangers of shaking or bouncing a baby has been shown to reduce the incidence of head trauma ("shaken baby syndrome").[207] The Triple P program, which includes a public education campaign on effective parenting, has been shown to reduce the level of child abuse in counties where the intervention was implemented as contrasted with those without Triple P.[208] Programs that provide targeted information in relevant settings, such as OB/GYN clinics, maternity wards, neonatal intensive care nurseries, and pediatricians' offices, are likely to have a high payoff.

Reducing exposure to toxic stress and trauma. While public education is a fundamental part of public health, structured interventions can reduce risk factors directly.   Any intervention, program or social policy that lowers the level of toxic stress experienced by an individual – particularly a child - can help to prevent the cascade of risk described earlier. In the previous section, programs and policies were cited that reduce family-based stressors, such as poor parenting, mental illness and substance abuse; and community risk factors like access to substances, street violence and unsafe housing. A variety of violence prevention programs also exist targeting specific forms of violence, including bullying, cyber-bullying, child sexual abuse, campus date rape, stranger rape, intimate partner violence, human trafficking, violence against the LGBT community and other minorities, and gang violence. Some of these programs teach strategies for avoiding victimization. Others work with potential perpetrators to reduce the risk of offending, and/or seek to change the behavior of significant others and bystanders. Some have been carefully evaluated, others have not. Better understanding their deployment, penetration and effectiveness will be key to assessing this component of the public health strategy.

Many of these prevention efforts are initiated and sustained in part by advocacy groups with a deep concern about a specific issue. While each problem is significant, the research on adverse experiences demonstrates that impact is cumulative across different forms of adversity. This argues for an integrated prevention strategy that seeks to reduce overall exposure to toxic stress and trauma – including all forms of violence – in any given setting. Programs that work with families, schools, or communities to identify major sources of toxic stress and respond to priority concerns move in this direction. While problem-specific tools and strategies can and will still be used, a less categorical implementation and monitoring structure is more consistent with a population-based focus. Current
investments in child welfare, juvenile justice, education, behavioral, mental and general health are all relevant here. Focusing and understanding these investments and their effects at the individual level is essential.

Increasing resilience.   A third critical public health function at the individual level is building resilience by increasing skills and supports. Since some exposure to toxic stress and trauma is inevitable, people need to be as prepared as possible to cope with it. Several evidence-based programs were reviewed earlier that teach children the cognitive and emotional skills they need to overcome adversity, and that provide support to families under stress. Wider implementation of these programs would clearly be beneficial. The U.S. military has also developed resilience training to help mitigate the effects of trauma and adversity experienced during deployments. [209] [210] People in other dangerous or high-stress jobs (e.g., first responders) could potentially benefit from similar programs. Mindfulness meditation, breathing practices and other "life skills" are being introduced in schools to help children calm themselves after stressful events. [211] Clearly, this is an area that should be further developed.

Many of the resilience-building programs mentioned above are used for entire populations, in anticipation of potentially stressful events. Another strategy is to provide special supports to children who have experienced a potentially traumatic event, with the intention of preventing or reducing the impact. For example, we know that infants born pre-term have a significantly higher risk than full-term babies of developing behavioral health disorders, obesity and cardiovascular disease, and attempting suicide in adulthood. Clearly, trauma-informed parent education and resiliency-building programs should be routinely made available in neonatal intensive care units.[212]

The national domestic violence (DV) network provides a good example of how a program for adults can be used to identify high risk children. While originally designed for adult women, the DV network quickly recognized the impact of DV on children and the frequency of concurrent child abuse. In the past two decades, effective linkages have been developed with child-serving agencies, and it has become routine for DV programs to provide support (and if needed, mental health counseling) to affected children.[213] Similar responses could be developed for children who experience other risk factors – for example, the suicide of a friend or family member, loss of a parent,[214] a family member being incarcerated or hospitalized for mental health or substance abuse, or witnessing street crime. Developing this kind of response capacity would require an enhanced level of coordination between criminal justice, treatment and prevention activities and between adult and child-serving agencies.

New technology may also be used for resilience-building. Technological innovations to increase people's ability to monitor and manage their own stress have already started to emerge. For example, an app was recently developed that monitors stress levels of parents with high-demand children, and then provides real-time parenting advice in stressful situations.[215] Another example is the use of text messages to monitor and respond to symptoms of PTSD following a traumatic injury, a more efficient form of "watchful waiting" than repeated visits to the clinic.[216] An app under development helps children who have survived a major disaster handle their anxiety with a cell phone-based game.[217] Clearly, the popularity of Facebook and other social media underscores the possibility of enhancing social support through online connections. While the development of applications for resilience-building and prevention is a very new field, the potential is high for reaching large groups of people with low-cost interventions.

Effective treatment. As reviewed in an earlier section, effective treatments exist for trauma-related problems in both adults and children. Additional therapeutic interventions are likely to be developed and tested as our understanding of the impact of toxic stress and trauma unfolds. Until recently, clinical interventions and research studies have largely been based on specific categories of psychiatric disorder rather than underlying causal factors. The assumption has been that people with a common psychiatric diagnosis will, in general, benefit from the same forms of treatment. But we now know that behavioral health disorders can have different and/or multiple causes. It is quite possible that people whose disorders have different causal pathways may respond differently to the same treatment. In addition, without intervention, the cognitive and emotional consequences of toxic stress and trauma in childhood may persist into adulthood, and may contribute to difficulties experienced by adults with mental health disorders. There is emerging evidence that sensory stimulation and other cognitive interventions can be helpful for people diagnosed with severe mental illnesses.[218] These issues are only recently being explored, but the evidence suggests that they represent an important new direction in treatment.

Taking a public health approach to treatment would also have significant implications for service delivery and financing.   A population focus requires outreach to high-priority groups and automatic access to services, rather than our current system which largely waits for an individual to present for treatment and depends on insurance coverage for payment. Furthermore, since the impact of trauma is cumulative, individuals who have experienced multiple adversities would be identified for special consideration. The framework of geographical "catchment areas" in the Community Mental Health Centers Act of 1963 is an example of a mechanism designed to ensure that responsibility is taken for the entire population.

In a public health approach, treatment and support are considered in the larger context of an individual's life. People diagnosed with serious behavioral health problems are often at elevated risk for traumatic experiences. For example, women diagnosed with serious mental illness are up to five times more likely than the general population to be victims of sexual assault and two to three times more likely to suffer domestic violence.[219] Both treatment and rehabilitation can serve as mechanisms to reduce risk factors for the person who has experienced trauma and for the next generation.[220] Delivering services with both goals in mind will require better coordination among what are currently very discrete responses.

Community

In the public hygiene movement, communities played a very significant role. The physical infrastructure improvements that we associate with the germ theory – including plumbing, sewers and waste treatment plants, and draining swamps – are by definition local projects. As knowledge about infectious diseases grew, voluntary associations and citizen coalitions sprang up across the country to improve water and sewage systems, clean streets, provide pure milk for infants, and establish public health clinics. None of these changes came easily. While progressive businessmen argued for the long-term benefit of a healthy workforce, they often faced opposition from others who felt that publicity about public health problems would drive investors and tourists away. [221] Opposition also came from people who saw public health measures as a threat to individual rights, and in the beginning, even from physicians who felt that the approach weakened their personal relationship with patients.[222] Nonetheless, in the early years it was community associations that led the reform movement.

But what exactly defines a community today? We live in a vastly more interconnected and globalized world than the early public health reformers, with a growing number of "communities of interest." However, many citizens still identify strongly with their geographical community or neighborhood. That is still the place where individuals and institutions meet, where it is easiest to get different stakeholders around the table, and where people naturally see the interconnectedness of problems. Many of the goals of a public health approach can best be implemented at this level.

One definition of community is "Everything that happens outside of systems and institutions."[223] This definition emphasizes the role of individual citizens and informal associations in social change. Involving citizens, who are almost always unpaid volunteers, is critical in building a social movement. A growing number of communities across the country are, in fact, taking this approach to addressing the consequence of toxic stress and trauma.[224] Community-based services also have an important – although different - role to play. They can play a leadership role in developing more responsive services, building community coalitions, sharing information and resources, and creating new forms of social action networks.[225]

The theory of toxic stress and trauma outlined in this paper is a powerful framework for bringing different constituencies together. It is clear that trying to eliminate one risk factor or address one consequence will ultimately be less productive than more systemic approaches. In the public hygiene movement, many of the most effective interventions – like clean water, safe food and effective sewage systems – prevented dozens of different diseases. Similarly, efforts to make our communities safer, more inclusive, less toxic and less violent will help us to reduce a number of problems that appear to be distinct, but aren't. In this section, we will briefly describe some of the most important public health functions that operate at a community level.

Community coalitions. Coalitions, stakeholder groups, and collaborative efforts are commonly used in preparing for and responding to disasters and in addressing long-standing issues such as racism. They can also play an important role in a public health approach to toxic stress, helping communities to become safer, healthier and more productive. Many community coalitions and "place-based initiatives"[226] [227] use common strategies, including mapping community assets, assessing community needs and priorities, engaging local opinion leaders, and monitoring results. One of the best known place-based initiatives is the Harlem Children's Zone.

While there has been considerable controversy about the outcomes and cost of the Zone, most evaluations conclude that it has been successful in improving outcomes for poor and minority students in Harlem. However, questions remain about its replicability in other communities.[228] Tools and resources exist to help communities get started on their own efforts. For example, SAMHSA has developed a five-step strategic prevention framework designed to help states and local communities develop effective and sustainable prevention programs.[229] Other groups have identified ways in which organizational behavior needs to change in order to work effectively in a collaborative.[230] However, categorical, program-based funding can hamper these efforts. Funding strategies that put resource allocation decisions in the hands of local groups, with assistance in developing interventions and evaluation, can be helpful.[231]

Community anti-drug coalitions provide an excellent infrastructure for coordinating overall prevention efforts. By design they involve a broad based group of community interests (e.g., health, law enforcement, education, etc. [232]) and a systematic approach for assessing community needs. The Berks County Community Prevention coalition in Reading, Pennsylvania exemplifies a coalition that, following its initial support from the federal anti-drug abuse grant, has been successful in broadening its portfolio of prevention programs beyond the required environmental interventions. They now embrace a broad range of prevention activities and a broad array of funders, including both core environmental interventions and other youth programs in juvenile delinquency prevention, early childhood development, and mentoring. Washington State is also seeking to maximize the effects of its anti-drug coalition network by promoting a broad range of evidence-based practices and environmental strategies.[233]

Creating trauma-informed services and communities. In the past decade, a movement to create "trauma-informed" services, settings and communities has taken hold across the country. While the approach grew out of the work of researchers and practitioners.[234] [235] [236] SAMHSA has played a leading role in developing common definitions and principles and in supporting application of the approach. According to SAMHSA, a setting is trauma-informed if it *realizes* the widespread impact of trauma, *recognizes* the signs and symptoms, *responds* by changing policy and practice, and *resists* doing further damage by understanding the root causes of behavior.[237] This approach directly aligns with the theory and research reviewed in this paper. It suggests that understanding the consequences of toxic stress and trauma can improve the functioning of *all* organizations and systems, not just behavioral health. The approach is now commonplace in behavioral health.[238] It is also being applied in a wide range of settings, including neonatal intensive care units,[239] prisoner re-entry programs,[240] and even community athletics.[241] Although careful implementation research is needed, early efforts are promising. With trauma-informed approaches, schools are seeing reduction in disciplinary problems,[242] Head Start programs are getting better results with inner city children,[243] and psychiatric hospitals are using less seclusion and restraint.[244] Applying trauma-informed approaches to entire communities – whether based on geography or some other commonality – takes the change process one step further. Every community is unique, with its own history, strengths and weaknesses, racial and ethnic mix, and economic conditions. Trauma-informed approaches provide a template for acknowledging and addressing historical trauma[245] and for addressing unique local circumstances.[246]

Local monitoring and response capacity. One of the most basic functions of a public health system is monitoring the spread of disease-causing circumstances (in this case, toxic stress and violence) and responding quickly to prevent contagion. The Interrupters program described earlier (called Cease Fire in Chicago) is a direct application of this principle. Designed by an epidemiologist with a background in infectious diseases, the program interrupts the likely spread of urban violence at its source, works to prevent the future spread of violence, and shifts norms in the community to reduce the likelihood of additional outbreaks.[247] The approach has been demonstrated to be effective, and has now been adopted by numerous cities in the U.S. and abroad.

Similar applications are being developed in communities concerned about all forms of violence. Early warning and monitoring systems for ethnic violence are currently being developed in several African countries. [248] [249] In Canada, police departments have achieved significant reductions in violent crime, domestic violence and youth victimization using a system of "community mobilization." [250] In this approach, information from local social

services (including mental health, child services, education, probation, etc.) is used to identify at-risk youth and to mobilize needed action within 24 hours. The key to the system's success is not service availability – that remains unchanged – but transparency and cooperation. Special attention is paid to protecting privacy and keeping at-risk individuals from harm. The Yale-New Haven Child Development-Community Policing Program is a similar model, where mental health, law enforcement, juvenile justice, education, judicial and social service professionals collaborate with the specific goal of healing the wounds that traumatic exposure to violence inflicts on children and families.[251] New geomapping technologies make it possible for local communities to examine their own public health "hotspots" and to mobilize appropriate action.[252]

Environmental modifications. Communities are also the places where building and development decisions get made.   Just like investment in clean water and plumbing was essential in eliminating epidemics of infectious disease, investment in safer, more supportive environments may be key to addressing toxic stress and trauma. Environmental considerations are highlighted in SAMHSA's approach to trauma-informed care,[253] and changes to the physical environment of service settings can make a difference to both clients and staff.[254] Recently, behavioral health programs have started using "trauma-informed architecture" to create settings where children and families feel more welcomed and empowered.[255] Urban development strategies have been shown to help create safer communities and to encourage social interactions, including the use of lighting, video cameras, walkable streets and pedestrian malls, and the reduction of environmental toxins.

Societal

While many of the infrastructure developments associated with the public hygiene movement occurred at the local level, other changes were statewide or national in scope. The federal government proclaimed the seriousness of the problem;[256] developed uniform data collection systems to help track infectious diseases and to measure their economic impact;[257] passed legislation to enact quarantines, created the National Board of Health, and established standards for clean water and safe food; and eventually, established the Public Health Service.[258] State governments were also involved, shifting resources and administering the new public health system. National media played a critical role in heightening public concern about the issues, as Americans closely followed stories about the international spread of cholera and newspapers editorialized about "cholera panics" taking hold in major seaports.[259] National professional groups helped to shift the institutionalized knowledge base by changing professional standards of practice. Similar tasks face us today.

Setting and monitoring public health goals. One of the most important tasks for government is setting collective goals for society and monitoring progress. What to measure, and how, are of course very complex issues. Many current databases exist that relate directly to the consequences of toxic stress and trauma. However, since the problems have previously been considered as separate issues, the databases exist in different systems. In order to use information across systems, there will need to be standard (or at least compatible) definitions and measures, standardized data collection and reporting systems, and elimination of barriers to cross-sector data sharing.

One approach consistent with the theory presented in this paper would be to use a composite measure of toxic stress. Recently, the ACE study has been replicated in the U.K, [260] and an international charity is now advocating for the government to set a national public health goal of a 70% reduction in child maltreatment and adverse childhood experiences by 2030.[261] The Centers for Disease Control (CDC) and the World Health Organization are working together to revise ACE categories and to develop an international surveillance capacity for ACE scores, which would make it possible for countries not only to monitor changes in that important measure of toxic stress, but also to compare their progress.[262] As mentioned earlier, the CDC has also developed an optional ACE score component for the annual BRFSS conducted by all states.

Creating a collaborative public health framework for service delivery. Public behavioral health and human services are largely administered and funded by state governments. States therefore have significant leverage to shift existing services and resources into a collaborative public health framework. Several states have already made

significant strides in this direction. In some regions of the country, states have also started collaborating to address issues that cross state borders. For example, the New England states have begun a groundbreaking interstate effort to address the current epidemic of heroin use, using a public health approach. [263]

Legislative strategies. Federal legislation is often an effective way to change social norms and behaviors. As mentioned earlier, the Violence Against Women Act, first passed in 1996, provided the first systematic mechanism for enforcing laws against domestic violence, and has contributed to shifts in norms and behavior. Similarly, the Clean Air and Clean Water acts have resulted in substantial improvements for environmental quality and the public's health. The American with Disabilities Act and the Rehabilitation Acts began to change social norms and expectations regarding the inclusion of individuals with disabilities and a re-engineering of both the physical environment such that barriers to participation (such as curb cuts) were eliminated. Interestingly, these improvements helped everyone who uses wheels to move either themselves or their luggage. Similar arguments could be made regarding the Individual with Disabilities Education Act and several other federal leadership initiatives that have had profound impacts on the inclusion of individuals with special needs and circumstances.

The Affordable Care Act (ACA) has many provisions that are directly relevant to the expansion of preventive services. First, by moving toward universal coverage and eliminating the pre-existing condition exclusions for insurance, insurers have new incentives to keep populations healthy. Second, organizations envisioned in the ACA such as Accountable Care Organizations, have responsibility for the health of specific populations and ultimately will be evaluated on measures of population health. At risk financing strategies within this population framework also increase the incentive to help assure population health. Lane County in Oregon, for example, recently used financing available through a Medicaid waiver to implement the Good Behavior Game (GBG). The GBG is a classroom intervention used in early elementary years in which students participate in games that shape prosocial behaviors. The game has been evaluated experimentally, is listed on the National Registry of Effective Program and Practices and has been shown to improve classroom management and student achievement in the short to intermediate term. Additionally, it has long term outcomes by decreasing substance use and increasing graduation rates and college attendance[264].

ACA also includes specific appropriations for the Prevention and Public Health Fund that seeks to implement preventive interventions through the CDC, HRSA and SAMHSA. The Act also encourages workplace wellness programs and sets new community benefit obligations that require non-profit hospitals to invest in the health of their community. These funds seem ideal for universal prevention interventions. The ACA therefore explicitly recognizes the importance of population health and prevention and enacts several provisions that will strengthen these efforts.[265] [266]

Shifting institutionalized knowledge base. Professional groups and associations, think tanks and research institutes, advocacy organizations, and institutions of higher education all have important roles to play in developing and maintaining society's institutionalized knowledge base. There is evidence that advocacy organizations are beginning to promote new approaches based on the science reviewed in this paper. For example, the Australian Association of Adults Surviving Child Abuse has recently disseminated extensive practice guidelines for treatment of complex trauma.[267] Similarly, the National Child Traumatic Stress Network and the Center for Pediatric Traumatic Stress at the Children's Hospital of Philadelphia have developed guidelines and best practices for trauma-informed pediatric care.[268] Healthcare professionals are also beginning to adopt new positions and to advance new standards of care as their understanding of toxic stress and trauma grows. The American Academy of Neurology has recently developed a position statement on abuse and violence.[269] Numerous trauma training curricula have been developed, including a program for psychiatry residents,[270] and a few short years after publication of a "call to action" to include trauma in the graduate curriculum for professionals,[271] a group of national experts has developed a consensus document outlining competencies in the areas of trauma knowledge, assessment, interventions, professionalism and relational/systems.[272] The Harvard Center for the Developing Child has also consolidated information regarding

the impacts of early exposure to adversity on health and well-being and provided valuable communication tools to help express the urgency of the problems that we confront.[273]

National advocacy organizations play a vital role in generating the political will to build the public health infrastructure needed to realize the promise of our science. The Mother's March of Dimes provides an historical example of the power of advocacy to engender a sense of urgency. We need to create that urgency and the possibility of successfully addressing these problems much as they did in conquering polio.[274] Mental Health America (MHA) was originally formed as the National Committee on Mental Hygiene in 1909. As the name suggests, the organization was intended to accomplish for mental health what the public hygiene movement had realized in public health. MHA therefore has always had an emphasis on population health and the prevention of mental illnesses. Along with its 230 affiliates, MHA is an example of an organization that could continue the efforts to spread this message and advocate for needed change.

Philanthropic foundations have also played a key role in helping to emphasize and underwrite prevention and population health efforts at both the local and national level. Given the current constraints on federal funding, foundations will continue to play an essential role in supporting these activities both by seeding projects and by helping to underwrite infrastructure development. Hospital conversion foundations may be a particularly important part of the equation. We are reminded of the important work that Andrew Carnegie did in building public libraries in the U.S. that have become an essential piece of community infrastructure. Perhaps major foundations concerned with health and wellbeing could endeavor to seed this public health infrastructure consistent with today's greatest challenges to our human capital.

Private investment has recently emerged as a financing source to address social problems. Social Impact Bonds (SIBs) are pay-for-success contracts that allow private investors to provide capital for the implementation and scaling of programs that are known to be effective and save the government money in the long-term. After rigorous evaluation, private investors are only repaid if the program yields outcomes and an economic impact designated at the start of the contract. The greater the benefit to the government, the greater the return on investment, up to an agreed upon cap. SIBs are a new financing mechanism to address social and health problems, but are gaining in popularity and may be a major funder for public health infrastructure in the future.[275] [276]

<div align="center">**Action Plan**</div>

Just as the germ theory sparked a fundamental social transformation, emerging insights about the impact of toxic stress and trauma on human development are changing how we think about social problems and how we craft solutions. No one can anticipate exactly how a shift of this significance will unfold. However, this action plan identifies some areas for strategic action.

Cultural Transformation

The changes will require collective, sustained efforts over time. What is most required at this point is the political will to move forward and a systematic concentration on implementation to assure that we deliver on the promise of the science.   An important first step is to create a common vision among a broad alliance of individuals and groups. The vision for change must include the understanding that our health and well-being depends on the health and well-being of our neighbors. It must also create a sense of urgency to act, instill optimism, and inspire an outpouring of American ingenuity. It is important to remember that the problems we face as a society are not inevitable or intractable. In areas where we have developed and implemented social policies, such as efforts to end violence against women and child abuse, we have seen significant improvements.[277] [278] [279]

Developing common language and understanding. Given the diversity of interest groups touched by toxic stress and trauma, it is critical to develop a common understanding of the problem. While different sectors will always

need specialized language, a common vocabulary used across sectors and accessible to the general public would be extremely helpful. The theory presented in this paper has the potential to unify a wide variety of groups, but we have to have a language that doesn't "belong to" one particular field.   Relatedly, it is important to identify areas of confusion resulting from the use of common terms that denote different meanings. It is also important to understand how the language that is used reflects deep seated professional or personal perspectives on the causes of our current health crises and the methods that may be used to address them. Bridging these perspectives may be more challenging than we initially suspect. Insights from other reform movements (e.g., introducing the concept of recovery from severe mental illness to mental health professionals) should be helpful. Widespread dissemination of the basic ideas presented in this paper is also essential in order to develop national momentum for change.

Setting a national public health agenda and goals. Once people understand the nature and urgency of a problem, it requires national leadership to set unifying goals, inspire widespread action, and maintain focus over time. Better incorporating this approach into Healthy People, where some of these issues already have prominence, would help to ensure inclusion in overall public health planning.[280] Reducing levels of toxic stress and trauma and improving our overall public well-being need to become major social priorities. We also need to be able to monitor progress over time.   Developing and/or adopting one or more "public well-being" or "human capital" indices could help in tracking the effectiveness of various initiatives as well as maintaining public interest. Improving coordination among several existing data sets maintained by differing components of government as well as building merged data sets with common definitions and specifications of variables will greatly assist in these operations. Washington State's integrated data sets may provide a template that others could use to develop merged data.   Several groups have the technology to assist with the process of melding existing data sets to produce overall indices of health and wellbeing. Optimally, the public would start to follow these aggregate measures of well-being just as many watch the Dow Jones industrial average.

Developing broad-based coalitions. Given the breadth of these concerns, broad-based coalitions will be required at all levels to move the agenda forward. Health and human services, parent and youth groups, business and industry, all levels of government, professional organizations, advocacy groups, education, law enforcement and the justice system, labor unions, faith-based organizations, the military, philanthropy, civic organizations and others all have an important interest in these issues. Many efforts already exist to address specific issues addressed in this paper, including national coalitions to end interpersonal violence across the lifespan, to eliminate child abuse, to improve mental health and wellness, to reduce and prevent substance abuse, to reform education, to end homelessness, to eliminate suicide, and many others. Strategies should be developed to reach out to these groups, organizations and coalitions to better understand their interests and current investments and to align efforts based on common root causes. Methods for effectively convening and supporting coalitions also need to be developed and current investments expanded. Much work on coalition-building has already been done and can form a basis for further expansion.[281]

Implementing a national reform strategy. The federal government is a critically important player in this movement. At the national level, the government invests in human well-being across most of its sub-components. Legislation could be crafted to establish national health and well-being as a priority and to articulate a national agenda for reform, including scaling up of prevention, support and treatment efforts. Such legislation could provide the framework for better coordinating federal efforts. The Departments of Education, Justice, Labor, Health and Human Services, Veterans Affairs, Defense, Housing and Urban Development, Commerce, and Agriculture as well as distinct divisions within these departments all have initiatives and data sets that are germane to these efforts.   A national initiative could provide resources for strategic leadership, better support state and local infrastructure efforts, and begin to articulate national standards for assessing the well-being and trauma/toxic stress status of states, counties and municipalities. There are many different ways such an effort could be organized. The 2009 IOM report on the prevention of mental, emotional and behavioral problems in youth proposed a national prevention office located in the Executive Office of the President.[282] The President's Emergency Plan for AIDS Relief (PEPFAR) provided a framework for coordinating the efforts of seven federal agencies (State, USAID, DOD, DOC, DOL, HHS and Peace Corps). PEPFAR had an international focus,

helping countries to create an "AIDS-free generation." However, a similar effort could be designed to help states and localities contain and respond to the current epidemic of toxic stress and trauma.

Continued Support for Innovation

We have strong scientific evidence to support action, and effective techniques for treatment and prevention already exist. Nonetheless, further advances in both science and technology can be anticipated as we move forward. Along with a focus on implementing what we already know, continued support for innovation is essential.

Higher education. Higher education has a particularly important role to play. It is here that the next generation of practitioners, policy makers and informed public citizens are being trained. It is also here where much of our knowledge regarding the impacts of toxic stress and strategies for preventing and ameliorating these effects is being developed. Grant programs for curriculum development, workforce preparation, research on the effective translation of basic research findings into implementation strategies as well basic research programs are effective vehicles to engage higher education. Special attention should be paid to existing gaps, new partnerships, and emerging areas for research and development. For example, behavioral health does not currently have a strong engineering component that could help us develop solutions to the complex problems of integrating and understanding this broad array of investments as well as more systematically implement program interventions.   Similarly, we have barely begun to explore the potential use of technology to support prevention and well-being. Exploring new areas like this could have a significant payoff.

Innovation in the field. Many of the ideas presented in this paper are already generating innovative applications in the field. With SAMHSA's leadership, "trauma-informed approaches" are being adopted in a wide variety of settings, including behavioral health, primary health, education, social services, justice, and the workforce. Similar efforts going by different labels are arising in other fields, including law enforcement, architecture, nutrition, and urban planning. Municipalities and states are also beginning to adopt trauma-informed approaches as a way to address multiple social problems simultaneously. By expanding awareness of the impact of trauma and toxic stress, these approaches help identify people in need, create a platform for joining prevention and intervention efforts, and improve services. SAMHSA could play a leadership role by identifying early adopters and creating mechanisms for them to share their experiences. Expanded support for innovation and for evaluation of the effectiveness of trauma-informed approaches is also essential.

Public-private research and development partnerships. Currently, research and development efforts are spread between government, academia, nonprofit think tanks and research institutes as well as private enterprise. The science reviewed in this paper has important implications for future research and for the development of new treatment and prevention technologies. As our focus on the underlying causes of behavioral health and social problems increases, new questions for both basic and applied research will emerge. Targeting even a fraction of our formidable research and development capacities towards a common set of public health problems would likely yield significant solutions.

SAMHSA's Leadership Role

Our new understanding regarding the critical nature of behavioral health to overall health and well-being presents a unique leadership opportunity for SAMHSA. Important internal work is already underway through the two strategic initiatives: 'Prevention of Substance Abuse and Mental Illness' and 'Trauma and Justice'. Further internal discussion in these areas as well as work with key stakeholder groups and other federal partners could help develop a common vision and agenda for the next era in public health.

Building strategic partnerships. With or without legislation, SAMHSA can build strategic partnerships with other federal agencies to move this agenda forward. Clearly, the Centers for Disease Control (CDC), the Administration for Children and Families (ACF) and the Health Resources and Services Administration (HRSA) will play key leadership roles. CDC oversees the country's public health efforts, and ACF houses many of the most important prevention programs, including child abuse prevention and programs established by the Violence Against Women Act. HRSA has direct links with primary care clinics and helps to support home visitation programs. With the Federal Partners Committee on Women and Trauma, SAMHSA has already demonstrated success in

bringing agencies together to address these issues. The Federal Partners Committee is now in its fifth year, with a membership of almost 100 representatives from 33 divisions of 11 Federal Agencies. Convening and supporting the development of leadership in other agencies is a key role for SAMHSA.

Integration of treatment and prevention. In behavioral health, these two constituencies have often operated in separate spheres, and have at times viewed one another as competitors. In a public health approach, it is essential that prevention, care and treatment are integrated with the common goal of containing and eliminating identified problems. Our understanding of the causes and interrelationship that underlie our current problems makes it possible to envision such collaboration. SAMHSA could play a leadership role by bringing the constituencies together, identifying and addressing barriers to integration, and creating structural incentives for collaboration.

SAMHSA's traditional commitment to people diagnosed with severe mental illnesses and addictions will be a significant strength in this effort. Often, people with the most disabling conditions are unintentionally excluded from broad-based social coalitions due to stigma and misunderstanding. The issues reviewed in this paper affect every citizen, and SAMHSA is in a unique position to ensure that everyone has a place at the table, regardless of disability or circumstance. SAMHSA is also in a unique position to lead a continued effort to develop and test new promotion, prevention, engagement, treatment and rehabilitation approaches based on our emerging understanding of mental illness and addictions.

Creating a focus on systemic change. SAMHSA could also formally underwrite efforts to better understand change processes and to disseminate current knowledge. Much has been learned from the experience of other major system change strategies in both the public and private sector. SAMHSA has been a national leader in the implementation of the Recovery model in behavioral health, and has developed knowledge, experience and strategic partnerships that will be directly applicable. Making information about successful change strategies widely available through toolkits, resource lists of evidence-based change strategies, and on-line networking would likely increase the speed and effectiveness of innovation. SAMHSA's strong relationship with state behavioral health authorities will be an asset in supporting state involvement in the change process.

Financing strategies can also be developed to support transformation. In addition to traditional grant making activities (including training grants, block grants, research grants, etc.), SAMHSA could lead in the development of innovative financing approaches. Formal and informal studies are being conducted in the field right now, using information about the relationship of seemingly discrete problems to reallocate resources to a better balance of prevention, care/support and treatment.

Conclusion

As a nation, we are confronted by serious challenges to our health, wellbeing and competitiveness. These challenges are not broadly understood nor are the implications of these challenges for *all* Americans' health and wellbeing appreciated. Individuals were once resigned to early mortality and morbidity from infectious illnesses. After understanding the germ theory and building public health infrastructure, expectations changed and resignation transformed into action. We now must address the contemporary resignation to the inevitability of toxic stress and trauma and their impacts on health, wellbeing and productivity.   In part, this would represent a change in social norms about maltreatment, violence, deprivation and poverty. These are not small changes, but recall the magnitude of the challenges in developing municipal water and sewer systems. With the emerging theory and the urgency of our human capital needs, we now have the opportunity to usher in the next major era in public health. The science is adequate for action. The need is compelling. The role of behavioral health is central. While more science will be developed and our insights enhanced, our knowledge is clearly adequate for action. It is in our enlightened self-interest to act now.

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