HIDI HealthStats

Statistics and Analysis From the Hospital Industry Data Institute

HIDI
HOSPITAL INDUSTRY DATA INSTITUTE
The Data Company of the Missouri Hospital Association

Background

A child that experiences abuse, neglect, a troubled home or toxic stress can carry the burden for a lifetime. The direct and indirect effect of these experiences can influence physical and behavioral health, and even result in premature death. Mitigating the harm of these adverse childhood experiences requires that communities identify the drivers of long-term health and social problems, and build communitywide systems to better serve children at risk for ACEs.

No community is completely immune from families or circumstances that contribute to ACEs. However, using data from several different sources, researchers are able to identify communities where children have a potentially increased risk of ACEs. This risk analysis allows stakeholders to develop initiatives to address the upstream social determinants of downstream physical and emotional health outcomes for children experiencing adverse events.

One approach to reducing the harm of ACEs is to build community resilience — a system defined as "the sustained ability of a community to utilize available resources to respond to, withstand and recover from adverse situations."[i] Resilience initiatives align and leverage assets across multiple sectors of local economies to maximize residents' ability to cope with adversity.

Figure 1: 2013-2015 ZIP-Level ACE-Risk Scores
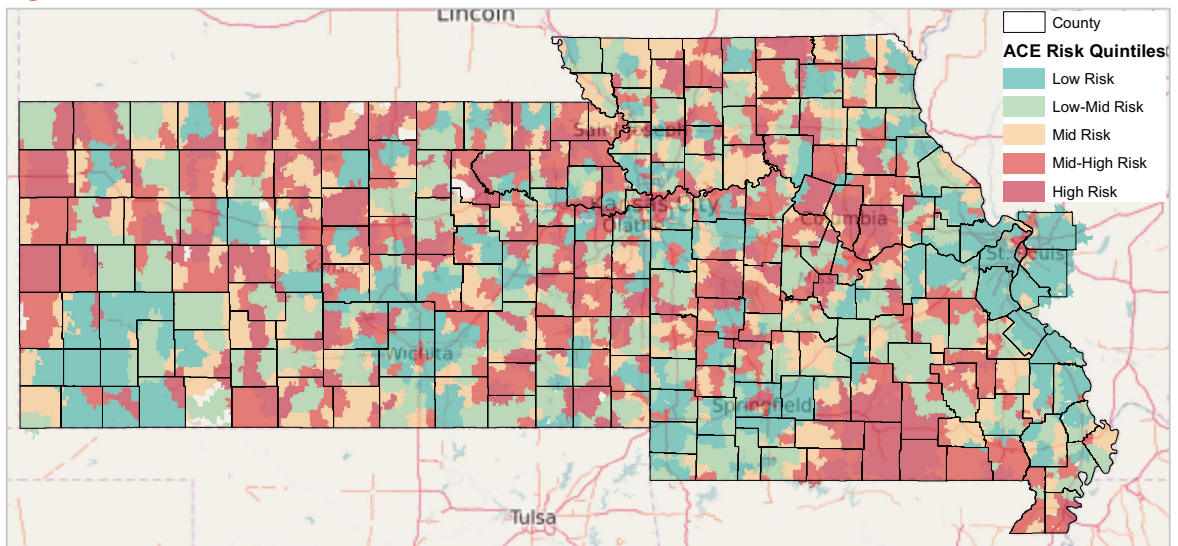
Source: Hospital Industry Data Institute

Kansas and Missouri benefit from several resiliency-focused initiatives, including the following. Resilient KC, is a partnership between the Greater Kansas City Chamber of Commerce and Trauma Matters KC.[ii] The project's aims are three-fold: Raise communitywide awareness of the consequences of trauma and adversity, build community resiliency, and generate a baseline of data-informed empirical evidence around resiliency and ACEs. Resilient KC engages community stakeholders from a broad spectrum of sectors, including health care, business, education, armed services and law enforcement.

Alive and Well STL is another multisector, communitywide initiative in the St. Louis area aimed at minimizing the adverse impact of stress and trauma on long-term health outcomes.[iii] The objectives of the effort are to enable communities to be aware and informed of the negative effects of stress and trauma, promote trauma-informed responses from service providers, increase access to mental health services and bolster communities that act to reduce the triggers of traumatic events and stress.

Understanding Adverse Childhood Experiences

ACEs were identified in a foundational study conducted by the Centers for Disease Control and Prevention and Kaiser Permanente that linked traumatic events in childhood to individual health and well-being in adulthood.[iv] The researchers developed a survey that evaluated adult risk behavior, health status and disease against the presence of childhood experiences across several domains: psychological, physical or sexual abuse; witness of mother's violent treatment; and household members who were drug or alcohol abusers, mentally ill or suicidal, or ever imprisoned. The study found strong statistical associations between the number of ACEs present and each adverse health and well-being measure evaluated in adulthood. The study concluded that adverse experiences in childhood produce a chain reaction of diminished physical and emotional well-being throughout the lifespan, and the risk increases substantially with the number of ACEs the individual underwent. From near to long-term, ACEs result in the following.

- social, emotional and cognitive impairment
- adoption of risky behaviors
- disease, disability and social problems
- premature death

Table 1: Latent Variable Model Inputs by ACE Domain

ACE Domain	Measure	Selection Criteria & Rate Base
Abuse	Emotional Abuse	Under age 19
	Physical Abuse (Child)	Under age 19
	Physical Abuse (Perpetrator)	All
	Sexual Abuse	Under age 19
Household Challenges	Criminal Household Member	All
	Household Substance Abuse (Adult)	Over age 18
	Household Substance Abuse (Child)	Under age 19
	Mental Illness in Household (MDC 19)	Over age 18
	Mental Illness in Household (Suicide)	All
	Mother Treated Violently (Physical)	Female Ages 18-49
	Mother Treated Violently (Sexual)	All
	Parental Separation or Divorce (Counseling)	All
	Parental Separation or Divorce (Population)*	ZIP Population
Neglect	Emotional Neglect (Mental Illness)	Under age 19
	Childhood Poverty Rate*	ZIP Population
	Emotional Neglect (Substance Abuse)	Under age 19
	Rate of Female-Headed Households*	ZIP Population
Toxic Stress	Behavioral Responses	Under age 19
	Family Counseling	All
	Family Disruption	Under age 19
	Gun Violence	All
	Premature Death	Under age 50
	Unemployment and Low Education	All
	Insufficient Housing and Social Supports	Under age 19

Variables gathered from the 2013-2015 Nielsen Claritas PopFacts Premier databases.

Identifying ACE-Risk Factors at the Community Level

To identify communities with children at risk of potentially experiencing ACEs and associated downstream health outcomes, a model was developed around the ACEs study framework using hospital discharge and census-based data inputs for Missouri, Kansas and St. Louis metro-area Illinois ZIP codes. A risk index was produced for each ZIP code with sufficient data using a latent variable modeling approach. All model data and risk scores are available at: http://bit.ly/2dBJIKt. The aim of this study is to inform resilient community initiatives and other community health stakeholders of potential strategies to optimize the allocation of scarce community health improvement interventional resources.

Data

Three years (fiscal years 2013 to 2015) of hospital inpatient, outpatient and emergency department data were aggregated at the ZIP-code level for the study area which included Missouri, Kansas and 65 Illinois ZIP codes located in the St. Louis metro area. More than 200 ICD 9-CM, major diagnostic category and discharge disposition codes were categorized into 25 measures which were attributed to one of four ACE-related domains: abuse, neglect, household challenges and toxic stress. All measures and domains are presented in Table 1, and a detailed description of measure definitions, including the categorical coding approach, is available in the data set available at: http://bit.ly/2dBJIKt. Six percent of ZIP codes (119 out of 1,832) were excluded for having missing population data[v], or a total population less than 50.

All measures were calculated as population-based rates using the most relevant population cohort as the base denominator, such as children or females between ages 18 and 49 (Table 1). The population-based rate for each measure was then standardized within its distribution with limits imposed on outliers (z-scores were winsorized at +/-3 standard deviations). The standardization process was completed separately for Kansas and Missouri-Illinois ZIP codes to account for regional differences in the frequency of outpatient data availability.

Models

Latent Variable Models are designed to capture unobservable characteristics by relating latent effects to observed manifest variables.[vi] This analysis used four LVMs each for Missouri-Illinois and Kansas: abuse, household challenges, neglect and toxic stress. The manifest variables used in each domain are described in Table 1. LVMs account for correlation between the measures used within each domain for each ZIP code evaluated. Measures with higher degrees of correlation and larger numbers of observation are weighted more heavily by the factor loading process of LVMs. The LVMs developed for this analysis were weighted by the numerators of each measure, or the number of events — such as the number of diagnosed child abuse cases — observed in each ZIP code. LVMs account for ZIP codes with low volume and missing data, and sampling variation across ZIP codes Additionally, the four ACEs LVMs were fit independently for Kansas ZIP codes to further account for sampling variation.

The ACEs LVMs seek to measure the latent risk children in different communities face by evaluating the observed rates of diagnosed and population-based adverse experiences for children across communities. A risk score was estimated for each of the four ACE domains for all ZIP codes included in the analysis. An overall ACE-risk score was calculated with the average of the four domain scores, weighted by the number of measures included in each. All risk scores are available in the model data set.

Results

In general, high ACE-risk ZIP codes were intermittently dispersed throughout each state included in the study area. ACE risk does not

Figure 2: 2013-2015 ZIP-Level ACE-Risk Scores for the KC Region
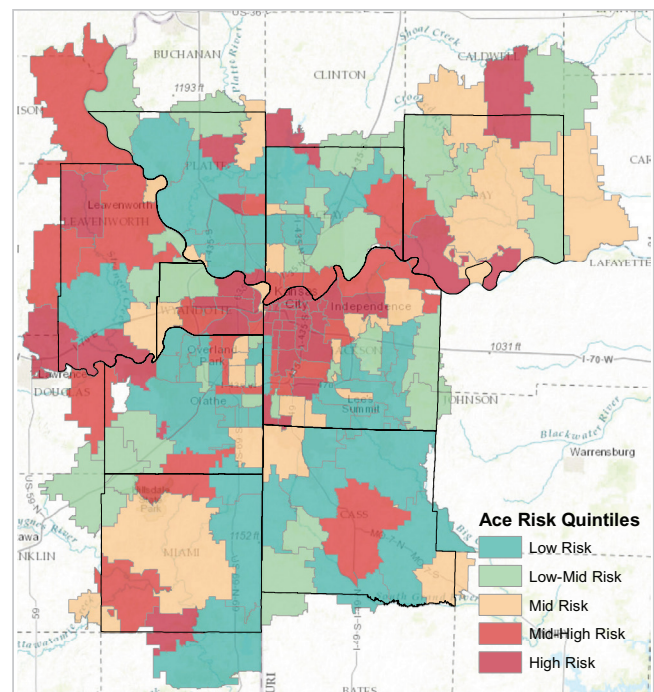
Source: HIDI

appear to be exclusively associated with rural or urban communities. Portions of the largest cities included in the study area were found to have high ACE risk as were many rural ZIP codes. The largest geographically contiguous high ACE-risk areas were observed in south central Missouri into the boot heel, stretching from Ozark to Dunklin counties, and in western Kansas from Hamilton to Rawlins counties. Figure 1 shows the geographic distribution of the overall ACE-risk score quintiles for all ZIP codes included in the study area.

The highest ACE-risk ZIP codes in the greater Kansas City metro area were observed in inner Kansas City stretching from portions of Jackson County, Mo., into much of Wyandotte County, Kan. The majority of ZIP codes in northern and western Jackson County were identified as high risk, with the exception of several communities around the affluent Country Club District in Jackson County and Mission Hills in Johnson County, Kan. Figure 2 includes an inset of Figure 1 for the nine counties included in the Mid-America Regional Council service area.

Figure 3 includes an inset of Figure 1 for the ZIP codes in seven Missouri and Illinois counties included in the St. Louis region. The highest ACE-risk ZIP codes were observed in most of the city of St. Louis, predominantly on the city's north and south sides, North St. Louis County and East St. Louis in Illinois.

Limitations

This study is intended to demonstrate a proof of concept designed to inform resilient community and population health-improvement initiatives of geographic variation in childhood ACE risk at the ZIP code level within specific service areas. The results presented here may be limited by several

Figure 3: 2013-2015 ZIP-Level ACE-Risk Scores for the St. Louis Region
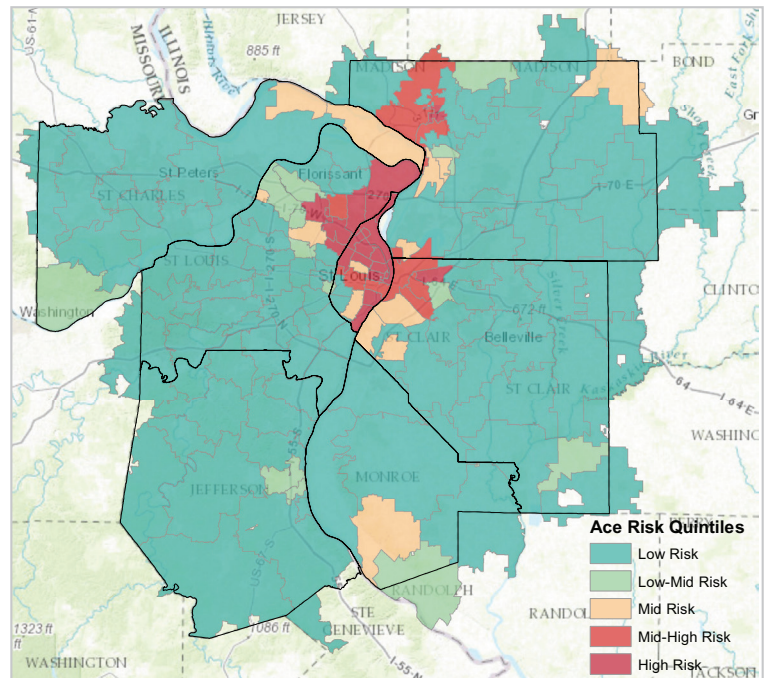
Source: HIDI

factors including variation in the data generation process at different hospitals and the density of hospital-affiliated outpatient services in various markets. For example, ZIP codes in a service area with providers who under report the diagnosis codes used to inform the LVMs may have underestimated ACE-risk scores. Additionally, ZIP codes in markets with high hospital and health system-based outpatient penetration may have overestimated ACE-risk scores. While LVMs are designed to account for such sampling variation and additional steps were taken to bolster inferential reliability, some bias may exist as a result of these regional differences.

Conclusion

Additional validity testing of the estimated ACE risk put forth by this conceptual model is needed. For example, future research may include a panel study of the manifestation of the longer term health outcomes

identified by the original ACEs study for youth growing up in high ACE-risk ZIP codes to evaluate differences in the onset of chronic diseases, adoption of risk behaviors and premature death. At the same time, the ZIP code level estimated ACE-risk scores correlate highly with social determinants of health that have a well-established relationship with long-term outcomes. For example, the ZIP code level correlation between the ACE-risk scores estimated here and a validated measure of socioeconomic deprivation[vii] produces a significant positive linear relationship ($r=0.48$, $P<.0001$).
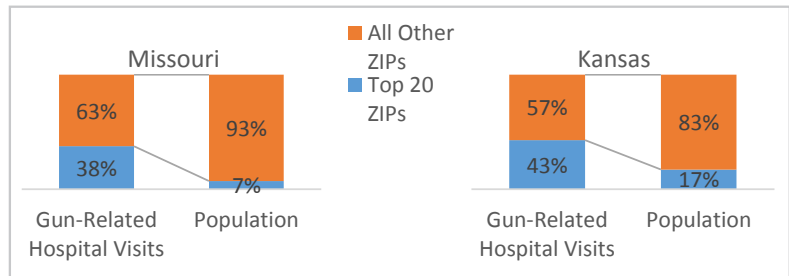
This research brief identified a conceptual method to evaluate the risk of children experiencing traumatic events across ZIP codes in Missouri, Kansas and the St. Louis region in Illinois. The data used to inform the analysis are available for community resiliency initiatives to provide baseline ACEs data, and inform targeted outreach efforts.

Gun Violence: An Emerging Public Health Crisis

Gun-related violence has been referred to as a public health threat in the U.S.[viii] Throughout 2015, there were more than 40,000 acts of violence with firearms in the U.S., including 372 mass shootings. One-third of victims (13,286) died as a result of their injuries.[ix]

Missouri and Kansas ended 2015 with 5,054 hospital visits for shooting victims — this was a 27.4 percent increase throughout 10 years. The 20 ZIP codes in each state that had the most residents treated in a hospital for gun-related injuries were represented in large disproportion to their total populations. In Missouri, 20 ZIP codes, accounting for only 7 percent of the total population in 2015, accounted for 38 percent of hospital visits for gun-related injuries. In Kansas, the disparity was 17 percent of the population compared to 43 percent of shootings treated in a hospital setting in 2015.
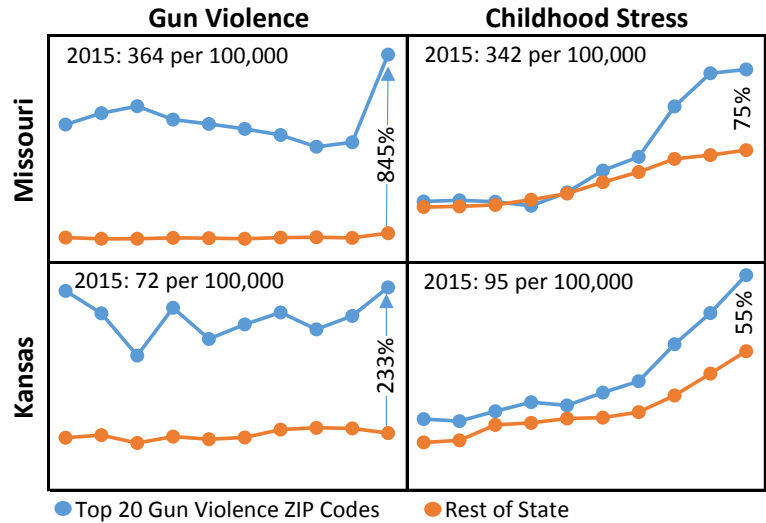
The rates of gun-related hospital utilization for the top-20 ZIP codes in Missouri and Kansas also have trended upward between 2013 and 2015, including an 82 percent jump in the top-20 Missouri ZIP codes during the last three years evaluated. These ZIP codes in Missouri had a gun-related hospital utilization rate that was 845 percent higher than the rest of the state in 2015. For Kansas, the difference was 233 percent.

The rates of toxic stress-related diagnoses for children in the top-20 highest gun-related hospital utilization ZIP codes also are significantly higher than other communities in Missouri and Kansas. Throughout 2015, the rate of stress-related hospital diagnoses — including post-traumatic stress disorder — was 75 and 55 percent higher in the top-20 ZIP codes in Missouri and Kansas, respectively. The rates of stress-related diagnoses for children in these ZIP codes were similar to statewide rates until 2010 when the trends diverged sharply in each state.

Top-20 ZIP Codes for Gun-Related Injuries in 2015

Source: HIDI

Rates of Gun-Related Hospital Utilization and Pediatric Stress Diagnoses for Missouri and Kansas: 2006 to 2015

Notes: Hospital discharge data for gun- and pediatric stress-related visits were gathered from fiscal years 2006 to 2015 HIDI inpatient and outpatient databases for Missouri and Kansas residents. Arrays of diagnosis codes based on keyword search and appearing at any position on the discharge record were used to identify encounters for gun-related injury for patients of any age and stress-related diagnoses for patients under age 19. A full list of codes are available in the downloadable data in the definitions tab: http://bit.ly/2dBJIKt. Population-based rates were calculated with Nielsen-Claritas PopFacts Premier 2006-2015 data. The top-20 Missouri ZIP codes were: 63136, 63115, 63121, 63118, 63135, 63033, 63137, 64130, 63113, 63112, 64127, 64132, 63107, 63134, 63120, 63106, 63111, 64128, 63104 and 65202. The top-20 Kansas ZIP codes were: 66102, 66104, 66101, 67214, 66067, 66106, 67401, 66048, 67846, 66605, 67357, 67801, 67218, 66604, 66607, 67208, 67211, 66103, 66109 and 66061.

Alive and Well STL

Contributed by Jennifer Brinkmann, Chief of Staff at St. Louis Regional Health Commission

The research is clear that trauma and toxic stress stand in the way of many people achieving good health, a good education or viable employment. When people's bodies experience persistent, high levels of stress hormones, chronic diseases can take root, learning is stunted and executive functions, such as decision making and judgment, are impaired.

With the science about toxic stress and trauma, Alive and Well STL is using a public health model to help the region achieve emotional well-being to be physically well. Alive and Well STL is a comprehensive campaign designed to accelerate the understanding of the science about toxic stress and trauma and the adoption of practices that can mitigate the impact for residents of the region.

The public information campaign has been led by the St. Louis NBC affiliate, KSDK NewsChannel 5; Radio One stations, HOT 104.1 and Old School 95.5; and The St. Louis American. As a result, more than 145 million media impressions have been generated with more than 100,000 unique visitors to aliveandwellstl.com and more than 28,000 engaged users on social media platforms.

Since the beginning of the campaign, demand for trainings created by the Missouri Department of Mental Health has exceeded expectations, leading to the development of new curriculum, the recruitment of a team of volunteer trainers and the formation of two learning collaboratives for 26 schools and 7 major health care providers. This comprehensive approach to training has reached more than 8,000 people and is building capacity throughout the region for better responding to residents who have a history of trauma and are living with toxic stress.

Individual citizens and community organizations are working to apply principles advanced by Alive and Well STL in their own communities or workplaces.
- Signature Medical Group has incorporated trauma-informed practices in their work to serve pregnant women and their families. *The Washington Post* featured Signature's approach as a promising practice in a column about the experience of pregnancy for women who have experienced sexual violence.
- Mercy Hospital St. Louis launched an Alive and Well STL-branded employee wellness effort across locations to support the emotional well-being of their staff.
- St. Louis' five major community health centers are working together in a learning collaborative to design trauma-informed models of care in order to improve health outcomes for patients.
- Schools throughout the region are developing strategies for managing classroom behaviors in new ways that lead to fewer in-school and out-of-school suspensions, and increase staff satisfaction.
- Ambassadors who work at universities are integrating the content into curriculum.
- Community organizations, including the St. Louis Cardinals' Redbird Rookies program, Greater St. Louis Council of the Boy Scouts of America and the Girl Scouts of Eastern Missouri are working to train their adult volunteers, so they are better able to engage the youth and families they serve.

Alive and Well STL is supported by the St. Louis Regional Health Commission, Missouri Foundation for Health and St. Louis Mental Health Board.

Truman Medical Center-Behavioral Health

Jennifer Osborne, Ph.D., Clinical Psychologist Supervisor, PTSD Services

At Truman Medical Center-Behavioral Health, we provide outpatient treatment to patients of all ages experiencing trauma-related symptoms. We utilize a trauma-informed approach and offer a wide range of therapeutic interventions including early intervention for exposure to recent trauma. Specialty services for adults include skills training in affect and interpersonal regulation (STAIR), eye movement desensitization and reprocessing (EMDR), prolonged exposure, cognitive processing therapy and hypnosis. Individual and group treatments are available, as well as adjunctive services, such as case, housing and medication management services. Many of our clients come from the highest ACE-risk ZIP codes in the greater Kansas City metro area. Below I have included the stories and outcome data for three successful treatment completers. All individuals carry diagnoses of post-traumatic stress disorder and high ACE scores.

A 41-year old female client experienced significant trauma including abuse, neglect, household challenges and toxic stress. She engaged in EMDR therapy with one of our psychologists and has worked through all but two remaining target memories (trauma memories that are processed until they are no longer distressing). During treatment she was awarded disability benefits, regained custody of her youngest daughter and shifted from a negative to a positive outlook despite continued challenging life circumstances, such as significant medical issues. She also completed respect speakers training and has committed to telling her story in the community to benefit others in need. Her original score on the PCL (PTSD symptom checklist used to measure PTSD symptoms) was 81 and now is down to 35 (a remarkable decrease). Her PHQ-9 (patient health questionnaire used to measure symptoms of depression) was 24 at the start of treatment and now is down to 9 (also a significant decrease from severe to mild depression).

A 53-year old male client also experienced significant trauma including physical and emotional abuse, sexual abuse, neglect, substance use, and domestic violence in his family of origin. He began to experience depression and likely PTSD as a young adult, although he wasn't aware the symptoms were trauma-related at the time. He started to drink excessively then turned to marijuana and crack cocaine. He lost his job and became homeless, which in turn led to more trauma exposure. He presented to one of the downtown Kansas City homeless shelters and received substance abuse treatment, then was referred to TMC-BH. He successfully completed EMDR treatment with one of our social workers. He no longer experiences PTSD symptoms, and has a much lower level of depressive symptoms. He maintains his own apartment, makes friends in the community and is able to set healthy boundaries with others. His PCL went from 45 to 16 (significant decrease in PTSD symptoms), and his PHQ-9 went from 10 to 6 (moderate to mild depression).

A 52-year old female client suffered from sexual abuse and lived with family members who abused substances and engaged in domestic violence culminating in the death of her mother. She spent time in foster care along with her siblings. She was haunted by past memories related to wishing she could have protected her mother. She was referred by TMC-Hospital Hill as an oncology patient identified as experiencing PTSD as a result of past trauma. The social worker who worked with this client noted her remarkable resilience. When she started treatment she had undergone extensive cancer treatment and wasn't feeling well. Through her determination and the high skill level of her therapist, she completed EMDR treatment in one year. She also participated in group treatment, learning adaptive coping skills to manage her symptoms. When she initially presented for treatment, she rarely left her home. By the end of treatment, she was participating in community activities through Turning Point, regularly using the library and attending cooking classes. She also reestablished contact with her siblings, and formed healthier relationships with her husband and two sons. She is much happier and now smiles a lot more. Her PCL went from 63 to 16 (significant decrease in PTSD symptoms), and her PHQ-9 went from 12 to 5 (moderate to mild depression).

[i]   RAND Corporation. Community Resilience. Retrieved from http://www.rand.org/topics/community-resilience.html

[ii] Kansas City Chamber of Commerce. Resilient KC. Retrieved from http://www.kcchamber.com/Resilient-KC/About-Resilient-KC.aspx

[iii] Alive and Well STL. Retrieved from http://www.aliveandwellstl.com/about-alive-and-well/

[iv] Felitti, V. et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. *American Journal of Preventive Medicine, 14*(4), 245-258. Retrieved from http://www.ajpmonline.org/article/S0749-3797(98)00017-8/abstract

[v]   2013-2015 Nielsen Claritas PopFacts Premier Databases

[vi] Landrum, M., Bronskill, S. & Normand, S. (2000). Analytic methods for constructing cross-sectional profiles of health care providers. *Health Services and Outcomes Research Methodology, 1*(1), 23-47.

Henderson, C. (1975). Best linear unbiased estimation and prediction under a selection model. *Biometrics, 31*(2), 423-447.

Shwartz, M., Ren, J., Pekoz, E., Wang, X., Cohen, A. & Restuccia, J. (2008). Estimating a composite measure of hospital quality from the Hospital Compare database: Differences when using a Bayesian hierarchical latent variable model versus denominator-based weights. *Medical Care, 46*(8), 778-785.

[vii] Lian, M., Schootman, M., Doubeni, C., et al. (2011, October 1). Geographic variation in colorectal cancer survival and the role of small-area socioeconomic deprivation: A multilevel survival analysis of the NIH-AARP Diet and Health Study Cohort. *Am J Epidemiol, 174*(7), 828-838.

[viii] National Public Radio. Gun violence 'a public health crisis,' american medical association says. (2016, June 14). Retrieved from http://www.npr.org/sections/thetwo-way/2016/06/14/482041613/gun-violence-a-public-health-crisis-says-ama?utm_source=twitter.com&utm_campaign=npr&utm_medium=social&utm_term=nprnews

[ix] BBC News. Gun violence in the US: The statistics behind the violence. (2016, January 5). Retrieved from http://www.bbc.com/news/world-us-canada-34996604

HIDI
HOSPITAL INDUSTRY DATA INSTITUTE
The Data Company of the Missouri Hospital Association