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MONTEREY, CALIFORNIA

THESIS

SOCIAL NETWORKS AND HIGH HEALTHCARE UTILIZATION: BUILDING RESILIENCE THROUGH ANALYSIS

by

Michael D. Baker

September 2016

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SOCIAL NETWORKS AND HIGH HEALTHCARE UTILIZATION: BUILDING RESILIENCE THROUGH ANALYSIS

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Submitted in partial fulfillment of the
requirements for the degree of

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This thesis explores the links that exist between human beings and how the presence, or absence, of connectivity within a person's social network impacts one's health and well-being. Through the analysis of both the social and clinical sciences, this research explores the question: What role do social relationships, and their associated networks, play in the lives of high healthcare utilizers? This thesis studies the origins of human connection and presents the science of social network analysis to demonstrate how interconnected relationships influence the well-being of networked individuals. The findings indicate that the quality of an individual's social network can have a positive or negative effect on the individual's health. Those who are socially isolated in their community often have difficulty managing complex health conditions and navigating the fractured national healthcare system. Deficits in community healthcare and social support networks cause these individuals to frequently utilize expensive and finite public safety and hospital emergency department resources for primary healthcare services. This research presents four recommendations to promote improved healthcare system navigation for high healthcare utilizers by not only understanding the patients' social networks, but also the healthcare provider network.

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

ACA	Affordable Care Act
CHCS	Center for Health Care Strategies
CMS	Center for Medicare and Medicaid Services
ED	emergency department
EMS	emergency medical services
FEMA	Federal Emergency Management Agency
HIPPA	Health Insurance Portability and Accountability Act
HITECH	Health Information Technology for Economic and Clinical Health
HNHC	high-need, high-cost
MECE	mutually exclusive and collectively exhaustive
MIH	Mobile Integrated Healthcare
NCHS	National Center for Health Statistics
PARTNER	Program to Analyze, Record, and Track Networks to Enhance Relationships
SFFD	San Francisco Fire Department
SNA	social network analysis
STD	sexually transmitted disease

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EXECUTIVE SUMMARY

A group of unique patients exists within the United States healthcare system—a group that finds managing health and well-being difficult despite receiving quality care from leading physicians and modern hospitals. This relatively small group of Americans accounts for approximately half of the annual Medicare and Medicaid spending.[1] Known as superusers, high utilizers, or high-need high-cost patients, these individuals are faced with complex health conditions and functional limitations that are difficult to manage on their own. Combine these challenging health conditions with a national healthcare system that suffers from inefficient care coordination and a fractured network of providers, and the task of reducing this excessive care utilization seems insurmountable. In addition, high healthcare utilizers are often socially isolated and without the positive support networks that contribute to health and social connectedness.

The high utilizer exists within systems of care that are inherently complicated and uncoordinated, making them challenging to navigate without the proper support. High utilizers need help making physician appointments, completing benefit documents, arranging transportation, and filling prescriptions. The reality is that, without the system knowledge and social capital required to affect changes to their healthcare, the excessive resource utilization continues. It is this lack of healthcare and social services support that contributes to the cycle of high utilization.

The nation's public safety resources and police, fire, and emergency medical services (EMS) are on the front line of the battle to reduce high healthcare utilization. In communities across America, high healthcare utilizers are also consuming the service hours of finite emergency resources when poorly managed health conditions become exacerbated and the only option is a trip to the hospital emergency department. A person with functional limitations may also request frequent responses by firefighters for help with daily tasks, such as moving in and out of bed or using the toilet. Often an

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[1] Centers for Medicare & Medicaid Services, "Targeting Medicaid Super-Utilizers to Decrease Costs and Improve Quality," *CMCS Informational Bulletin*, July 24, 2013.

overlooked component of the comprehensive healthcare system, pre-hospital fire and EMS providers are the default care team when a person's social support network fails.

Social network analysis (SNA) reveals the hidden connections that impact an individual's health, and allows us to more deeply study the healthcare provider network. SNA can help improve not only the well-being of individuals, but also the nation as a whole. Through an organizational social network analysis, physicians, case managers, home health providers, or any element of the care team can assess its role in reducing the fractured nature of care delivery, improve the support for the socially isolated patient, and guide the navigation of complex systems that present monumental barriers to the high healthcare utilizer.

It is the high healthcare utilizer's social network that offers a unique opportunity for healthcare providers to understand the barriers to their well-being, initiate improvement activities, and ensure the efficient use of resources. Medicine is a social science and the relationships that connect humans are essential for providing a feeling of security, building social capital, and promoting behaviors that improve general and behavioral health. The invisible network of relationship links allows people to collectively build strong support systems and achieve the unimagined. By studying the individual social network of a high healthcare utilizer, a map of human connection can be revealed. Analyzing this network map can help us visualize the presence or absence of health-promoting network connections and design targeted interventions that address the high utilizer's needs.

The thesis recommends mapping the high utilizer's social network through a formal analysis process in an effort to overcome the broad and ineffective healthcare schemes that fail to promote human engagement, address the social determinants of health, and improve patient outcomes. Fire and EMS within a community cannot solely sustain social and healthcare support for the highest need patients; these groups should consider implementing programs that address excessive demands for service such as Mobile Integrated Healthcare. In general, SNA offers a new opportunity to understand health; with it, we can promote human connections that encourage the design of collaborative, integrated care systems beneficial to all patients.

ACKNOWLEDGMENTS

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I. INTRODUCTION

Bill struggles as he attempts to push Mary's wheelchair across the hot asphalt parking lot, hoping to quickly reach the shade of a lone tree near their apartment building. Mary's health is far worse than Bill's, but his respiratory difficulty has resulted in increasing early-morning ambulance rides to the emergency room. In a single month, Bill made 17 trips to the hospital for a breathing treatment and a fresh inhaler. He lacks the ability to manage his chronic health condition and frequently returns to the hospital not only to feel better, but also to feed his addiction to prescription medications. Complicating Bill and Mary's poor physical health is the fact that each one has a diagnosed mental illness that is rarely treated by medication or supported by professional counseling. Their housing is unstable; the couple bounces from low-rent apartments to budget motels, and they are often evicted at the management's whim. Bill's brother is their only means of support and, as the couple's legal guardian, he does his best to oversee their financial affairs, pay their bills, and stock their refrigerator. However, Bill's health is also suffering, and caring for two families is beyond his current capacity.

Police officers, fire fighters, paramedics, and emergency room staff across the nation respond to calls for service or provide care for people like Bill and Mary. Often called high utilizers or superusers, these high-need, high-cost (HNHC) individuals are the most vulnerable to changes in their medical conditions. Every community has a population of individuals who are dependent upon local emergency services for managing the challenges associated with poorly coordinated healthcare and weak social support, or with simply maintaining a stable household. It is this misaligned relationship pattern that increases local public safety service expenditures and decreases emergency unit availability. High utilizers often rely on fire and emergency medical services (EMS) responders to treat their exacerbated medical conditions or assist with their daily needs, such as getting up from a chair, using the toilet, or preparing food. In addition to prehospital care responders, hospital emergency departments are often the high utilizers' primary source of healthcare as they seek comfort and counsel in a facility that is not the most appropriate for their care, and frequently without available beds.

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Finding a long-term solution to the problems associated with this population group can be a significant community challenge. The system that is designed to provide emergency care when lives are the most threatened has been forced into social worker and home health provider roles to manage patients who are without any other means of help. As a result, the relationships formed between the patient and EMS, fire, or law enforcement personnel are often the only stable source of support that exists in a fractured healthcare system.

A.   RESEARCH QUESTION

This thesis explores the following research questions:

- What role do social relationships, and their associated networks, play in the lives of high healthcare utilizers?

- Can analysis of high utilizers' social networks provide information that could improve their healthcare support while increasing resilience within community emergency response mechanisms?

To answer these questions, this thesis explores social networks, the relationships among the elements of these networks, and the emerging patterns that might be utilized to improve the lives of a community's highest care utilizers. Several supporting questions emerge related to social network analysis:

- What is a social network and why is it important to our well-being?

- How do social networks affect individual behavior?

- What makes social network analysis (SNA) a powerful tool for addressing the needs of the high utilizer?

- Is the strength, or weakness, of an individual's social network ties correlated to his or her consumption of healthcare resources?

- Can applying programs directed at strengthening social network ties reduce the demand for emergency healthcare services and simultaneously increase personal and community resiliency?

B. PROBLEM STATEMENT

In 2012, the Federal Interagency Forum on Aging-Related Statistics issued a report on the status of the nation's aging population. Due to a growing life expectancy, the report indicated that communities can anticipate an increasing number of older adults.[1] Older adults are often the highest utilizers of EMS and healthcare resources, as they struggle to manage multiple health conditions. This difficulty may be a result of a fractured healthcare delivery system or inadequate social support.[2] Among nations, the United States continues to lead healthcare spending; 18 percent of the country's gross domestic product goes toward its health needs.[3] Of significance is the small number of individuals who consume the largest volume of healthcare spending.

As the fire service's EMS role has evolved into a critical component of the community's healthcare system, responders are not immune to the challenges of poorly managed chronic healthcare, including increased obesity and the increased number of adults over 65 living alone or in long-term care centers. Firefighters and other prehospital care providers respond repeatedly to individuals who require immediate intervention to manage conditions such as chronic obstructive pulmonary disease (COPD), asthma, diabetes, and chronic renal failure.[4] As a result, EMS providers may be the first to recognize changes to an individual's social and healthcare support network. What is often missing is a support system capable of effectively managing chronic illness while respecting an individual's desire for independent living. All those involved with the care of high utilizers will benefit from the implementation of social network analysis. Table 1 describes the challenges faced by the relationship connections within the high utilizer's social and healthcare support network.

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[1] Federal Interagency Forum on Aging-Related Statistics, *Older Americans 2012: Key Indicators of Well-Being* (Washington, DC: U.S. Government Printing Office, 2012), xv.

[2] Meredith Cohn, "Reducing Emergency Room Use by Targeting 'Super Utilizers,'" *Baltimore Sun*, September 29, 2015, http://www.baltimoresun.com/health/maryland-health/bs-hs-super-utilizer-20150916-story.html.

[3] Susan J. Blumenthal and Nina S. Russell, "Healing the Sickest Patients: How 'Hot Spotters, 'Frequent Fliers,' and 'Super-Utilizers' Impact Health Care in America," *Huffington Post*, August 18, 2015, http://www.huffingtonpost.com/susan-blumenthal/healing-the-sickest-patie_b_8003826.html.

[4] Atul Gawande, "The Hot Spotters," *New Yorker*, January 24, 2011, http://www.newyorker.com/magazine/2011/01/24/the-hot-spotters.

Table 1.   Stakeholder Analysis

Care/Response Component	Benefit from the Application of Social Network Analysis
Patients	Developing targeted intervention programs based on the individual's needs may potentially help improve the individual's overall health and quality of life. Can a solution be developed that strengthens the support networks and reduces their dependency upon emergency response?
Physicians and Hospitals	Seeking a method to reduce emergency department utilization and readmission—which impacts financial reimbursement from the Centers for Medicare and Medicaid Services—is a major goal of healthcare institutions. The over utilization of the emergency department as a primary healthcare resource is a consistent problem that requires a systemic approach.
Fire and EMS Responders	Frequent, recurring response places responders at risk for injury and increases operational demand. In 2015, the Tulsa Fire Department responded to over 1,800 requests for lifting assistance.[5] In one case, responders were requested 8 times in a 24-hour period in order to provide assistance in the bathroom. Prehospital providers are often placed in a challenging position: they must meet the individual's needs without becoming a long-term care provider. Often, the only alternative to case management is transportation to an already crowded hospital emergency department.
Homeland Security	The National Health Security Strategy, National Disaster Recovery Framework, and the National Infrastructure Protection Plan all mention the need for public health resilience.[6]
Local Governments	The ability to develop a healthy and disaster-resilient community involves social support, economic development, and community stability.[7]
Emergency Manager (EM)	Tasked with the management of community safety, emergency managers (EMs) plan for worst-case scenario situations and seek to ensure that all residents are prepared to withstand a disaster. Vulnerable populations are one of the highest concerns for an EM and ensuring their safety requires significant planning and resource utilization.

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[5] Tulsa Fire Department Emergency Medical Services Branch, *TFD Community Health Pilot Program Review* (Tulsa, OK: Tulsa Fire Department, 2016), 4.

[6] See Department of Health and Human Services, *National Health Security Strategy and Implementation Plan 2015−2018* (Washington, DC: Department of Health and Human Services, 2015), 1, http://www.phe.gov/Preparedness/planning/authority/nhss/Documents/nhss-ip.pdf; Federal Emergency Management Agency, *National Disaster Recovery Framework* (Washington, DC: Department of Homeland Security, 2016), 8, http://www.fema.gov/media-library-data/1466014998123-4bec8550930f774269e0c5968b120ba2/National_Disaster_Recovery_Framework2nd.pdf; Department of Homeland Security, *National Infrastructure Protection Plan 2013* (Washington, DC: Department of Homeland Security, 2013), 7, https://www.dhs.gov/sites/default/files/publications/National-Infrastructure-Protection-Plan-2013-508.pdf.

[7] Anita Chandra et al., *Building Community Resilience to Disasters: A Way Forward to Enhance National Health Security* (Santa Monica, CA: RAND, 2011), 9, http://www.rand.org/content/dam/rand/pubs/technical_reports/2011/RAND_TR915.pdf.

Research into the relationship of an individual's health with his or her social network reveals the importance of the network structure. Where an individual is situated within a network can impact the quality of his or her health.[8] This position in a social network is also relevant to promoting quality health behaviors; habits that improve health can diffuse throughout a network and influence the behavior of others.[9] Therefore, the analysis of a social network and an individual's position within that network could become a key research component in the study of community residents with the highest medical needs at the highest delivery costs.

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[8] Nicholas A. Christakis and James H. Fowler, *Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives* (New York: Little, Brown and Company, 2009), 106.

[9] Ibid.

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II.   LITERATURE REVIEW

The social science community has a well-established body of knowledge related to the importance of human social networks. Connections, or ties, within these social networks greatly impact and are impacted by our personal behavior.[10] Many researchers have studied social networks in an effort to understand the spread of disease, address obesity, and trace the origins of sexually transmitted disease.[11] Understanding the connection between medicine and sociology is becoming even more important as our nation's healthcare systems attempt to address an increasing demand for service. In seeking to assist the high healthcare service utilizers while diminishing their recidivist demands, decision-makers may benefit from adapting existing SNA research and applying the result to the challenges facing our most frequent patients.

A.   HEALTHCARE SYSTEMS AND THE IMPACT OF HIGH UTILIZERS

Despite the best efforts of many healthcare professionals and national insurance coverage legislation, the United States healthcare system is one of the most expensive in the world.[12] Federal healthcare programs under the direction of the Centers for Medicare & Medicaid Services (CMS) have reported that only five percent of those enrolled in the health benefit are responsible for over half of the agency's spending.[13] The nation's healthcare funding systems face continued stress due to the rapidly growing number of adults over 65, which is projected to reach 88.5 million persons in the United States by the year 2050.[14] The journal for the Society for Academic Emergency Medicine published a 2007 nationwide study of emergency medical service utilization by older adults. The study found that there were 167 service requests per every 1,000 older

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[10] Sean F. Everton, *Disrupting Dark Networks* (New York: Cambridge University Press, 2012), 5.

[11] Thomas W. Valente, *Social Networks and Health: Models, Methods, and Applications* (New York: Oxford, 2010), 4.

[12] Organisation for Economic Co-operation and Development (OECD), *Health at a Glance 2015: OECD Indicators* (Paris: OECD Publishing, 2015), 164, doi: 10.1787/health_glance-2015-en.

[13] Blumenthal and Russell, "Healing the Sickest Patients."

[14] Federal Emergency Management Agency, *Impact of an Aging Population on Fire and Emergency Medical Services*, (Washington, DC: Department of Homeland Security, 2013), 1.

adults.[15] Rapid population growth combined with a higher EMS utilization rate not only strain the services that provide EMS care in a community (fire department and ambulance transport), but also impact the hospital emergency department capacity and staff, and continue to increase the cost of care.

B.   CONNECTING HEALTHCARE UTILIZATION TO THE INDIVIDUAL'S SOCIAL NETWORK

In their paper "Applying Social Theory to Understand Health-Related Behaviours," authors Daniel Holman and Erica Borgstrom specifically address the social aspect of health behavior. They posit that the current focus on improving health behaviors does not evaluate the context in which an individual's behavior occurs—specifically, within the relationships associated with a person's social network.[16] Researchers of prehospital care have also noted the need to identify the components of a patient's social network. Ricky Kue et al. discuss the opportunity for EMS responders to evaluate elderly patients' social support systems in an effort to verify that referrals to social agencies are actually completed and a response for assistance is initiated.[17] Their paper explains that many older adults have smaller, or less dense, social networks than they did when they were younger. They may also be less capable of providing their own care.

The 2015–2018 National Health Security Strategy stresses the importance of social networks in its introduction. The strategy clearly states that the locus of national health security is at the community level and that at-risk individuals may be more vulnerable to the effects of disaster due to "weak social networks."[18] The strategy advocates that by developing stronger ties within social networks, a community can build

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[15] Manish N. Shah et al., "The Epidemiology of Emergency Medical Services Use by Older Adults: An Analysis of the National Hospital Ambulatory Medical Care Survey," *Academic Emergency Medicine* 14, no. 5 (2007): 443.

[16] Daniel Holman and Erica Borgstrom, "Applying Social Theory to Understand Health-Related Behaviours," *Medical Humanities* (October, 2015): 144, doi: 10.1136/medhum-2015-010688.

[17] Ricky Kue et al., "Evaluation of an Emergency Medical Services–Based Social Services Referral Program for Elderly Patients," *Prehospital Emergency Care* 13, no. 3, (2009): 273, 276, doi: 10.1080/10903120802706179.

[18] Department of Health and Human Services, *National Health Security Strategy and Implementation Plan*, 1.

its overall resiliency to disaster.[19] Analyzing an individual's social network structure may well contribute to a better evaluation of that person's health and resilience.

Utilizing SNA as a research approach emphasizes the network structure's composition and relationships, rather than relying solely on an individual's characteristics or attributes.[20] A strong social support network that includes a frequent exchange of information can speed a person's recovery from illness, provide a coping mechanism in the event of traumatic or stressful situations, improve overall health, and promote healthy behaviors.[21] To better understand the connections within an individual's healthcare support system, a basic understanding of the social network is addressed in this thesis.

C.   UNDERSTANDING SOCIAL NETWORKS AND SOCIAL NETWORK ANALYSIS

Analyzing a social network in relation to an individual's health differs from traditional research, which focuses on an individual's personal attributes; SNA focuses, instead, on structural aspects and associated metrics of the individual's social ties and their impact on behavior.[22] Marin and Wellman argue that the cause of an individual's problem is not solely determined by his or her personal attributes, but also by the individual's position in a social network.[23] By studying a high utilizer's network, we can potentially identify strengths and weaknesses in his or her support system.

Two books—*Connected* by Drs. Nicholas A. Christakis and James H. Fowler and *Six Degrees* by Duncan J. Watts—have addressed the importance of networks. Watts states that the structure of the network plays a dual role, both in terms of the individual and his or her social ties, "because it affects either their individual behavior or the

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[19] Ibid., 10.

[20] Steve Ressler, "Social Network Analysis as an Approach to Combat Terrorism: Past, Present, and Future Research," *Homeland Security Affairs* 2, no. 8 (2006): 2, https://www.hsaj.org/articles/171.

[21] Betty J. Blythe, "Social Support Networks in Health Care and Health Promotion," in *Social Support Networks: Informal Helping in the Human Services*, ed. James K. Whittaker and James Garbarino (New York: Aldeine De Gruyter, 1983), 107–108.

[22] John Scott and Peter J. Carrington (eds.), *The SAGE Handbook of Social Network Analysis* (London: SAGE, 2011), 3.

[23] Ibid., 7.

behavior of the system as a whole."[24] The potential for research in this area is not specific to just an individual—it can analyze the entire network that supports the individual's social well-being. Christakis and Fowler describe the social network–health connection by evaluating the obesity epidemic and other health-related issues. One of the most important concepts presented in their book is the individual's "embeddedness" within social networks. This embeddedness principle addresses the structure of human networks and the connections among members.[25] Finally, Christakis and Fowler point out that by taking a social network perspective of health, we can approach both our public and personal healthcare in a new manner. This area of research, both in social sciences and healthcare, is significant; many authors believe we can improve our nation's healthcare by critically analyzing social networks.

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[24] Duncan J. Watts, *Six Degrees: The Science of a Connected Age* (New York: WW Norton, 2004), 28.

[25] Christakis and Fowler, *Connected*, 130.

III. THE ORIGIN OF HUMAN CONNECTION

A. FORMING RELATIONSHIPS

An early story describing man's necessity to be connected to others can be found in the beginning chapter of the Bible. In Genesis 2:18, Adam is walking among the animals and other living creatures of the earth, alone and isolated, as the only human being. "The Lord God said, 'It is not good for the man to be alone. I will make a helper suitable for him.'"[26] Even after naming all the creatures of the earth, "no suitable helper" could be found within the new creation.[27] So the Lord God made a woman, Eve, from Adam's rib as he slept. Not only was a helper found for man, but this also brought the creation of the first connection between two people.[28] The world's first pair of human beings relied on each other for support; from Adam's need for a helper, the two bore children that eventually formed the network of concealed interconnections that continues to link us to others.[29]

Early man faced beasts that were not only abundant sources of food and shelter, but that also represented a threat. With larger bodies and fiercer weapons, such as claws, many animals made hunting a dangerous, yet essential, activity for survival. Seeking sources of food, providing shelter, and maintaining safety for the family required a collective effort of other tribal members in order to thrive in the natural world.[30] Although today's human population is no longer a hunter-gatherer society, the significance of membership within a social group for collective support is still relevant. Author John Bruhn writes in his book *The Group Effect: Social Cohesion and Health Outcomes* that, although the survival needs are not the same, man still requires a social

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[26] Gen. 2:18 (New International Version)

[27] Gen. 2:20 (New International Version)

[28] Gen. 2:21–22 (New International Version)

[29] Charles Kadushin, *Understanding Social Networks* (New York; Oxford University Press, 2012), 13.

[30] John Bruhn, *The Group Effect: Social Cohesion and Health Outcomes* (New York: Springer, 2009), 1.

connection to his family, friends, and neighbors.[31] Bruhn clarifies why belonging to a social group and the associated interaction remains important for all individuals—the connections that are established with others, from birth onward, he explains, add meaning to peoples' lives and make them unique individuals.[32] Membership in a social group not only helps to establish an individual's identity, but also provides the ability to accomplish tasks beyond the capabilities of a lone human. It is the social connections, or networks, we form with others that shape our lives and simultaneously establish a pathway for us to contribute to the greater society.

Our first connection is formed at birth, when we are initially dependent upon our mother for subsistence.[33] Reliance on family continues throughout the life course as individual networks are built and the dependency upon one's primary caregiver is reduced. This psychological need for security will remain constant throughout life; it becomes an embedded element of our networks along with our desire to form external connections that structurally support basic human needs.[34]

As children progress through developmental stages, they begin to explore the boundaries of their world and to discover the benefits associated with incremental freedoms. Charles Kadushin writes that individuals' drive to explore both activities and relationships is an element of their need to establish themselves within a human social structure that offers opportunity and simultaneously provides security.[35] Internal agency—or motivation—develops, and the benefits related to external social connections are realized outside of the family unit.[36] These social networks function through an exchange of social currency among the members. Social capital, as defined by Robert Putnam, Lewis Feldstein, and Donald Cohen in *Better Together*, consists of "social networks, norms of reciprocity, mutual assistance, and trustworthiness" that provide the

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[31] Ibid.

[32] Ibid., 1.

[33] Ibid., 59.

[34] Ibid., 56.

[35] Ibid., 60.

[36] Ibid., 63.

members with "value" and drive the motivation for expanding connections.[37] Social capital is the currency of human networks.

B.   SOCIAL CAPITAL AND BUILDING NETWORKS

Putnam et al.'s definition of social capital, and Putnam's collective writings on the subject, provide the foundation for understanding how our connections with others are critical to our well-being. Researchers have established many variations on the definition of social capital, but the essential components remain similar despite comprehensive study. Ichiro Kawachi and Lisa Berkman provide a broader definition of social capital as "resources that are accessed by individuals as a result of their membership of a network or a group."[38] Two terms remain consistent between the authors: network and resources. John Bruhn defines social capital with greater focus on the element of value, asserting that the value of social capital is simply "the resources gained from relationships."[39] Humans create connections between individuals to both build and collect the resources required to maintain the many facets of their social world.

Social capital as a theory first appeared in 1916 in the writing of West Virginia Supervisor of Rural Schools L. J. Hanifan, who was attempting to gather support for the schools under his administration.[40] Hanifan, as quoted by Putnam in *Bowling Alone*, asserts that if we are not connected to others, we are "helpless socially."[41] He continues by declaring that, as people come together, they form a community strong in social capital; these connections benefit not only the individual, but also the group.[42] The following statement by Hanifan conveys the concept of social capital and the nature of the humans who form the associated connections: "The community as a whole will

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[37] Robert D. Putnam, Lewis Feldstein, and Donald J. Cohen, *Better Together: Restoring the American Community* (New York: Simon & Schuster, 2004), 3.

[38] Ichiro Kawachi and Lisa F. Berkman, "Social Capital, Social Cohesion, and Health," in *Social Epidemiology* in *Social Epidemiology*, eds. Lisa F. Berkman, Ichiro Kawachi, and Maria Glymour (London: Oxford University Press, 2014), 291.

[39] Bruhn, *Group Effect*, 56.

[40] Robert D. Putnam, *Bowling Alone: The Collapse and Revival of American Community* (New York: Simon & Schuster, 2001), 19.

[41] Ibid.

[42] Ibid.

benefit by the cooperation of all its parts while the individual will find in his associations the advantages of the help, sympathy, and the fellowship of his neighbors."[43]

Although Hanifan presents the positive aspects associated with social capital, it should be understood that social capital also has the potential to diffuse negative behaviors, practices, or resources via an established network.[44] Examples of this are the transmission of unhealthy conditions such as obesity across a social network; tight clustering of family or group units, promoting strong cohesion and resulting in the exclusion of (or biases against) non-members; strained group resources through disproportionate demands; and excessive social control over group members.[45] Therefore, it is important to consider the restrictions that may be placed on an individual as a member of a socially structured network. In general, it is important to understand social capital because it demonstrates the implicit and explicit value in networks that are formed of a person's desire to seek a secure and socially connected environment.[46]

There are two forms of social capital that must be considered within the context of associated networks: bonding social capital and bridging social capital. In their book *Social Epidemiology*, social scientists Ichiro Kawachi and Lisa Berkman provide the following definitions:

- **Bonding Social Capital**—The resources that are accessed within networks or groups in which the members share similar background characteristics such as class or race/ethnicity.

- **Bridging Social Capital**—Refers to the resources that are accessed across networks that cross, or bridge, class, race/ethnicity, or other social characteristics.[47]

Developing an understanding of these two aspects of social capital is important when evaluating an individual's, or community's, connective network. One example that demonstrates bonding social capital is a family living in poverty. The family's need to

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[43] Ibid.

[44] Kawachi and Berkman, "Social Capital," 294.

[45] Ibid., 295–296.

[46] Putnam, *Bowling Alone*, 18–19.

[47] Kawachi and Berkman, "Social Capital," 297.

maintain a secure existence results in a tight social bond within the unit that may subsequently promote an increased isolation from potentially beneficial, or threatening, outside resources.[48] On the other hand, and often seen as complementary, a bonded social network offers a quality of "density" that indicates a higher level of confidence, reliance, trust, and embeddedness within the network.[49] Robert Putnam adds that bonding social capital is "a kind of sociological superglue."[50]

In contrast to bonding, the bridging form of social capital extends connections beyond the exclusive group membership and expands the potential for further resources, encouraging reciprocity among those connected. Bridging is sometimes difficult to encourage due to our inherent nature to pursue homophily—the network principle that we inherently want to connect with people who are similar to us or share like values and interests.[51] In *Better Together*, Putnam et al. address the fact that bridging social capital is "the most essential" element in building strong and vibrant communities, and describe overcoming homophily as a significant barrier to extending networks and increasing social diversity.[52] Considering the two forms of social capital provides a foundational understanding of motivations for individual or collective behavior, but also contributes valuable information to the study of exchanges originating and moving through established networks and clusters.

Even with an understanding of how resources are diffused via networks, measuring social capital is a difficult task for researchers. When evaluating the network of individuals, communities, or groups, considering the connected actors' density and structure will help describe the social capital the group members share. It is also important to understand that retaining and utilizing social capital can have disparate value. The dynamic nature of the social capital within human relationships, and the

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[48] Ibid.

[49] Kadushin, *Understanding Social Networks*, 60.

[50] Putnam, *Bowling Alone*, 23.

[51] Kadushin, *Understanding Social Networks*, 9.

[52] Putnam, Feldstein, and Cohen, *Better Together*, 3.

ability to maintain social connections at both the individual and group level simultaneously, demonstrates the value of assessing how people engage with others.

C.   COMMUNITY SOCIAL CAPITAL

In a 2014 report titled *Civic Engagement and Social Cohesion: Measuring Dimensions of Social Capital to Inform Policy*, the National Academies of Science's National Research Council recognized the multiple dimensions of social capital and explored the important role they play in our communities.[53] The result of this collective research was presented in the form of six recommendations designed to promote multilevel study of how our individual and collective actions form socially stable and stress-resilient communities.[54] The recommendations are based on a multitude of conclusions presented by the researcher. The first conclusion provides the most comprehensive reasoning for evaluating the cohesion among community members:

> Data on people's civic engagement, their connections and networks, and their communities—aggregated at various levels of demographic and geographic granularity—are essential for research on the relationships between a range of social capital dimensions and social, health, and economic outcomes, and for understanding the directions of those effects. This research in turn informs policies that seek to maximize beneficial outcomes and minimize harmful ones.[55]

Assessing the validity of social capital measurement is addressed throughout the National Academies of Science report, yet it is the connections and networks that are featured as the area of focus. Analyzing these social networks can help researchers understand not only how social capital flows across networks, but also how positive and negative relationships impact communities and the individuals within them.

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[53] Kenneth Prewitt, Christopher D. Macki, and Hermann Habermann (eds.), C*ivic Engagement and Social Cohesion: Measuring Dimensions of Social Capital to Inform Policy* (Washington, DC: The National Academies Press, 2014), 1.

[54] Ibid., 2.

[55] Ibid.

Humans are social beings who form connections with others for security, exchange of resources, and information gathering about the world. The presence of a network begins at birth and is forever connected from those first moments of life, though it should be noted that the relationships we establish through social networks are dynamic, and the roles we play in those networks are constantly changing. Our networks are the conduits for exchanging social capital. This bonding or bridging resource can isolate us within close family or like-minded groups. or grow our network influence beyond our immediate physical proximity. Networks are a powerful tool, and their analysis can reveal a great deal of information about the individuals and groups connected they connect.

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IV.   THE HUMAN SOCIAL NETWORK

This chapter provides common definitions and concepts of a social network's fundamental components. Although much of the information is based on the work of network researchers Stanley Wasserman and Katherine Faust in their book *Social Network Analysis: Methods and Applications*, variations in terminology and definition do occur between researchers.

A.   SOCIAL NETWORK TERMINOLOGY

(1)   Social Network

The social network is defined as a "finite set or sets of actors and the relation or relations defined on them."[56] There are many forms of relationships that can exist among the entities, and "economic, political, interactional, or affective" are a few examples provided by Wasserman and Faust.[57]

(2)   Actor

An actor is the social entity of the network and can be a "discrete individual," corporation, or "collective social unit."[58] The term "node" may also be used to describe an individual element of a network and is often exchanged with actor.[59] In the context of researching social networks, it is important to understand that "actors and their actions are viewed as interdependent rather than independent, autonomous units."[60]

(3)   Relational Tie

Actors are connected to other actors through ties. A tie is a relationship connection, or "linkage," that functions as a path for exchanging information or

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[56] Stanley Wasserman and Katherine Faust, *Social Network Analysis: Methods and Applications* (New York: Cambridge University Press, 1999), 20.

[57] Ibid., 3.

[58] Ibid., 17.

[59] United States Army and United States Marine Corps, *Counterinsurgency Field Manual* (FM 3-24; MCWP 3-33.5) (Chicago: University of Chicago Press, 2007), 318.

[60] Wasserman and Faust, *Social Network Analysis*, 4.

resources—social capital—between the actors.[61] According to Wasserman and Faust, "ties may be any relationship existing between units—for example, kinship, material transactions, flow of resources or support, behavioral interaction, group co-memberships."[62] One of the most important elements of a relational tie is that the flow of resources can be directional or bidirectional. The presence of two actors in a room is considered a network connection. If there is no exchange of resources, then the tie is considered simple.[63] If there is an exchange moving from the first actor to the second, however, then a directional relationship can be established. Finally, a mutual exchange between the two actors is bidirectional or symmetric.[64] In order to analyze these relationships, it is important to evaluate and understand the direction of the resource flow.

(4) Dyads and Triads

A dyad is a set of two actors and the relational tie that exists as a component of the pair's relationship.[65] This is the simplest form of a network, and an example of the relationship between Adam and Eve, as previously discussed. Additionally, the dyad forms the "basic unit for the statistical analysis of social networks."[66] When a third actor joins one or both of the actors in a dyad, a triad forms (see Figure 1). Triads are the foundational element of social networks because they tend to complicate simple one-to-one relationships by their very nature and provide building blocks for network growth.[67]

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[61] Ibid., 18.

[62] Ibid., 8.

[63] Kadushin, *Understanding Social Networks*, 14.

[64] Ibid., 14–15.

[65] Wasserman and Faust, *Social Network Analysis*, 18.

[66] Ibid.

[67] Kadushin, *Understanding Social Networks*, 16.
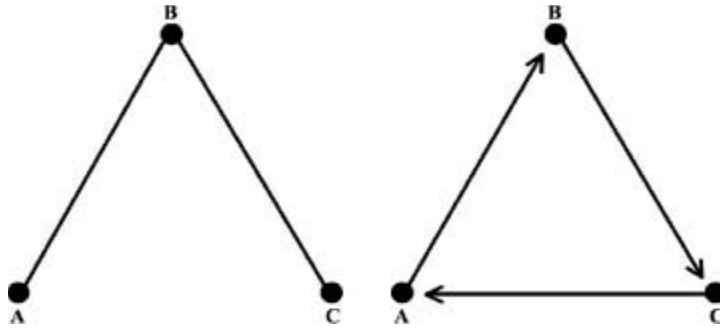
Figure 1. Basic Triad[68]

A social network's components are not limited to the relationships established within dyads or triads. Wasserman and Faust look at the group as the larger visualization of the relationships among the individual components. A group is "the collection of all actors on which ties can be measured."[69] This provides an important definition, especially as it relates to the analysis of social networks. Groups are not infinite and must be "bounded" in order to provide a reason for the actors to be tied together in a logical relationship.[70]

B.   THE CONNECTED WORLD

The invisible connections that exist within our lives form a conduit for sharing our emotions, shape courses of action, and provide a pathway for our social interactions with others.[71] Critical community infrastructure that provides transportation, healthcare, and communications are examples of networked systems that exist in our collective environment—they all comprise countless numbers of individual components (nodes) and an expansive volume of connections (ties).[72] Even our bodies represent a biological network that connects our various organs and associated metabolic systems to ensure

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[68] Source: George A. Barnet (ed.), *Encyclopedia of Social Networks* (London: SAGE, 2011), 873.

[69] Wasserman and Faust, *Social Network Analysis*, 19.

[70] Ibid.

[71] Christakis and Fowler, *Connected*, 7.

[72] Committee on Network Science for Future Army Applications, *Network Science* (Washington DC: National Academies Press, 2006), vii, doi: 10.17226/11516.

their function and to maintain our health.[73] We live in a connected world and are dependent upon biological, technical, social, and other networks in our daily lives.[74] We find ourselves in a modern world that is highly connected, complicated, and non-linearly complex.

Watts warns that even though people "exist as identifiably individual units, they function by interaction."[75] It is the "patterns of interaction" that emerge as a result of complexity that sets apart closed linear systems from open, non-linear human and socio-technical systems and the networks that connect them.[76] By studying the aggregated group and removing independent behavior, social and network scientists can analyze the collective's behavior exclusive of the individual components.[77] Watts presents two additional elements that frame the understanding of social networks. First, networks are dynamic in nature and can change based on the activity of their individual components. The individual elements within the network are continuously completing tasks—communicating, exchanging resources, or sharing ideas. Second, the network's structure is important because it reflects, and in turn impacts, the behavior of an individual element or potentially the network as a whole.[78] Humans associate themselves with social networks based upon a variety of motivations (e.g., propinquity, homophily, safety, or sense of security) as well as upon the various organizational roles that change throughout a lifetime (family, employment, community, religion). The network's structure can reveal how these activities impact the behavior of a collective group (a cluster) as well as how group behavior (at the system level) affects individual behavior at the local level.[79]

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[73] Frederic H. Martini and Edwin F. Bartholomew, *Essentials of Anatomy and Physiology*, 4th ed. (San Francisco: Benjamin Cummings, 2007), 5–7.

[74] Ibid., 1.

[75] Watts, *Six Degrees*, 26.

[76] Ibid., 26.

[77] Ibid.

[78] Ibid., 29.

[79] Kadushin, *Understanding Social Networks*, 56.

C.   SOCIALLY CONNECTED

Our social networks comprise two components: actors (e.g., individuals, organizations) and the ties that bring the actors together.[80] In their book *Connected: How Your Friends' Friends' Friends Affect Everything You Feel, Think, and Do*, Dr. Christakis and Dr. James Fowler discuss not just the presence of ties among individuals, but the importance of the arrangement of those ties. The arrangement of ties within a social network is different than the attributes associated within a collection of individuals. The network provides the group with something more important than mere association; it provides "a specific set of connections."[81] Two elements, the ties and the "particular pattern" of the ties, are "often more important than the individual people themselves."[82] It is the patterns, arrangements, and connections that make social network analysis such a valuable tool for evaluating group behavior and an individual's social identity. When arranged in a networked configuration, a group can complete tasks that a lone individual could not. One of the most fundamental building blocks in understanding the power of a social network is presented by Christakis and Fowler in the following statement: "The ties explain why the whole is greater than the sum of its parts. And the specific pattern of ties is crucial to understanding how networks function."[83] By studying the presence and patterns of ties, much can be learned about an individual, his or her network, and the support relationships required for his or her livelihood.

Sociology scholar Charles Kadushin describes a network as a "set of relationships" and provides the following definition in his book *Understanding Social Networks*: "A network contains a set of objects (in mathematical terms, nodes) and a mapping or description of relations between the objects or nodes."[84] In a social context, the nodes represent people; the relations between them can range from physical proximity

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[80] Wasserman and Faust, *Social Network Analysis*, 9.

[81] Christakis and Fowler, *Connected*, 9.

[82] Ibid.

[83] Ibid., 9.

[84] Ibid., 14.

to the exchange of information, gifts, or other objects.[85] By analyzing the structure of social networks, it is possible to quantitatively and qualitatively assess an individual's degree of connectivity and influence in terms of strong or weak ties within the network.

Christakis believes there are two fundamental components of a social network. The first component is a connection, "who is connected to whom," and the second is a contagion, or "what, if anything, flows across the ties" that link the nodes.[86] The exploration of social networks requires the researcher to understand connection, contagion, and arrangement of the associated relationships.

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[85] Ibid., 14–15.

[86] Christakis and Fowler, *Connected*, 16.

V.   THE ORIGIN OF SOCIAL NETWORK STUDY

A.   A NEW SCIENCE

Early sociologists recognized that there was value in understanding the behavior of individuals, groups, and organizations by studying the structure of their associated networks. It is the nexus of sociology and mathematics that establishes the basis for social network analysis and provides a method for the research of network structure and behavior.[87] Writings from sociologists such as Emile Durkheim, Karl Marx, and Max Weber contained philosophies that reflected the need to explore the structure of social relationships.[88] But it was Georg Simmel who recognized that the social structures created from human interaction could be studied and used to explain the patterns of behavior associated with society.[89]

Simmel presented his argument in the early 1900s. He believe that what comprises a society is the group interaction that "attains the form of reciprocal influence," and not single organisms amassed as a group.[90] He also believed that these interactions could be analyzed. From this theory, Simmel established two initial social network analysis concepts: form and content. *Form* is defined as the "patterns" that emerge from reciprocal connections between individuals. He described *content* as the "individual motives, emotions, thoughts, feelings, and beliefs."[91] Simmel believes the study of form, derived from collective content, should be the focus of a sociologist's research.[92] This position is based on his belief that form reflects society's action, unlike content, which is unique to the individual.[93]

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[87] Everton, *Disrupting Dark Networks*, 4.

[88] Ibid., 3.

[89] Ibid.

[90] Scott and Carrington, *SAGE Handbook*, 11.

[91] Ibid.

[92] Ibid.

[93] Ibid.

In order for sociologists to find answers to the questions posed by a multifaceted society, they needed a tool to visualize social networks' topology. The goal was to measure various aspects of the network's structure in order to better understand the patterns of behavior that result from its connections and interactions. In 1933, Dr. Jacob L. Moreno revealed what he called "psychological geography" to a meeting of the Medical Society of the State of New York.[94] This mapping of the "currents" associated with human social connections that represented the "forces of attraction and repulsion" within a group was the result of his research within the State Training School for Girls and local public schools.[95] These maps of interaction offered an opportunity to visualize the nature of connections among the individuals studied by showing "galaxies" of highly connected individuals and their associated lines of flow, or "emotions," expressed graphically by links and arrows representing both connection and movement.[96] Moreno thus established the science of sociometry and visually presented the collective research in the form of a sociogram.[97] This graphic map of a social network is defined as follows:

> Network visualization is a form of exploratory analysis…[and] allows network mapping through a visual representation of the actors as points and ties as lines among points; such maps are called sociograms. Sociograms depict existing ties and can include additional actor attributes represented through the color, shape, and size of the points and tie attributes through the direction, color, and thickness of the lines. The position of the points in such plots is determined through an algorithm that places points that have many ties to other points toward the center of the plot and less well-connected points toward the periphery, while trying to maintain equal line length. For directional relationships that presuppose a "sender" and a "receiver," the lines have arrows to indicate the direction.[98]

From Moreno's work, sociologists, along with researchers from other fields such as anthropology, continued to expand the study of social networks and supported the

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[94] "Emotions Mapped by New Geography," *New York Times*, April 3, 1933.

[95] Ibid.

[96] Ibid.

[97] Wasserman and Faust, *Social Network Analysis*, 12.

[98] Miruna Petrescu-Prahova et al., "Using Social Network Analysis to Assess Mentorship and Collaboration in a Public Health Network," *Preventing Chronic Disease* 12 (August 2015), doi: 10.5888/pcd12.150103.

foundational principle that networks can reveal a group's organizational properties and the attributes/characteristics of individuals contained within it.[99] It is from the work of these pioneering sociologists that the origins of modern social network analysis was born. This valuable field of study provides the tools to analyze emergent behavior of social networks and their actors.

B.   NETWORK CONCEPTS

This section provides a broad overview of the principles associated with social network analysis (SNA). The descriptions within this section are based on commonly accepted concepts of SNA that include network distribution metrics—density, structural holes, strong and weak ties, clusters, and centrality—as presented by Charles Kadushin in the book *Understanding Social Networks*.[100]

1.   Apples to Apples

SNA does not simply evaluate connections, or ties, between the actors (nodes) in order to build a picture of the network. Nodes generally represent individuals, but they can also represent groups, organizations, a community, or even events.[101] SNA assesses the set of an actor's links to "similar objects" within a network, allowing for equal comparison between the arrangement and quantity of ties.[102] This like-element analysis is best understood by considering the comparison of apples to apples.[103] An important outcome of the social network structure is found in the patterns of interconnection that develop between nodes. It is this linking through common nodes, "the A➔B link shares a node in common with the B➔C link," that constructs a "web" of connectivity from the powerful links that can establish cause-and-effect relationships among the interrelated nodes and clusters.[104]

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[99] Ibid., 13.

[100] Kadushin, *Understanding Social Networks*, 27.

[101] Stephen P. Borgatti, Martin G. Everett, and Jeffrey C. Johnson, *Analyzing Social Networks* (London: SAGE, 2013), 2.

[102] Everton, *Disrupting Dark Networks*, 7.

[103] Ibid.

[104] Borgatti, Everett, and Johnson, *Analyzing Social Networks*, 2.

2. Focus on the Relationship

Relationships, represented as ties between actors, form the social network structure. There are two foundational elements that comprise the initial building blocks of social networks: the dyad and triad, as described previously.[105] Transitivity is the sharing of a mutual relationship between nodes; transitivity is responsible for the clustering of nodes that form "communities" of people based on geography, common interests, or other group activities.[106] Wasserman and Faust point out that "the fundamental difference between a social network explanation and a non-network explanation is the inclusion of concepts and information on relationships among units in a study."[107] As previously discussed, actors and groups have many unique attributes, such as gender and race. Focusing on individual members' attributes in a social network seeks to identify common nodes and links, but may fail to consider more subtle motivations that drive the formation of strong and weak ties.[108] In contrast to this approach, SNA measures network characteristics that result from the ties or relationships, versus individual node attributes, between the nodes or actors, to determine how these relationships influence the collective network's behavior (see Table 2).[109]

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[105] Wasserman and Faust, *Social Network Analysis*, 18–19; Kadushin, *Understanding Social Networks*, 122.

[106] Ibid.

[107] Wasserman and Faust, *Social Network Analysis*, 6.

[108] Alexandra Marin and Barry Wellman, "Social Network Analysis: An Introduction," in *The SAGE Handbook of Social Network Analysis*, eds. John Scott and Peter J. Carrington (London: SAGE, 2011), 7.

[109] Wasserman and Faust, *Social Network Analysis*, 8.

Table 2.   Node Relation Categories[110]

Relations Category	Example
Similarities	Demographic characteristics, attitudes, geographic locations, group membership
Social Relations	Kinship, like, dislike, cognitive awareness, study of the personal community
Interactions	Behavior-based ties, communicating, helping, support
Flows	Exchanges of resources, information, or influence movement

Through SNA, the researcher seeks to describe the actions, behaviors, and other social interactions that occur as a result of an established connection between the actors.[111] Wasserman and Faust offer the following for researchers analyzing social networks: "Of critical importance for the development methods for social network analysis is the fact that the unit of analysis in network analysis is not the individual, but an entity consisting of a collection of individuals and the linkages among them."[112]

3.   Evaluating Network Type

SNA can involve research focused on an individual's role in the network (egocentric) or an approach that considers a network in its entirety (whole network).[113] In their SNA writing, Alexandra Marin and Barry Wellman describe a whole network as taking a "bird's eye view of social structure" that considers both the nodes and relational data that exists between them.[114] In contrast, the egocentric study is focused on a single node whose adjacent relationships are studied to establish the boundary of measurement.[115] On many occasions, it is useful to study the connections within an egocentric network that link an individual to a group, an organization, or commonly attended events. As mentioned previously, SNA principles respect the measurement of

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[110] Adapted from Marin and Wellman, "Social Network Analysis," 5–6.

[111] Everton, *Disrupting Dark Networks*, 13.

[112] Wasserman and Faust, *Social Network Analysis*, 5.

[113] Marin and Wellman, *Social Network Analysis*, 27.

[114] Ibid., 19.

[115] Ibid.

similar objects, so that reaching beyond what is known as a "one-mode" network—the study of a network connected by a "single type" of node—creates a problem of divergence for the researchers.[116] The solution to this dilemma is to conduct two-mode analysis that looks for "co-membership/co-attendance" (e.g., in organizations joined by individuals or events attended) and builds a graphical depiction of this structure.[117] This graphical depiction primarily consists of a two- or three-dimensional network topology with weighted directional ties between nodes (see Figure 2).
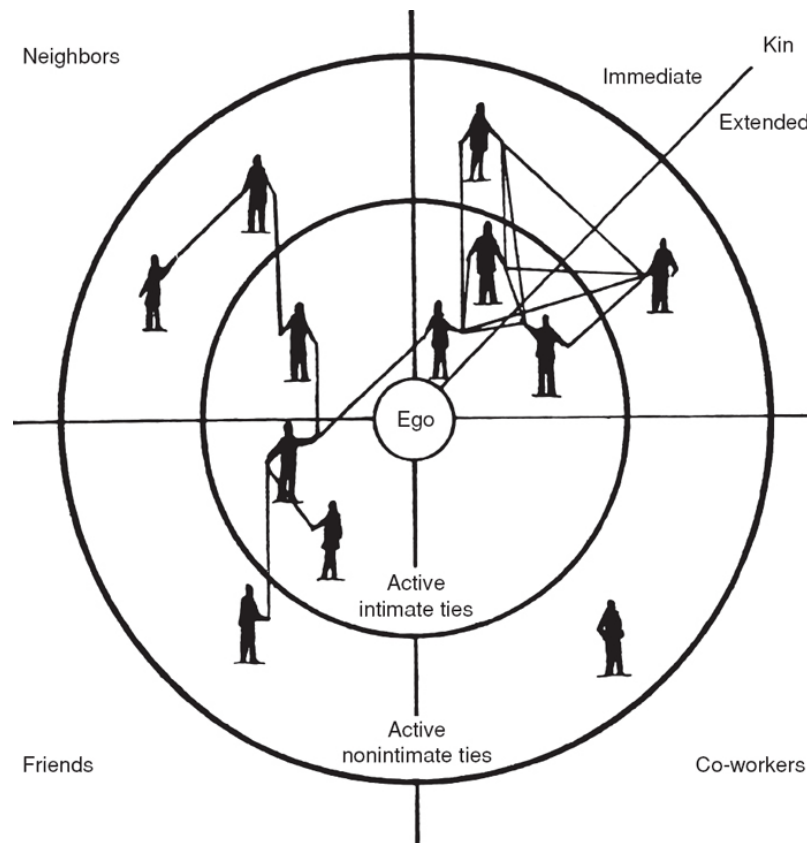
Figure 2. Typical Personal Community[118]

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[116] Ibid.

[117] Ibid.

[118] Source: Vincent Chua, Julia Made, and Barry Wellman, "Personal Communities: The World According to Me," in *The SAGE Handbook of Social Network Analysis*, eds. John Scott and Peter J. Carrington (London: SAGE, 2011), 161.

4.   Density and Path

Kadushin defines density as "the number of direct actual connections divided by the number of possible direct connections in a network."[119] Density is important as a network measurement in the evaluation of "community, social support, and high visibility."[120] Through measuring density, the researcher can evaluate the presence, or absence, of connections in an effort to understand the level of information exchange, social support, or even STD transmission throughout a network.[121] The density within a network may help to reveal the cohesiveness of a group through the presence of either highly connected actors or areas that are minimally linked.[122] When evaluating density, it is also important to consider the network's overall size. As the number of actors within a network grows, the level of density decreases due to an expansion in the number of ties available for connection.[123] In order to understand the level of connectivity between the actors within a network, it is important to know whether relationships are linked directly or indirectly and the number of actors between the connections.[124] The term "path" is used to visualize the route traveled if actor A is to reach actor D via B and C (A-B-C-D).[125] The links in a path may also reveal if the informational or resource flow between two actors is reciprocal in nature.[126] In a network with a weak structure, every actor can be reached through the established paths without the consideration of direction. This contrasts with a strong network, in which actors can "reach their counterparts following paths of particular direction."[127] This reciprocal nature of ties through a directed network

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[119] Kadushin, *Understanding Social Networks*, 29.

[120] Ibid.

[121] Ibid.

[122] Linton C. Freeman, "The Development of Social Network Analysis—With an Emphasis on Recent Events," in *The SAGE Handbook of Social Network Analysis*, eds. John Scott and Peter J. Carrington (London: SAGE, 2011), 31.

[123] Everton, *Disrupting Dark Networks*, 399.

[124] Tetiana Kostiuchenko, "Paths/Walks/Cycles," in *Encyclopedia of Social Networks*, ed. George A. Barnet (London: SAGE, 2011), 695.

[125] Ibid.

[126] Ibid.

[127] Ibid.

builds and maintains social cohesion between the actors.[128] The directional nature of ties also impacts the distance between the connections. Distance is defined as "the shortest paths between two indirectly connected actors."[129] The path that has the fewest number of connections between two connected nodes is known as the geodesic distance. Once again, in a network without a direction in flow, the geodesic distance will be the absolute shortest path; however, the path may be geodesic based on the reciprocal nature of directed network connections. By measuring the longest geodesic distance, the size of the overall network can be established and effectively analyzed.[130]

5.   Structural Holes

In contrast to density, a structural hole is present when two connected groups are linked to each other through a single node or "ego" (see Figure 3).[131] The ego in this case is only connected through a limited number of network ties and therefore is limited in the volume, and quality, of resources it is able to receive from the network.[132] These limits in connectivity constrain a person's ability to strengthen his or her social capital across the network by exchanging information through the in-place connections.[133] In general, structural holes limit both an individual's benefit and the benefit of the group that could be gained through information exchange among disconnected network clusters.

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[128] Ibid.

[129] Ibid., 696.

[130] Ibid.

[131] Kadushin, *Understanding Social Networks*, 30.

[132] Stephen P. Borgatti and Virginie Lopez-Kidwell, "Network Theory," in *The SAGE Handbook of Social Network Analysis*, eds. John Scott and Peter J. Carrington (London: SAGE, 2011), 42.

[133] Ibid.
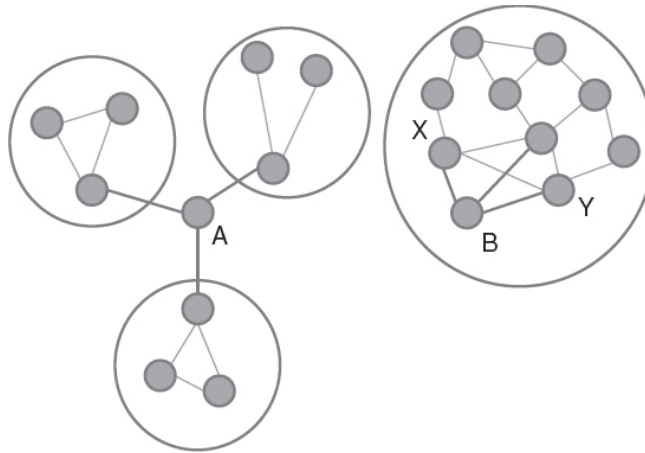
In this example, the left image (A) has more structural holes than the right image (B).

Figure 3. Structural Hole Example[134]

6.   Weak Ties

In 1974, Stanford University Sociologist Mark Granovetter introduced the concept of weak ties to explain the diffusion of information related to employment opportunities across social networks (see Figure 4).[135] His goal was to better understand how people learned about job openings through their informal network connections.[136] It was discovered that employment information was not necessarily shared within strongly connected clusters, but was instead often shared by contacts outside the person's family or closest friends.[137] He found that weak ties throughout the network bridge information from the highly bonded groups to the larger social network.[138] Weak ties are understood to be acquaintances. Strong ties, in this case, are the bonds between close friends.[139] In *Connected*, Christakis and Fowler provide examples of how weak ties play important roles in our networks. The exchange of information is one of the primary functions of human networks. The information contained within our closest circles is commonly

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[134] Source: Ibid., 41.

[135] Scott and Carrington, *SAGE Handbook*, 34.

[136] Ibid.

[137] Ibid.

[138] Christakis and Fowler, *Connected*, 157.

[139] Kadushin, *Understanding Social Networks*, 30.

shared and lacks the diversity often needed to build social capital.[140] This search for new information often begins "two to three degrees away" (a degree in this context is defined as the number of links from one node to another within the network) from the highly clustered sections of our networks to ensure that we are truly finding new information.[141] For network analysis, understanding both strong and weak ties is important in order to properly evaluate network structure and recognize the impact of seemingly distant ties.
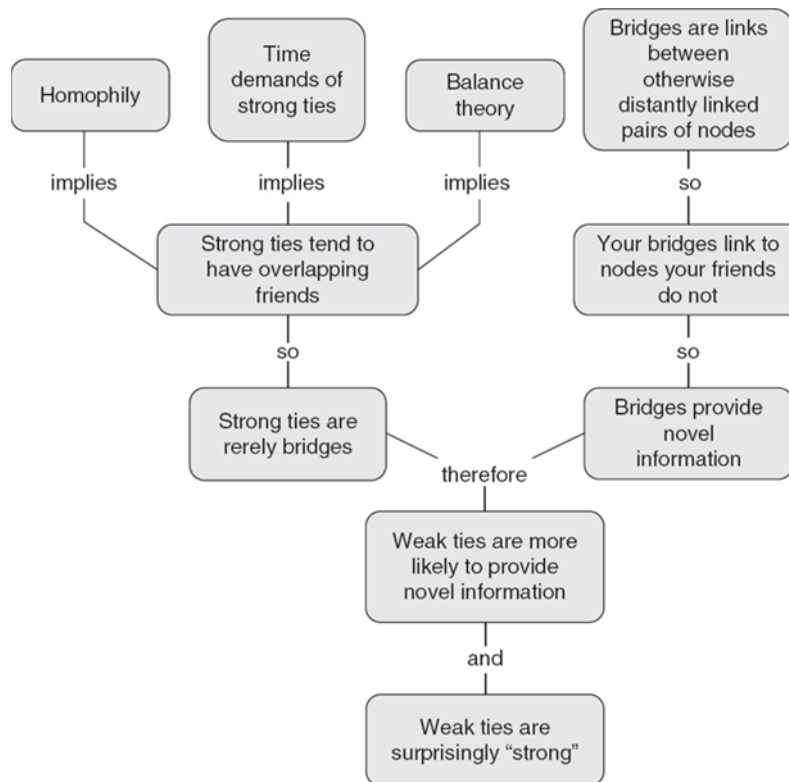
Figure 4. Granovetter's Strength of Weak Ties Theory[142]

[140] Christakis and Fowler, *Connected*, 158.

[141] Ibid.

[142] Source: Borgatti and Lopez-Kidwell, "Network Theory," 40.

7. Centrality

When a network is visualized, certain nodes will appear with a high number of relationship connections. Actors that appear with multiple connections have high centrality and could be considered popular components of the network.[143] Individuals with high centrality are often the links between divergent areas of the network.[144] This powerful central "switching point" of information exchange is a network characteristic known as "betweenness," and it extends a person's influence beyond his or her own personal network.[145] Two additional motivations for group connectivity, propinquity and homophily, also warrant discussion. Propinquity relates to the increased likelihood that individuals will be connected if they share a close geographic association.[146] Residing in the same housing unit, working in the same office building, or serving on a mutual community board may result in an increased level of social connection among the members.[147] The concept of homophily can be rather complex, but it is important to have a general understanding of its relationship to social connection. People, organizations, groups, etc., will generally form social connections with others who share similar attitudes and beliefs, or who possess similar qualities.[148] Kadushin clarifies this concept by explaining, "If people hang out together they tend to have the same attitudes, and if they have the same attitudes, they tend to hang out together."[149] When studying a network, considering the concepts of propinquity and homophily may provide an understanding of the issues facing the group, or drive interventions that impact its structure. Understanding the fundamental concepts associated with social network structure is essential in order to introduce the practices associated with social network analysis.

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[143] Kadushin, *Understanding Social Networks*, 32.

[144] Ibid.

[145] Ibid.

[146] Ibid., 18.

[147] Ibid.

[148] Ibid., 18–19.

[149] Ibid., 19.

C.   THE SNA PROCESS

Analyzing social networks involves both quantitative and qualitative methodologies. Modern software applications are improving the potential for network modeling, but researchers must begin their work with a basic understanding of SNA principles.

1.   First Steps

SNA is a method for understanding how our relationships and their connected structures impact our lives, organizations, and world. The first two steps in conducting a network analysis are developing a framework for research based on a theoretical perspective and building the associated research questions.[150] Christina Prell offers the following examples of common theories used for SNA research: social capital, network exchange, social influence, and social selection.[151] Once a theory is selected for study and the research questions are determined, the population for study can be selected and clear boundaries established.

2.   Establishing Research Boundaries

Selecting the proper nodes and type of ties for analysis is an important step in the SNA process. Establishing which members to evaluate within a particular network requires a measured approach to ensure that the potentially limitless boundaries of the network do not overwhelm the process.[152] Achieving the desired outcome, and the ability to ultimately visualize the network under study, requires the researcher to define the nodes for measurement and to establish the parameters for evaluating relationships (ties).[153] Boundary issues can be a challenging component of this process, but they can be improved by narrowing approaches, as presented by Marin and Wellman, to ensure that the comparison of like elements is preserved (see Table 3).

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[150] Christina Prell, *Social Network Analysis: History, Theory, and Methodology* (London: SAGE, 2012), 62.

[151] Ibid.

[152] Marin and Wellman, "Social Network Analysis," 4.

[153] Christakis and Fowler, *Connected*, 16.

Table 3.   Approaches to Boundary Specification[154]

Approach	Description	Example
Position-based approach	Members of an organization or formally defined positions within an organization and all others excluded	Hospital staff, physician network, public safety organization, community welfare provider
Event-based approach	Defining the boundaries by who has participated in key events that define the population	Conference attendees
Relation-based Approach	Small set of nodes within the population of interest then expands to others that share relations with the seed nodes as well as with nodes added	The approach most often used in the study of egocentric networks

The approaches in Table 3 still require a narrowing of the group sample size for effective research. One approach for providing a manageable population is "snowball sampling." As researchers gather information from the primary study group, they will notice a point when respondents' data starts to duplicate.[155] If the data collection process continues, this duplication becomes ineffective and valuable research time is wasted. Instead of "rolling a snowball" of nomination layers, two zones should be established as the sample limit.[156] Zone one is the initial study group and zone two is collected from the connections identified by group one.[157] Using a sampling method in conjunction with a position, event, or relationship-based approach helps maintain an efficient research project. Once the broad limits have been determined, the examiner can begin to shift his or her focus to the nature of the relationships that exist between the nodes. Again, this alignment with like-elements for measurement adheres to the principle of common node linking.

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[154] Adapted from Ibid., 4–5.

[155] Prell, *Social Network Analysis*, 62.

[156] Ibid.

[157] Ibid.

3. Gathering Data

The SNA researcher has several options for collecting data associated with the individual or group of interest. The most common data collection methods are the survey and interview.[158] Carefully considering the study group's answers should help drive the creation of SNA survey questions, as they are the foundation for data collection; simple changes in phrasing may impact the quality of the respondent's answer.[159] When conducting egocentric data analysis, survey questions will often seek both the names and the type of relationship connecting nodes, which requires qualitative accuracy in order to collect the data in a timely fashion and to ensure it aligns with the established research parameters.[160] Once the data collection portion is complete, a multitude of software applications, such as NetDraw, UCINET, ORA, NetMiner, and PAJEK, can be used to model simulated network interventions or behavior (see Figure 5).[161]
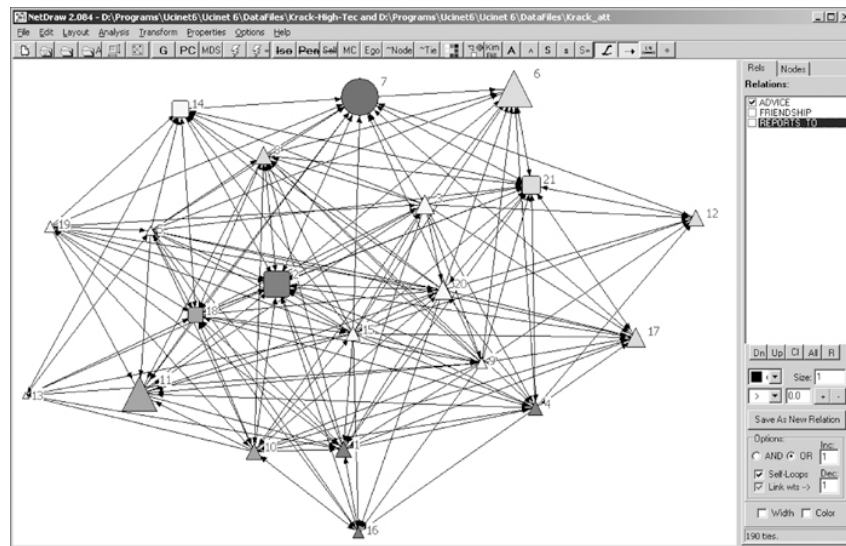
Figure 5.   Sample NetDraw Social Network[162]

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[158] Marin and Wellman, "Social Network Analysis," 22.

[159] Prell, *Social Network Analysis*, 71.

[160] Marin and Wellman, "Social Network Analysis," 25.

[161] Source: Lisa F. Berkman and Aditi Krishna, "Social Network Epidemiology," in *Social Epidemiology*, eds. Lisa F. Berkman, Ichiro Kawachi, and Maria Glymour (London: Oxford University Press, 2014), 256–257.

[162] Mark Huisman and Marijtje A. J. van Duijn, "A Reader's Guide to SNA Software," in *The SAGE Handbook of Social Network Analysis*, eds. John Scott and Peter J. Carrington (London: SAGE, 2011), 586.

D. CONCLUSION

Effective social network analysis is a significant undertaking. It requires a detailed qualitative and quantitative understanding of the dynamic nature of networks and the strength or weakness of the connecting ties in order to generate effective data collection instruments. Analyzing collected information requires extensively understanding the actors and their environment in order to identify appropriate network metrics/measurement and to effectively employ computer software applications.

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VI. THE HIGH HEALTHCARE UTILIZER

A. HEALTHCARE IN THE UNITED STATES

The provision of healthcare within the United States consumes a significant portion, 16.4 percent, of the nation's gross domestic product.[163] Additionally, U.S. citizens spend more for healthcare services than those in any other nation.[164] This excessive cost is not spread evenly across the U.S. population. It is unequally focused on a small population group, as outlined by the following statistics from the CMS.[165]

- One percent of the population accounts for 22 percent of the total health care expenditures annually.

- Five percent of Medicaid beneficiaries account for 54 percent of total expenditures.

- Of the above five percent, the top one percent accounts for 25 percent of total Medicaid expenditures.

- Within this top level, 83 percent have at least three chronic health conditions and more than 60 percent have five or more chronic conditions.

The United States Department of Health and Human Services commissioned a report in 2010 to study chronic health conditions and functional mobility limitations. The report immediately established that the cost of care is a significant policy issue and the widespread combination of chronic medical conditions with functional limitations within certain demographics is impacting care providers, healthcare systems, and the economy.[166] These economic and demographic considerations signal the need for program development in areas that impact the health and wellness of our communities,

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[163] OECD, *Health at a Glance 2015*, 166.

[164] Karen Davis et al., *Mirror, Mirror on the Wall: An International Update on the Comparative Performance of American Health Care* (New York: The Commonwealth Fund, 2007), 7.

[165] Centers for Medicare & Medicaid Services, "Targeting Medicaid Super-Utilizers to Decrease Costs and Improve Quality," *CMCS Informational Bulletin*, July 24, 2013, 2.

[166] Lisa Alecxih, Iris Chan, Sophie Shen, and Duke Taylor, *Individuals Living in the Community with Chronic Conditions and Functional Limitations: A Closer Look* (Washington, DC, Department of Health and Human Services, 2010), 1, http://aspe.hhs.gov/daltcp/reports/2010/closerlook.pdf.

and that include provisions for effectively utilizing limited resources and reducing the costs associated with healthcare.

In the 2014 update to the Commonwealth Fund's healthcare report series *Mirror, Mirror on the Wall: How the Performance of the U.S. Health Care System Compares Internationally*, it is revealed that the United States continues to outspend and underperform in healthcare when compared to 11 other nations.[167] Not only does the United States surpass these comparison nations in overall healthcare cost, it also struggles to achieve high rankings in care quality and coordination.[168] Within the five dimensions of healthcare performance evaluated by the Commonwealth Fund—quality, access, efficiency, equity, and healthy lives—the United States ranked last in two areas, efficiency and equity, and sixth in care coordination.[169] Underperformance in any one of these areas is cause for concern; however, addressing these combined patient care measures contributes most importantly to one of the most significant, disproportional challenges facing many healthcare systems: the high utilizer.

B.   DEFINING HIGH UTILIZATION

High utilizers, superusers, or "frequent fliers" can be defined through the regularity of their primary care physician visits, number of 911 calls requesting an emergency EMS response, hospital emergency department (ED) utilization, or high treatment costs associated with care. One of the leaders in the management of high healthcare utilizers is Dr. Jeffrey Brenner of the Camden Coalition of Healthcare Providers in Camden, New Jersey. Dr. Brenner identifies a superuser based on spending. Brenner states, "In Camden, we spend about $108 billion a year on ED and hospital care, and the over utilizers are about one percent of that population, which is about 1,000

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[167] Davis et al., *Mirror, Mirror on the Wall*, 7.

[168] Ibid., 8.

[169] Ibid.

people. Yet, they account for about 30 percent of the total payment for hospitalization and ED care in Camden."[170]

Expanding population growth among older adults, combined with a higher EMS utilization rate, not only strains the services that provide EMS care in a community, but also impacts the hospital emergency department capacity. For some of the costliest patients, emergency department visits can occur as many as 20 times a year.[171] Marie Rosenthal adds that in addition to consuming facility resources, superusers also create a "business problem" for hospitals; they increase operational costs and the risk of a provider medical error during their treatment.[172] However, superusers may also be most legitimately in need of urgent health care, as their primary care physicians are not always available.[173] Rosenthal suggests that overutilization is a result of poorly coordinated care and, similar to Dr. Brenner's conclusions in Camden, believes that identifying superusers and helping them navigate the healthcare system is the long-term key to success.[174]

There are also parameters outside of age or a chronic health condition that drive high healthcare utilization within the United States. The National Center for Health Statistics (NCHS) monitors the patterns of hospital emergency department utilization within the United States, and the agency readily admits measuring utilization is multifaceted.[175] The NCHS provides the "paradigm" outlined in Table 4 to understand the factors that contribute to healthcare utilization.[176]

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[170] Marie Rosenthal, "Superusers Lack Social, Primary Care Resources," *Managed Healthcare Executive*, November 1, 2013, para. 3, http://managedhealthcareexecutive.modernmedicine.com/managed-healthcare-executive/content/tags/emergency-department/superusers-lack-social-primary-care-r?page=full.

[171] Ibid., para.1.

[172] Ibid., para. 12.

[173] Ibid., para. 3.

[174] Ibid.

[175] Amy B. Bernstein et al., *Health Care in America: Trends in Utilization* (Hyattsville, MD: National Center for Health Statistics, 2003), 6.

[176] Ibid.

Table 4.   NCHS Paradigm of Healthcare Utilization[177]

Utilization Factor	Description
Predisposing	The propensity to seek care, such as whether an individual's culture accepts the role of victim or encourages stoicism, and what types of care are preferred for specific symptoms.
Enabling	The depth and breadth of health insurance coverage, whether one can afford copayments or deductibles, whether services are located so that they can be conveniently reached, and other factors that allow one to receive care.
Need	The need for care also affects utilization, but need is not always easily determined without expert input. Many people do not know when they need care or what the optimal time to seek care is. Many conditions are not easily diagnosed or treated.

The 2003 NCHS report *Health Care in America: Trends in Utilization* offers data that contrast with previous assertions that age and chronic health conditions alone are driving high utilization. The NCHS specifically notes that establishing a direct association between age and an increase in general healthcare utilization is difficult; there are many individual factors that determine if a person is a high utilizer.[178] It is important to note that seeking care more often may be associated with global healthcare improvements and availability, and not necessarily with health disparity. This should be considered during utilization research.[179]

An updated 2016 NCHS report, *Reasons for Emergency Room Use among U.S. Adults Aged 18–64*, compiled survey results about ED utilization and noted three categories of particular concern: urgency of the medical problem, limitations in doctor office or clinic office hours, and lack of access to other providers.[180] The study found that Medicaid users continue to be high ED utilizers when compared to private or even uninsured patients with serious medical problems. Urban residents had higher utilization

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[177] Adapted from Ibid.

[178] Ibid., 8.

[179] Ibid., 7.

[180] Renee M. Gindi, Lindsey I. Black, and Robin A. Cohen, *Reasons for Emergency Room Use among U.S. Adults Aged 18–64: National Health Interview Survey, 2013 and 2014* (Hyattsville, MD: National Center for Health Statistics, 2016).

when the condition was serious; those living outside a metropolitan area, however, more often indicated their reason for an ED visit was "not having an open doctor's office."[181] Adult patients living in an urban environment, without insurance, or who receive coverage through Medicaid also often report that they do not have a physician outside of the ED, prompting ED use.[182] The lack of an established physician's office or clinic location that provides consistent care coordination limits Medicaid users' ability to receive efficient services.[183] This factor aligns with common U.S. efficiency and care coordination deficits, which cause patients to shift from a primary care physician to the hospital emergency department for low-priority healthcare services.[184]

C.   CLINICAL ASPECTS OF HIGH UTILIZATION

The clinical aspects of high healthcare utilization can be evaluated within two main categories: chronic medical conditions and functional limitations.[185] Frequent ED utilization or high reliance on prehospital emergency responders can be associated with several health conditions that impact the patient's overall well-being, or perception thereof. Lisa Alecxih et al. define a chronic medical condition as an illness that "lasts or is expected to last 12 months or longer," based on a review of medical condition coding, and that is categorized as chronic by the Healthcare Cost and Utilization Project (H-CUP).[186] A chronic medical condition is often accompanied by a functional limitation that impedes the daily care and health maintenance required for quality living. Functional limitations may include one or more of the following:

- Physical activity, such as difficulty walking, bending, or stooping

- Normal life activity, such as work, housework, or school

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[181] Ibid., 9.

[182] Ibid., 8.

[183] Ibid.

[184] Davis et al., *Mirror, Mirror on the Wall*, 22.

[185] Alecxih et al., *Individuals Living in the Community*, 2.

[186] Ibid.; "HCUP Chronic Condition Indicator," Agency for Healthcare Research and Quality, May 2016, https://www.hcup-us.ahrq.gov/toolssoftware/chronic/chronic.jsp.

- Received assistance with Activities of Daily Living (ADL): bathing, eating, dressing, transferring (i.e., from bed to chair), toileting, and walking

- Received assistance with Instrumental Activities of Daily Living (IADL): doing housework, preparing meals, taking medications, shopping, telephoning, and managing money[187]

In addition, chronically ill individuals may be dealing with a coexisting mental illness, substance abuse, ineffective support networks, or numerous other factors that contribute to their dependency upon critical community resources for their daily needs. In their 2010 report for the United States Department of Health and Human Services, *Individuals Living in the Community with Chronic Conditions and Functional Limitations: A Closer Look*, Alecxih et al. found that individuals living with both a chronic medical condition and a functional limitation consume more healthcare services and require a greater amount of assistance in order to complete essential tasks associated with daily health and hygiene.[188] This group also shares common medical conditions such as hypertension, arthritis, and high cholesterol.[189] The report specifically notes that this combination places "heavy demands on service delivery, social support, and public budgets."[190] In 2006, the number of individuals in the United States living with both a chronic medical condition and a functional limitation measured 14 percent (42 million) of the population, but accounted for more than three times the spending of those with only a chronic condition—$473 billion (46 percent) of the $1.3 trillion spent on healthcare.[191] These individuals with clinically complex conditions also maintained a higher rate of pharmacy-related expenditures and utilized home healthcare services more often than those living with only a chronic medical condition.[192] Regardless of whether they suffer from a single disease or many, some individuals fail to manage both their personal health

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[187] Alecxih et al., *Individuals Living in the Community*, 2.

[188] Ibid., 1.

[189] Ibid., 9.

[190] Ibid., 1.

[191] Ibid., 3.

[192] Ibid., 24.

and common hygiene, which means seeking help from emergency assets may be their only known support mechanism. An individual's struggle to manage multiple health conditions may often be the result of a fractured healthcare delivery system or the individual's lack of social support.[193]

D. HIGH UTILIZATION AND PREHOSPITAL CARE

A 2015 retrospective ambulance response report analysis published in the journal *Prehospital Emergency Care* provides a baseline categorization of EMS utilization, corresponding health conditions, and the economic impact of high service demand. Dr. M. Kennedy Hall et al. provide criteria for measurement (see Table 5) based on their review of the patient care reports generated by the San Francisco Fire Department (SFFD).[194]

Table 5.   User Categorization by EMS Encounter[195]

EMS Encounters	User Category
1	Low
2–4	Moderate
5–14	High
≥15	Superuser

Hall et al. also noted that the clinical conditions associated with EMS response varied by individual paramedic assessment. Table 6 shows that requests for EMS services vary by complaint, that the dominant gender associated with the request is male, and that there is a high presence of alcohol in the categories of highest utilization.[196]

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[193] Cohn, "Reducing Emergency Room Use."

[194] M. Kennedy Hall et al., "Emergency Medical Services 'Superuser' Transport Associations: An Adult Retrospective Study," *Prehospital Emergency Care* 19, no. 1 (2015):62, doi: 10.3109/10903127.2014.936630.

[195] Adapted from Ibid.

[196] Ibid., 64.

Table 6.   Characteristics by Frequency Group[197]

		Encounter frequency group				
		Low (1)	Moderate (2–4)	High (5–14)	Superuser (≥15)	Total
Gender						
Male	Count	14,807	2,307	379	68	17,561
	% of group	55.5	56.6	62.6	68.0	55.9
Overview of paramedic primary impressions						
General medical	Count	15,488	7,221	3,360	1,910	27,979
	% of group	58.0	73.9	75.7	71.6	64.2
Trauma	Count	7,946	1,427	466	248	10,087
	% of group	29.8	14.6	10.5	9.3	23.2
Alcohol	Count	916	303	293	380	1,892
	% of group	3.4	3.1	6.6	14.2	4.3
No medical complaint	Count	816	380	166	91	1,453
	% of group	3.1	3.9	3.7	3.4	3.3
Dead	Count	626	106	15	4	751
	% of group	2.3	1.1	.3	.1	1.7
Poisoning/ drugs	Count	607	266	114	24	1,011
	% of group	2.3	2.7	2.6	.9	2.3
Other	Count	283	70	22	11	386
	% of group	1.1	.7	.5	.4	.9
Alcohol (secondary analysis)						
Alcohol use	Count	1,752	965	958	994	4,669
	% of group	6.6	9.9	21.6	37.3	10.7

In addition, the SFFD evaluated the service reimbursement associated with the responses, demonstrating that there is a higher cost of care associated with the high service utilizer. EMS charges in the superuser category were mostly reimbursed under the Medicaid program, and this small population segment—0.3 percent—accounted for 6 percent of the agency's service charges.[198] Perhaps one of Hall et al.'s most important findings, however, was the prevalence of alcohol among the highest service utilizers. Hall writes, "Our study provides empirical evidence that alcohol involvement increases exponentially in moderate-use, high-use, and superuser EMS groups when compared to the low-use group, suggesting that superusers have distinct characteristics and health-care demands."[199] This EMS-focused research provides a foundation for the prehospital measurement of high service utilizers, demonstrates the variety of clinical conditions that may initiate requests for EMS service, and reveals that the presence of alcohol is a contributing element to consider when evaluating superusers. All of these factors reveal the healthcare and social aspects that add to the complexity of the high care utilizer.

[197] Source: Ibid.

[198] Ibid., 65.

[199] Ibid.

San Diego Union Tribune Reporter John M. Gonzalez provided an in-depth report on the issues facing San Diego emergency systems in his series "Health Care 911." Dr. James Dunford, medical director for the City of San Diego, provides a concise review of the issues, revealing that the pattern of care for high EMS system utilizers involves frequent emergency responses for assessment, ambulance transport, and high-cost hospital emergency department testing, all culminating in a physician-issued care plan that the patient is unable, or unwilling, to follow.[200]

As quoted by Gonzalez, San Diego Fire Department Firefighter Paramedic Dave Stepp describes the responder's perspective of repeat callers to SDFD Station 7. Describing the situation as "Groundhog Day," Stepp comments, "Same people, same reason, different day."[201] This pattern of demand is repeated in fire and EMS systems across the nation; in cities like San Diego, where the frequent caller population comprises 17.2 percent of the total response volume, a select group of poorly managed individuals is impacting the prehospital provider in addition to the hospital ED.[202] Prehospital care response resources such as fire apparatus and ambulances are limited within a given community and their frequent response to persons with poor health management not only prevents them from servicing a greater number of those in urgent need, but also impacts other units within the response system. Often, when crews are tied to a high utilizer service request, another emergency medical response, structure fire, or rescue requirement will occur, causing the first available unit to travel a farther distance (e.g., from a neighboring facility), resulting in an extended response time.[203] Solving the issues that accompany high chare utilizers is important for all components of the U.S. healthcare system. It is likewise important to understand that the elements of care do not function as independent parts, but rather as system of interconnected care providers.

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[200] John M. Gonzalez, "Health Care 911," *San Diego Union Tribune*, March 31, 2012, http://www.sandiegouniontribune.com/health-care-911/

[201] Ibid.

[202] Ibid.

[203] Ibid.

Emergency resources have become the ad hoc community social support network for those living with chronic health conditions and functional limitations. The lift-assist call[204] is an example of a service provided by many of the nation's fire and EMS agencies; this service, in itself, further reveals individuals' widespread inability to manage their combined health conditions and the lack of an established care support system.[205] The nation needs a proactive program that addresses unmet healthcare needs and reduces the demand of emergency service providers.[206] Wider recognition of this need is the first step toward multi-agency care collaboration, which has the potential to reduce the demand on the hospital emergency department, decrease the cost of care associated with a hospital stay, and reduce the overall risk associated with poorly managed health among vulnerable populations.[207]

Although community public safety response teams are excellent resources for problem identification, over-utilization of fire and other EMS resources for an individual's long-term health and social support is both an ineffective utilization of a limited resource and an expensive alternative to a more effective and preemptive health care and social support system. A superuser's care must be shifted from the high-cost emergency response environment to a model that is proactive in nature.

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[204] Cone et al. define a lift-assist call as a situation when an uninjured person is "unable to move from an undesirable position to a preferred one." David C. Cone et al., "A Descriptive Study of the 'Lift-Assist' Call," *Prehospital Emergency Care*, 17:1 (2013): 51–56, doi: 10.3109/10903127.2012.717168.

[205] Ibid.

[206] Ibid., 51.

[207] Ibid.

VII.   SOCIAL NETWORKS AND HEALTH

A.   LINKING PHYSIOLOGY TO SOCIOLOGY

The human body is a network of systems that constantly exchange environmental information to maintain a physiological equilibrium.[208] The relationship between the neurological and the physiological responses associated with social connections was the subject of research conducted by University of California Los Angeles scientists Naomi Eisenberger and Steve Cole. In their May 2012 *Nature Neuroscience* article, Eisenberger and Cole begin by stating, "It is well established that social relationships are important for physical health." They provide supporting research suggesting that those with strong social connections have lower rates of mortality and morbidity when compared to the "socially isolated."[209] The authors explore the human neural and physiological responses that occur when an individual's social connection is threatened; specifically, they seek to understand if the same human "alarm system" that protects us against a bear attack is triggered when social ties are endangered.[210] It is this "basic neural alarm system" that they believe physiologically stimulates the body's autonomic nervous and endocrine systems.[211]

The authors readily admit that more research is needed on the interaction between the "macro" social context and the "micro" systems of the human body.[212] Their research does, however, conclude that the presence or absence of social connections can impact an individual's health. Disconnection within supportive social networks impacts the body's inflammatory response mechanism and exacerbates diseases of aging such as atherosclerosis (arterial narrowing) and diabetes, and stimulates the sympathetic nervous system through regulatory responses in the hypothalamus and pituitary and adrenal

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[208] Martini and Bartholomew, *Essentials of Anatomy and Physiology*, 7.

[209] Ibid.

[210] Naomi I. Eisenberger and Steve W. Cole, "Social Neuroscience and Health: Neurophysiological Mechanisms Linking Social Ties with Physical Health," *Nature Neuroscience*, May 2012, 1.

[211] Ibid.

[212] Ibid., 5.

glands.[213] "Chronic social disconnection" negatively affects the body's ability to fight disease and control inflammatory response.[214]

Understanding these concepts can aid in the development of community programs and initiatives that improve health through social connection, potentially resulting in improved utilization of costly health resources. Merging biology and sociology in an effort to better understand social determinants of health is further explored in the field of social epidemiology.

B.   SOCIAL EPIDEMIOLOGY

Epidemiology is defined by Lisa Berkman and Ichiro Kawachi as a scientific discipline that studies the "distribution and determinants of states of health in populations."[215] With roots in public health, epidemiologists trace the origins of the world's diseases and work toward improving a population's health through activities such as vaccinating against disease, refining municipal sanitation systems, and educating the public on the benefits of good nutrition.[216] These public health initiatives have reduced the impacts of disease and increased life expectancy across much of the globe; however, "noninfectious disease" and "social inequities of health" remain prevalent despite coordinated efforts.[217] It is this lingering social aspect of healthcare that has resulted in the field of social epidemiology, discussed by Berkman and Kawachi as "the branch of epidemiology concerned with the way that social structures, institutions, and relationships influence health."[218] Understanding the importance of social connections across all components of healthcare will help unravel the issues that impact both personal and population health.

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[213] Ibid., 2.

[214] Ibid.

[215] Lisa F. Berkman and Ichiro Kawachi, "A Historical Framework for Social Epidemiology," in *Social Epidemiology*, eds. Lisa F. Berkman, Ichiro Kawachi, and Maria Glymour (London: Oxford University Press, 2014), 1.

[216] Ibid.

[217] Ibid., 2.

[218] Ibid.

C.   ADOPTING A NEW PERSPECTIVE

A network perspective is critical to understanding how healthcare providers address complex patient care needs. Christakis and Fowler provide this foundational element when they suggest viewing our connections differently. They write, "A network perspective also helps us get away from thinking that the main risk factors for STDs are individual attributes, such as race."[219] The authors advocate for more study of social network structure, which can help paint a more complete picture of how health risk travels through a person's connections.[220]

Rina Alcalay from the University of California, Berkeley posits that there are four main ways in which social networks and healthcare are intricately inter-connected.[221] Alcalay's four elements of connection—stable ties promote healthy behavior, resources are needed for dealing with diverse aspects of life, one must maintain a sense of control over the environment, and the proximity of ties affects a person's sense of well-being— illustrate that there are physiological as well as psychological components to our well-being, and that additional discussion on the connection between social neuroscience and health is constructive.[222]

(1)   Stable Ties and Healthy Behavior

Alcalay's first point about social connections is that "social ties encourage people to engage in preventative health behavior."[223] Individuals who are members of community groups, attend church services, or socialize with friends and their neighbors take the role of prevention seriously and embrace the practices associated with a healthy lifestyle.[224] It is this connection to community that provides one of the strongest

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[219] Christakis and Fowler, *Connected*, 103.

[220] Ibid.

[221] Rina Alcalay, "Health and Social Support Networks: A Case for Improving Interpersonal Communication," *Social Networks* 5, no. 1 (March 1983): 76, doi 10.1016/0378-8733(83)90016-3.

[222] Eisenberger and Cole define social neuroscience as the interactions between the health-related physiological responses to the experiences associated with social connection or disconnection. Eisenberger and Cole, "Social Neuroscience and Health," 1.

[223] Alcalay, "Health and Social Support Networks," 76.

[224] Ibid.

arguments for developing programs that promote beneficial interaction among residents. Robust social ties that provide a supportive environment can impact individuals' overall health, reduce their susceptibility to disease, and speed the recovery process if they do become ill.[225] Citing work by Karen S. Rook, John Bruhn highlights that negative, harmful ties in an individual's social network may not provide beneficial support and can contribute to poor health.[226]

(2) Resources for Dealing with Diverse Aspects of Life

People with many social ties who frequently interact with friends and family have lower rates of illness than those with fewer or weaker social connections.[227] Alcalay writes that people who have a lower number of ties have a "death rate [that] was two to five times higher than for individuals with more extensive social connection."[228] Alcalay's position is rooted in foundational social science research completed by Berkman and Syme in 1979, which studied the population of Alameda County, California, concluding that "social networks were a strong predictor of morbidity and mortality rates."[229] Research conducted by Mark Pilisuk and Charles Froland in 1978 argues that trends in "urbanization and mobility" have significantly impacted the availability of social support once provided by an individual's family.[230] Pilisuk and Froland indicate that the mutual support relationships of the "extended kin group" that were once reliable during times of ill health or stress are declining, and the primary responsibility of care has shifted to the core family (if and when it is available).[231] Losses in extended family, a change in marital status, or a spouse's death can make an individual "substantially more prone to illness in all forms."[232]

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[225] Bruhn, *Group Effect*.

[226] Ibid.

[227] Alcalay, "Health and Social Support Networks," 77.

[228] Ibid.

[229] Ibid.

[230] Marc Pilisuk and Charles Froland, "Kinship, Social Networks, Social Support and Health," *Social Science and Medicine*, 12B (1978): 273.

[231] Ibid., 275.

[232] Ibid., 273.

(3) Control over Environment

The third connection between healthcare and social network interconnections is related to an individual's environment. People who have a sense of control over their environment can improve health outcomes and relationships and are generally more likely to experience a decreased mortality rate and improved overall well-being.[233] An individual's insecurity can often be traced to the presence of unstable relationships during childhood—if the same coping tools developed for childhood are retained throughout adult life, the individual is likely to repeat his or her patterns.[234] Children living without a sense of security may find that community healthcare services rescue them from the chaos, lack of control, and trauma in their lives.[235] A continued sense of insecurity into adulthood may drive them back to healthcare services for safety, thereby increasing the potential for excessive utilization.[236] An individual's historical use of community-provided health services may offer clues to the nature of his or her relationships within a social network. Because network connections have directional flow associated with the distribution of resources, there are health-related values associated with a sharing and supportive network environment.[237]

(4) Impact of Tie Mobility

Alcalay's final connective element relates to personal mobility and how the proximity of ties affects a person's sense of well-being. In order to reduce the potential for ill health, people need stable ties across their social networks.[238] A consistent mechanism for social support through "uninterrupted ties" reduces the potential that a personal will become socially marginalized within the community, which, according to

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[233] Ibid.

[234] Dawn B. Mautner et al., "Generating Hypotheses about Care Needs of High Utilizers: Lessons from Patient Interviews," *Population Health Management* 16, no. 1 (2013): S-31, doi: 10.1089/pop.20130033.

[235] Ibid.

[236] Ibid.

[237] Alcalay, "Health and Social Support Networks," 79.

[238] Ibid.

Alcalay, represents a "major factor in high morbidity rates."[239] Sato Ashida of Ohio State University and Catherine A. Heaney of Stanford University support this connectivity rule in their research evaluating the nature of social connection within older adult populations. In their 2008 *Journal of Aging and Health* article, the authors explore the value of social connection and social support. Safety, security, and the awareness that social network connections are available if needed can offer stress reduction, promote positive health activities, and develop a strong immune system.[240] Ashida and Heaney found that older adults reported an improved feeling of social connection when the physical proximity of the network was geographically closer (propinquity).[241] Older adults believe that the close physical location of connections contributes to a positive feeling of support, which can ultimately lead to improved individual health.[242] The principle concept in Ashida and Heaney's research is that health improvements are associated with the perceived level of social connectedness rather than the actual availability of social support.[243] Recognizing that an increased sense of well-being can be achieved by knowing that help is near can help communities develop programs that foster this sense of security among older adults.

D.   SNA FOR HEALTHCARE PROVIDERS

Healthcare providers, and the organizations in which they function, are components of a highly interconnected system of care delivery that can also benefit from social network analysis.[244] Harvard professors A. James O'Malley and Peter Marsden conducted a social network analysis of primary care physicians in order to evaluate peer-related discussions of women's healthcare.[245] The study revealed that SNA is beneficial in evaluating the interactions and professional relationships among physicians in the

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[239] Ibid.

[240] Sato Ashida and Catherine A. Heaney, "Differential Associations of Social Support and Social Connectedness with Structural Features of Social Networks and the Health Status of Older Adults," *Journal of Aging and Health*, 2008, 874.

[241] Ibid., 886.

[242] Ibid., 887.

[243] Ibid., 889.

[244] A. James O'Malley and Peter V. Marsden, "The Analysis of Social Networks," *Health Services Outcomes and Research Methodology* 8, no. 4 (December 2008): 222, doi: 10.1007/s10742-008-0041-z.

[245] Ibid., 225.

medical office environment, as well the connections between the networks involved in healthcare.[246] Overall, O'Malley and Marsden believe the SNA approach is beneficial, and highlighted the need for further research—instead of considering social networks as "fixed," the relationships must be carefully studied and explored.[247] Their research provides an encouraging view of SNA as it relates to healthcare:

> We anticipate that health-related applications of social network analysis will grow rapidly during the coming decade, since interpersonal relationships and support networks are crucial to the well-being of most persons, and because appropriate methods for addressing the difficult analytic problems posed by social network data are increasingly available. Informed applications of social network analysis in health services and outcomes research will not only yield new insights into these phenomena, but contribute toward continued improvements in social network methodology.[248]

In their conclusion, O'Malley and Marsden emphasized the statistician's critical role in the SNA process; the statistician not only ensures the quality of the data collected from the survey participants, but also provides data for the physician that is reliable and can be used to form an accurate diagnosis.[249]

For healthcare practitioners to better understand the role of social network analysis, and to consider its application an acceptable tool for improving their patients' well-being, a return to the work of Pilisuk and Froland is in order. Although their research was published in 1978, Pilisuk and Froland provide a timeless summary of network principles applied to individual health:

> These applications of the network approach to specific practice situations reveal both the power and relevance of social networks to individual functioning. They demonstrate that whether one is defined as ill, has resources to deal with being ill or under stress, utilizes professional services and experiences positive outcomes in large measure is a function of the structure and pattern of interaction in one's social support.[250]

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[246] Ibid., 251.

[247] Ibid.

[248] O'Malley and Marsden, "The Analysis of Social Networks," 251.

[249] Ibid., 251–252.

[250] Pilisuk and Froland, "Kinship," 278.

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E.   CONCLUSION

Lisa Berkman and Aditi Krishna provide a global understanding of social networks and their influence on an individual's well-being in the following statement: "The key function of social networks is provision of social support. Social support is one of the main ways social networks influence physical and mental health status."[251] However, the authors state that it is important to understand the entire network structure and not just the support activities closest to the individual.[252] By looking "upstream" beyond the micro level of the individual, it is possible to understand the "social and cultural contexts" that determine network structure and ultimately impact a person's health (see Figure 6).[253] In order to improve the health and social support of high care utilizers, it is necessary to understand the origins of human relationships and the fundamentals of social network science.

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[251] Berkman and Krishna, "Social Network Epidemiology," 241.

[252] Ibid.

[253] Ibid.

Upstream factors ⟵

Downstream factors ⟶

| Social structural conditions (Macro) | determine the extent, shape, and nature of … | Social networks (Mezzo) | which provides opportunities for … | Psychosocial mechanisms (Micro) | which impacts health through … | Pathways |

Culture:
- Norms and values
- Social cohesion
- Racism
- Competition/ cooperation

Social network structure:
- Size
- Transitivity
- Density
- Homogeneity
- Centrality
- Equivalence
- Distance

Social support
- Instrumental & financial
- Informational
- Appraisal
- Emotional

Social influence
- Constraining/enabling influences on health behaviors
- Norms towards help seeking/ adherence
- Peer pressure
- Social comparison processes

Health behavioral pathways:
- Smoking
- Alcohol/drug consumption
- Diet
- Exercise
- Adherence to treatments
- Help-seeking behavior

Socioeconomic factors:
- Relations of production
- Inequality
- Discrimination
- Conflict
- Labor market structure
- Poverty

Characteristics of network ties:
- Frequency of face-to-face contact
- Frequency of nonvisual contact
- Frequency of organizational participation (attendance)
- Reciprocity of ties
- Multiplexity
- Duration
- Intimacy

Social engagement
- Physical/cognitive exercise
- Reinforcement of meaningful social roles
- Bonding/interpersonal attachment

Person-to-person contact:
- Close personal contact
- Intimate contact sexual or romantic

Psychological pathways:
- Self-efficacy
- Self-esteem
- Coping
- Depression/ distress
- Emotional regulation

Politics
- Laws
- Public policy
- Differential political enfranchisement /participation

Access to resources & material goods:
- Jobs/economic opportunities
- Access to health care
- Housing
- Institutional contact

Physiological pathways:
- HPA axis response
- Allostatic load
- Immune function
- Cardiovascular reactivity
- Inflammation
- Aging pathways
- Transmission of infectious disease

Social change:
- Urbanization
- War/civil unrest
- Economic recessions

Negative social interactions:
- Demands
- Criticism
- Perceived isolation
- Direct conflict and abuse including early childhood trauma, marital conflict

Figure 6. Conceptual Model of How Social Networks Impact Health[254]

[254] Source: Ibid., 242.

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VIII. FINDINGS: SOCIAL NETWORK ANALYSIS AND HIGH HEALTHCARE UTILIZATION

Using a socially based instrument to analyze a group of connected people may initially appear to be a misalignment of healthcare intervention priorities related to individuals who excessively utilize healthcare system resources. Health and well-being programs are typically applied at the patient level through the delivery of patient education, physical therapy, or other rehabilitative services. This paradigm may be effective for the majority of the population, but for high utilizers the analysis of a person's social network may reveal hidden conditions that are detrimental to their emotional, social, or physical health. Three broad characteristics define high healthcare utilizers: (1) they comprise a small percentage of the overall patient population, (2) they account for a high percentage of the overall healthcare expenditure, and (3) they encompass all ages, locations, medical conditions, and payment types.[255] SNA has demonstrated benefits related to health awareness through its applications to both ego and broader social networks.[256] Because high utilizers encompass such a broad demographic, examining their social network may help determine why they are high utilizers and how to meet their needs.

The following analysis evaluates the strengths, weaknesses, opportunities, and threats associated with SNA applications for improved healthcare support.

A. STRENGTHS

1. Battle Proven

For the military, SNA has effectively evaluated the threats associated with insurgent groups and has helped analysts understand their organizational activities.[257] By conducting a social network analysis, military commanders are able to make decisions based on the insurgency's "network structure," from which they can determine how the

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[255] Rosenthal, "Superusers Lack Social, Primary Care Resources."

[256] Berkman and Krishna, "Social Network Epidemiology," 255.

[257] United States Army and United States Marine Corps, *Counterinsurgency Field Manual*, 317.

connected relationships influence the enemy's leadership, decision-making, and behavior.[258] SNA has also been used to study hidden networks that "operate in the dark by concealing their activities from authorities."[259] As outlined by Cunningham, Everton, and Murphy, dark networks possess properties that make their analysis difficult. Dealing with network characteristics and structure in the absence of complete data, tackling indistinct network boundaries, and attempting to manage a generally dynamic process present network analysts with many barriers.[260]

Dark networks are generally disrupted through two approaches: kinetic and non-kinetic.[261] A kinetic approach involves removing actors or eliminating ties between actors through direct intervention that disrupts the relationship connection.[262] In contrast, a non-kinetic approach is "less aggressive" and utilizes tactics such as community building, information dissemination and management, the introduction of mistrust among actors, information technology service impacts, and network member rehabilitation.[263] Utilizing these approaches to uncover terror networks, expose criminal organizations, and impact other threats to safety is still an emerging technological art; however, military analysts have demonstrated the value of network intervention as a tactical tool and established SNA as an essential strategic consideration for the modern commander.[264]

As the U.S. military continues to conduct operations on a global scale, and terror organizations threaten the safety of the homeland, the intricacies of social network analysis are being refined in the tactical environment and used by commanders to understand the insurgent organizations they face.[265] It is the military application of SNA

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[258] Ibid., 317–318.

[259] Daniel Cunningham, Sean Everton, and Phillip Murphy, *Understanding Dark Networks: A Strategic Framework for the Use of Social Network Analysis* (Lanham, MD: Rowman and Littlefield, 2016), xvii.

[260] Ibid., xviii–xix.

[261] Everton, *Disrupting Dark Networks*, 33.

[262] Ibid.

[263] Ibid., 34–36.

[264] Cunningham, Everton, and Murphy, *Understanding Dark Networks*, 26–27.

[265] United States Army and United States Marine Corps, *Counterinsurgency Field Manual*, 328.

that offers validation for SNA's use in other social research fields and provides a proving ground for developing new techniques for understanding our social networks.

2.   SNA as a Health Diagnostic Tool

Medical professionals develop a vast knowledge base related to human anatomy and physiology in order to assess the presence or absence of health in the body. A cadre of various diagnostic devices and machinery such as X-ray, electrocardiogram, or magnetic resonance imaging (MRI) often aid in this assessment by providing a visual appraisal of the person's medical condition. But what the physician cannot see—the person's social network—may also have a significant impact on his or her health, social support, and overall well-being.

The subject of social capital emphasizes the importance of networks in a person's health. Sharon Shiovitz-Ezra and Howard Litwin from the University of Jerusalem's Paul Baerwald School of Work and Social Welfare posit that it is the "social relationship aspect of social capital that is of primary importance for understanding health and well-being," and affirm that strong social support systems contribute to improving resilience to diseases such as hypertension.[266] In contrast, poorly developed social networks can limit the development of social capital and can have detrimental effects on an individual's health; those within an "isolated" network structure are at a greater "risk of morbidity and mortality."[267] By simply taking a network perspective when assessing patients and understanding the important link between social connection and health, the healthcare provider can look for either the presence, or absence, of effective support providers.[268]

An individual's social network is continuously shaped by conscious decisions, actions beyond immediate family or friends, and by the organizations to which the individual belongs.[269] This invisible, but highly influential, pattern of relationships is a critical component of human life. Lisa Berkman and Aditi Krishna write, "The social

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[266] Sharon Shiovitz-Ezra and Howard Litwin, "Social Network Type and Health among Older Americans," in *International Perspectives on Aging*, vol. 11 (Dordrecht, Netherlands: Springer, 2015), 15.

[267] Ibid., 16.

[268] Blythe, "Social Support Networks," 120.

[269] Kadushin, *Understanding Social Networks*, 11.

structure of the network itself is largely responsible for determining individual behavior and attitudes by shaping the flow of resources or information that determine access to opportunities and constraints on behavior."[270] Social networks are rarely totally isolated and facilitate diffusion of ideas, information, and resources; the consequences of positive or negative actions that occur distally on a network can unintentionally impact those connected to the same network.[271] A clinician that not only understands social network principles but also applies them through a formal visualization process—social network analysis—can potentially improve health beyond the single patient or intervene if changes in a person's network are detected, such as the movement from a poorly connected network or cluster to one of higher density.[272] Computer-based analytic tools that allow analysts to visualize and measure social networks can help clinicians develop patient-centered education, ease healthcare system navigation, and promote social behaviors that improve health to the high utilizer group within each community.[273]

3. Organization and Health System Analysis

As has been stated, beyond the visualization of social networks, social network analysis provides the ability to measure and evaluate the connections and strength of relationships established by an individual, group, community, or healthcare organization.[274] SNA offers the potential to assess the collaborative nature of organizations providing support to high healthcare utilizers, and researchers remind us that it is not always the individual who is most culpable for establishing a support structure.[275] Jessica H. Retrum, Carrie L. Chapman, and Danielle M. Varda, for the journal *Health Education and Behavior*, studied collaboration between networks formed among public health agencies. After completing a social network analysis of these organizations, the researchers found that challenges exist when groups working together

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[270] Berkman and Krishna, "Social Network Epidemiology," 237.

[271] Bruhn, *Group Effect*, 49.

[272] Shiovitz-Ezra and Litwin, "Social Network Type and Health," 28.

[273] Berkman and Krishna, "Social Network Epidemiology," 255.

[274] Kadushin, *Understanding Social Networks*, 14.

[275] Alcalay, "Health and Social Support Networks," 85.

attempt to align "missions, cultures, and governance structures" and simultaneously seek a collaborative outcome.[276] The researchers in this case were able to model the provider networks and evaluate their density and centrality, concluding:

> Collaboratives will have more diverse resource contributions and better processes when they do not exceed a certain threshold for breadth, are highly interactive, and centralized (most likely when a lead agency such as a health department or health care organization, takes on facilitation, governance, and even fiduciary responsibilities).[277]

Through network analysis, the authors achieved an understanding of the public health agency's potential for successful outcomes by visually mapping network density.[278]

In 2007, a partnership between the Robert Wood Johnson Foundation and the University of Colorado at Denver began work on the PARTNER (Program to Analyze, Record, and Track Networks to Enhance Relationships) software tool in order to measure "the process of collaboration, particularly the social infrastructure of interactions between members of public health collaboratives."[279] Using SNA, PARTNER provides an opportunity for public health organizations to measure the effectiveness of collaborative programs and to validate the resources assigned to public or privately funded efforts.[280] Through PARTNER, communities around the world have demonstrated the value of organizational network analysis to evaluate the strengths and weaknesses of multiple agency programs, reduce variation in commitment, and improve the allocation of financial assets.[281] The PARTNER project illustrates the rapidly emerging value of SNA for organizations and demonstrates that the data collection, entry, and visualization tools can themselves become a beneficial community service. The same type of organizational

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[276] Jessica H. Retrum, Carrie L. Chapman, and Danielle M. Varda, "Implications of Network Structure on Public Health Collaboratives," *Health Education and Behavior* 40, no 1 (October, 2013): 20S, doi: 10.1177/1090198113492759.

[277] Ibid.

[278] Ibid., 18S.

[279] "About," PARTNER, accessed April 5, 2016, http://partnertool.net/about/.

[280] "Tools and Training," PARTNER, accessed April 5, 2016, http://partnertool.net/tools-and-training/partner-tool/.

[281] "About," PARTNER.

analysis can benefit Accountable Care Organizations (ACOs)[282] or emergency medical response agencies by analyzing the comprehensive systems of care and suggesting areas for global system improvements.

B.   WEAKNESS: THE SNA PROCESS

Completing a social network analysis for an individual, organization, or community social support system requires a structure comprising interrelated steps that involve funding, personnel staffing, and information technology support. The following steps outlined by Christina Prell provide a broad overview of the process:

1.   Review current research and projects involving SNA

2.   Develop a theoretical framework

3.   Develop research questions or hypothesis

4.   Establish population boundary

5.   Gather data through survey methods

6.   Input data into matrix format

7.   Visualize the network

8.   Conduct additional analysis and interpret results[283]

While lack of data is a weakness, gathering the data may be the easiest of the steps; once the research direction has been established and survey questions completed, the instrument of data collection (e.g., a survey) can generally be administered to clients in less than one hour.[284] Selecting the appropriate analysis software is another potential weakness that can limit adoption. Lisa Berkman and Aditi Krishna list nine software-based approaches for conducting SNA (e.g., PAJEK, NetDraw, and UCINET) that must be fully understood (both their benefits and limitations) to determine if they fit an

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[282] Accountable Care Organization (ACO) groups of voluntarily associated doctors, hospitals, and other health care providers who are incentivized by the Centers for Medicare & Medicaid Services or a commercial payer to give coordinated, high-quality care to an assigned panel of patients. "Accountable Care Organizations (ACO)," Centers for Medicare & Medicaid Services, last modified January 6, 2015, https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/ACO/index.html?redirect=/Aco.

[283] Prell, *Social Network Analysis*, 61–87.

[284] Berkman and Krishna, "Social Network Epidemiology," 255.

organization's needs.[285] The processes associated with SNA can be overwhelming for one agency, especially when considering that these activities must be completed by trained personnel who understand the software applications and data entry elements. Further, there must be buy-in from the agency's leadership in order to support and implement the analysis.

C. OPPORTUNITIES

1. Emergency Preparedness

In addition to potentially reducing demand on critical health system components, a detailed analysis of high utilizers' social networks may also help increase overall community resilience. The 2015–2018 Department of Health and Human Services *National Health Security Strategy and Implementation Plan* provides the United States with a four-year strategic direction targeted at improving health security.[286] The purpose of the report is to address the threats to community well-being caused by both natural and manmade disasters.[287] The strategy specifically identifies community vulnerabilities that are intensified by "weak social networks" and a "large population of vulnerable individuals."[288] Increasing a community's resilience to a health-related disaster is achieved through improved health situational awareness, and by taking actions "to understand the population needs of a community before an incident occurs."[289]

> Community health resilience is the ability of a community to use its assets to strengthen public health and healthcare systems and to improve the community's physical, behavioral, and social health to withstand, adapt to, and recover from adversity.[290]

When community emergencies occur, the physical mobility of older adults complicates evacuation orders, movement to established shelters, and post-event

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[285] Ibid., 256–257.

[286] Department of Health and Human Services, *National Health Security Strategy and Implementation Plan*, v.

[287] Ibid., 1.

[288] Ibid.

[289] Ibid., 3.

[290] Ibid., 10.

recovery.[291] In 2009, 93 percent of persons over 65 reported that they lived in a traditional community setting, which is a residence without a support system for meals, housekeeping, or medication.[292] The number of older Americans living on their own is increasing. Many choose to retain functional independence by living at home, rather than in a nursing or long-term care facility. This increases the amount of resources needed to mobilize a resident population with potential, or confirmed, physical limitations during times of emergency. Effectively identifying a person in need is difficult without specific location information, and impossible when communications and transportation systems are inoperable.

Unfortunately, when disaster occurs, the older and socially detached public is often unprepared—or incapable of preparing for—a long-term interruption in support systems. Even with prior notification of a significant event, many elderly adults lack an emergency preparedness supply cache or a plan of action.[293] During a disaster, normal automobile or public transit systems may be disrupted, pharmacies may be closed, and home healthcare providers may be unable to visit as scheduled. Emergency preparedness information and advanced planning is essential for the elderly, as they may require significantly more support than other members of the population during disasters. SNA can show how information flows through those connected to a structured network based on the connections of their community ties.[294] Utilizing the network's inherent characteristics to diffuse information can help disseminate preparedness information to key nodes that can reach vulnerable populations.[295]

When disruptions occur and routines fail during large-scale emergencies, the elderly and isolated population's dependence on community, family, and healthcare

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[291] Lauren S. Fernandez et al., "Frail Elderly as Disaster Victims: Emergency Management Strategies," *Prehospital and Disaster Medicine* 17 (2002): 67–74.

[292] Federal Interagency Forum on Aging-Related Statistics, *Older Americans 2012*, xv.

[293] Jeffrey W. Bethel, Amber N. Foreman, and Sloane C. Burke, "Disaster Preparedness among Medically Vulnerable Populations," *American Journal of Preventive Medicine* 40, no. 2 (2011): 141.

[294] Christakis and Fowler, *Connected*, 9.

[295] Ibid., 106.

systems places them at higher risk of mortality.[296] Citing the events during and after Hurricane Katrina, the nation's largest advocacy group for older Americans, AARP, reported that 71 percent of the storm's victims were over the age of 60.[297] Even if they survived the disaster, these groups were often displaced from their residences and suffered from health deterioration due to network disconnection.[298] These experiences highlight how critical it is to identify members of a community's vulnerable population. Social network analysis can help establish programs to ensure preparedness messages are received through personal social networks, evacuation goals are achieved, and the medical needs of high utilizers are met when they are displaced or high-dependency social support is disrupted.

A review of research related to preparation, evacuation, and support of older adults reveals many lessons learned during Florida hurricanes and Hurricane Katrina. Betty Morrow of the International Hurricane Center at Florida International University explains that disaster vulnerability is a social construct; due to social and economic circumstances, vulnerable populations are at a greater risk during an emergency event. "Knowledge of where these groups are concentrated within communities and the general nature of their circumstances is an important step towards effective emergency management," writes Morrow.[299] The premise of Morrow's research on vulnerability is that once these areas are identified in a community, that information can be applied to a community vulnerability map, and their resource needs can be assessed and effectively prepared for emergency.

In 2009, the National Research Council, in conjunction with the Department of Homeland Security, conducted a workshop focused on exploring social network analysis

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[296] Ali H. Mokdad et al. "When Chronic Conditions Become Acute: Prevention and Control of Chronic Diseases and Adverse Health Outcomes during Natural Disasters," *Preventing Chronic Disease* 2 (October 2005): 1.

[297] In 1999, the American Association of Retired Persons officially changed its name to AARP.

[298] Mary Jo Gibson and Michelle Hayunga, *We Can Do Better: Lessons Learned for Protecting Older Persons in Disasters* (Washington, DC: AARP, 2006), https://assets.aarp.org/rgcenter/il/better.pdf.

[299] Betty Hearn Morrow, "Identifying and Mapping Community Vulnerability," *Disasters* 23, no. 1 (2014): 1.

as a tool for the emergency management and response community.[300] Although SNA received both criticism and praise from the workshop participants, important strengths emerged from the discussion. Those in attendance noted that the same elements that provide for community resilience during a major emergency—"being well informed, well networked, and possessing the ability to respond to situations with creativity and flexibility"—enable the same community to "thrive during normal times."[301] The 2014 Federal Emergency Management Agency (FEMA) report *Preparedness in America* specifically links preparedness to three key social networks: the workplace, school, and volunteer organizations.[302] Through preparedness drills and information exchanges in these socially networked locations, the members were better prepared, understood local emergency plans, and demonstrated improved disaster awareness.[303]

The report also evaluated vulnerabilities of community members living with a "disability or health condition" that could impact their ability to effectively prepare for or handle the impacts of a local disaster.[304] A survey evaluating the preparedness attitudes and experiences of those living with disabilities indicated that they would take advantage of established community alert systems and reported having disaster supplies at home; the survey also indicated, however, that for the first 72 hours of a disaster, 61 percent will rely on household members and 51 percent will rely on local emergency responders for assistance.[305]

FEMA recognizes that our work, education, and community volunteer connections "are important social networks and influencers for preparedness education" and recommends that plans be developed to "leverage their strengths for emergency

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[300] Sammantha L. Magsino, *Applications of Social Network Analysis for Building Community Disaster Resilience: Workshop Summary* (Washington, DC: National Academies Press, 2009), 1.

[301] Ibid., 4.

[302] Federal Emergency Management Agency, *Preparedness in America: Research Insights to Increase Individual, Organizational, and Community Action* (Washington, DC: Department of Homeland Security, 2014), 29, http://www.fema.gov/media-library-data/1409000888026-1e8abc820153a6c8cde24ce42c16e857/20140825_Preparedness%20in%20America_August%202014%20Update_508.pdf.

[303] Ibid., 29–38.

[304] Ibid., 42.

[305] Ibid., 42–43.

preparedness."[306] Utilizing SNA to exchange preparedness information, build social capital to bridge networks, and to proactively address the needs of high utilizing populations each day can have a positive impact on the community's ability to withstand the stressors induced by disaster.

2.   Passive Data Collection

With the implementation of the Affordable Care Act (ACA) in 2010, and an overall increase in patients' electronic healthcare data, a solution to SNA's data collection requirement may be readily available. The electronic health record format began to develop when the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed as part of the American Recovery and Reinvestment Act of 2009. Under the Department of Health and Human Services' oversight, the HITECH programs promote the development of healthcare information technology, work to ensure patient information security, and encourage the development of health information exchanges at the local level.[307]

The purpose of the Affordable Care Act is to reform the nation's healthcare system, and it aims to improve the care provided to American citizens through a focus on quality, value, and efficiency. The ACA was designed with a progressive implementation timeline; from 2010 forward, incremental changes have been instituted and subsequently mandated for healthcare provider compliance. One change the ACA sought was a reduction in paperwork and administrative cost:

> The new law will institute a series of changes to standardize billing and requires health plans to begin adopting and implementing rules for the secure, confidential, electronic exchange of health information. Using electronic health records will reduce paperwork and administrative burdens, cut costs, reduce medical errors and most importantly, improve the quality of care.[308]

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[306] Ibid., 52.

[307] "Health IT Legislation and Regulations," Department of Health and Human Services, March 2015, http://healthit.gov/policy-researchers-implementers/health-it-legislation.

[308] "Key Features of the Affordable Care Act by Year," Department of Health and Human Services, 2010, http://www.hhs.gov/healthcare/facts/timeline/timeline-text.html.

As a result of this change, patients' medical information will be converted from paper to electronic formatting to provide a new source of data and improved research capability. The patient's physician, emergency medical responders, and other agencies directly involved in the delivery of healthcare are the main sources for data collection. With the number of Medicare benefit recipients increasing, from 44 million in 2004 to over 55 million in 2013, and older adults representing the largest consumers of healthcare, the amount of digital information available is rapidly expanding.[309]

As the healthcare industry transitions from paper files to electronic records, the potential for integrating SNA data collection instruments as a component of the physician, hospital, or EMS provider electronic medical record is an opportunity worth exploring.

3. Impacting Healthcare Utilization

In a July 2016 article published in the *New England Journal of Medicine*, Dr. David Blumenthal et al. state with urgency that

> Improving the performance of America's health system will require improving care for the patients who use it most: people with multiple chronic conditions that are often complicated by patients' limited ability to care for themselves independently and by their complex social needs.[310]

The authors call for a focus on these patients not only because of their complex medical conditions, but also because they are vulnerable to "quality and safety" problems within healthcare services due to their higher utilization rate.[311] Blumenthal et al. remind health providers that high-need high-cost (HNHC) patients are not only those found within certain demographic categories, but they are "clinically diverse" and may have "functional limitations" or may suffer from a mental illness.[312] In the statement that follows, the authors' description of the clinical issues facing HNHC patients highlights

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[309] "Medicare Enrollment Charts," Chronic Conditions Data Warehouse, accessed August 28, 2016, https://www.ccwdata.org/web/guest/medicare-charts/medicare-enrollment-charts.

[310] David Blumenthal et al., "Caring for High-Need, High-Cost Patients—An Urgent Priority," *New England Journal of Medicine*, July 27, 2016, 1, doi: 10.1056/NEJMp1608511.

[311] Ibid.

[312] Ibid.

the opportunity for the use of social network analysis: "Others have conditions that are greatly exacerbated by social factors such as lack of housing, food and *supportive personal relationships*" (emphasis added).[313] Dr. Blumenthal et al. state that HNHC patients should be placed within "homogeneous subgroups" in order to receive the benefits of targeted intervention programs.[314] SNA not only provides the ability to identify subgroup candidates by evaluating the relationships that comprise the HNHC patient's network, but also the ability to identify the networks responsible for delivering healthcare to determine their effectiveness.[315]

Achieving a homogeneous subgroup for intervention can be challenging. Subgroup analysis conducted by Dr. Jeffery Brenner's Camden Coalition utilized "cluster analysis" to support their finding that high utilizers exist within a variety of demographic profiles.[316] Camden's cluster analysis process sorts the high utilizer, "so the degree of association is strong between people in the same group, and weak between members in different ones."[317] From this analysis, interventions are developed that not only address the specific needs of the high utilizer, but that are achieved through more effective resource deployment.[318]

The social determinants of health—social, behavioral, and environmental influences—have also emerged as a priority in developing programs designed to improve the nation's healthcare services and decrease the cost of care.[319] Lauren Taylor et al. write that, when considering "genetics, health care, and social, environmental, and behavioral" factors, it is the "nonmedical" elements that have a greater impact on a

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[313] Ibid.

[314] Ibid.

[315] O'Malley and Marsden, "The Analysis of Social Networks," 251.

[316] Dianne Hasselman, *Super-Utilizer Summit: Common Themes from Innovative Complex Care Management Programs* (Hamilton, NJ: Center for Healthcare Strategies, 2013), 4.

[317] Ibid.

[318] Ibid.

[319] Lauren A. Taylor et al., *Leveraging the Social Determinants of Health: What Works?* (New Haven, CT: Yale Global Health Leadership Institute, 2015), 3.

person's health.[320] The authors ask policy makers to consider whether addressing the social determinants of health is a better practice than simply relying on medical care alone.[321] Calling for further research on effective solutions to social issues, Taylor et al. highlight the "gap" in the awareness and the implementation of existing nonmedical solutions that could provide an overall improvement in the nation's healthcare system.[322]

The Center for Health Care Strategies (CHCS) is one of many organizations seeking to address the issues associated with high-utilizing patients.[323] Recommendations contained in a November 2015 CHCS report on complex-need patients echo the call to work within the social determinants of health to address high utilization.[324] The report emphasizes that "traditional models of care" are ineffective in addressing the needs of the individual living with a chronic health condition in conjunction with "complex social challenges."[325] The report strongly affirms that, despite provider awareness of the impact of social determinants on individual health, there is a failure to implement systemic changes that provide "community based, preventative health and social services, rather than expensive hospital based services" for high utilizers.[326] CHCS advocates for the "co-location" of medical and nonmedical care providers in an effort to improve care coordination and to ensure that, when a patient moves from hospital to community, the chance of a poor outcome is reduced, as is the potential for a costly readmission.[327] Opportunities to improve the excessive cost and utilization of services may also be found in programs that encourage community partnerships with non-traditional agencies, such

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[320] Ibid., 8.

[321] Ibid., 9.

[322] Ibid.

[323] Caitlin Thomas-Henkel, Allison Hamblin, and Taylor Hendricks, *Supporting a Culture of Health for High-Need, High-Cost Populations, Opportunities to Improve Models of Care for People with Complex Needs* (Hamilton, NJ: Center for Health Care Strategies, 2015), 2.

[324] Ibid., 3.

[325] Ibid., 7.

[326] Ibid., 5.

[327] Ibid., 7.

as public safety providers, to improve identification of high utilizers and the coordination of health and social support.[328]

In October 2013, the Robert Wood Johnson Foundation and Center for Health Care Strategies conducted a "Superuser Summit" in an effort to explore successful practices for addressing HNHC populations in communities across the nation.[329] Summit participants identified several obstacles in their path to improvement; one challenge specifically aligns with the potential benefits of applying SNA to high utilizers.

> Super utilizer programs are effective because they invest resources in making an impact one patient at a time. Each patient has very complex and specific medical, behavioral, and social needs that require creativity, flexibility, and patience on the part of the care team. Our current health care system is not designed to flexibly and creatively address the complexity and uniqueness of each super-utilizer.[330]

It is the challenge of addressing the single patient and his or her interaction within the entire healthcare system that presents an opportunity to deploy social network analysis toward developing targeted intervention programs for healthcare improvement.

D.   THREATS

1.   Failure to Evaluate Risk and Establish Governance

Analyzing the high utilizer's social network can present challenges for the healthcare provider or care organization. Betty Blythe of the University of Washington presents several of these challenges. First, shifting the responsibility for care to the members of an individual's social network from the professional environment is not without risk.[331] Ethical and legal risks could dissuade healthcare providers from relying on people who are inadequately prepared to address emergency situations or other problems that may arise over the course of care.[332] It is important to ensure information

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[328] Ibid., 9.

[329] Hasselman, *Super-Utilizer Summit*, 1.

[330] Ibid., 11.

[331] Blythe, "Social Support Networks," 127.

[332] Ibid.

privacy, maintain ethical practices, and review the legal implications associated with network member care.[333] Second, the medical education and professional experience differential between the formal professional healthcare provider and the informal care helpers within a social network may also pose a risk-management issue for healthcare organizations. Steps to clearly identify roles, responsibilities, and communication practices will be important to promote a collaborative care approach.[334] Finally, patients, families, and care helpers often view healthcare systems as "fractured, impersonal, and bureaucratic," resulting in a lack of trust in the established systems.[335] Whether trust issues are located at the individual, care provider, or hospital level, their presence may limit the adoption of social network support as a solution high care utilization.[336]

2. Failure to Address Health Information Privacy

The Department of Health and Human Services establishes the standards for protecting a patient's private medical information through the Health Insurance Portability and Accountability Act of 1996 (HIPAA).[337] The standards were developed to protect the long-established trust relationship that exists between physicians and their patients by encouraging open dialog related to their care through the assurance of medical record privacy.[338] To maintain information security, the HIPAA rule applies to "electronic, paper, or oral" formats and patients must authorize the release of their information to parties not directly involved in their care or payments.[339] The HIPAA Privacy Rule defines "individually identifiable health information" as "information, including demographic data" comprising

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[333] Ibid.

[334] Ibid.

[335] Ibid.

[336] Ibid.

[337] "Summary of the HIPAA Privacy Rule," Department of Health and Human Services, accessed July 29, 2016, 1, http://www.hhs.gov/hipaa/for-professionals/privacy/laws-regulations/index.html.

[338] Ibid.

[339] Ibid., 3–4.

- the individual's, past, present, or future physical or mental health or condition,

- the provision of health care to the individual, or

- the past, present, or future payment for the provision of health care to the individual.[340]

In general, any information that can be used to connect medical care to a specific person is considered protected, including items that may not typically be considered private, such as name, address, and date of birth.[341] The healthcare provider, organization, or social service agency seeking to implement SNA as a tool to address high healthcare utilizers' needs must consider the privacy implications associated with collecting and sharing data, and must establish practices that ensure HIPPA compliance.[342]

The emergence of mobile and electronic health monitoring technologies and the tracking of personal health on Internet-based applications have added complexity and risk to the management of health information privacy.[343] The Department of Health and Human Services is concerned that consumers may fail to fully understand the implications of storing their health information on mobile fitness-tracking devices or within shared data storage areas.[344] The implication for agencies seeking to utilize newly developed or existing software platforms for SNA is that they must understand the security requirements associated with gathering, analyzing, and storing information that falls within the category of protected health information.[345] To further develop the practice of SNA for addressing high healthcare utilizers, and to encourage patients' participation, programs should be established within health provider agencies that comply with HIPAA as a normal course of business.[346]

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[340] Ibid., 4.

[341] Ibid.

[342] Ibid., 1.

[343] "Examining Oversight of the Privacy and Security of Health Data Collected by Entities Not Regulated by HIPAA," Department of Health and Human Services, July 19, 2016, https://www.healthit.gov/sites/default/files/non-covered_entities_report_june_17_2016.pdf.

[344] Ibid., 4.

[345] Ibid., 5.

[346] Ibid., 13.

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IX. RECOMMENDATIONS

This thesis reaffirms the importance of social relationships in every aspect of human life. By establishing relationships with others, human beings create connections that are used throughout life to gather resources, exchange information, and build the social capital essential for strong communities. Connections formed from these relationships create a structure that, when visualized and measured, can reveal the density, strength, and cohesiveness of our social networks. The process of revealing a person's invisible network of connections is known as social network analysis.

An individual's healthcare can remain uncoordinated within fractured care delivery systems that reside at the mezzo and macro level, or through activities that fail to promote healthy behavior at the micro (individual) level. Adopting SNA for high healthcare utilizers can provide insights into the relationships associated with their well-being, both within their communities and within the local healthcare systems that support their needs. SNA can span the breadth of macro- and micro-level healthcare and can help us understand existing relationships at any or all of these levels. The following recommendations are proposed:

- Create an understanding for all levels of healthcare practitioners of the social determinants of health and the impact they have on individual and community wellness.

- Utilize social network analysis as an integral part of patient case management to improve healthcare system navigation.

- Promote the development of fire/EMS Mobile Integrated Healthcare (MIH) programs.

- Reimagine high utilizer support/response mechanisms and build integrated care teams.

A.   UNDERSTAND THE SOCIAL DETERMINANTS OF HEALTH

Evidence suggests the social aspects of an individual's life have a great impact on one's health. The World Health Organization defines the social determinants of health as the "conditions in which people are born, grow, work, live and age, and the wide set of

forces and system shaping the conditions of daily life" (see Figure 7).[347] With research indicating that as much as 60 percent of a person's health is determined by social factors, it is recommended that all providers understand the influences associated with an individual's social environment in order to develop targeted interventions that address his or her unmet social needs.[348] When conditions deteriorate within a community, individuals may become increasingly isolated. As a high utilizer's social network deteriorates, the patient may withdraw from health-promoting activities and interact with only the closest connections. High healthcare utilizers dealing with complex health conditions and functional limitations require network support structures that bridge social capital to extend beyond dense network locations in order to improve their access to information and resource exchanges.

Economic Stability	Neighborhood and Physical Environment	Education	Food	Community and Social Context	Health Care System
Employment	Housing	Literacy	Hunger	Social integration	Health coverage
Income	Transportation	Language	Access to healthy options	Support systems	Provider availability
Expenses	Safety	Early childhood education		Community engagement	Provider linguistic and cultural competency
Debt	Parks	Vocational training		Discrimination	
Medical bills	Playgrounds				Quality of care
Support	Walkability	Higher education			

Health Outcomes
Mortality, Morbidity, Life Expectancy, Health Care Expenditures, Health Status, Functional Limitations

Figure 7. Social Determinants of Health[349]

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[347] "Social Determinants of Health," World Health Organization, accessed August 12, 2016, http://www.who.int/social_determinants/en/.

[348] Taylor et al., *Leveraging the Social Determinants of Health*, 3.

[349] Source: "Social Determinants of Health," Kaiser Family Foundation, accessed August 12, 2016, https://kaiserfamilyfoundation.files.wordpress.com/2015/11/8802-figure-2.png?w=735&h=551&crop=1.

To achieve this stronger network support structure, care providers should assess a high utilizer's housing, transportation, food, and safety conditions as a routine component of the care plan. A loss, or fear of loss, of these resources can exacerbate the physiological stressors and potentially drive increased 911 use and reliance on emergency resources for primary care services. Healthcare providers must advocate for the development of community programs that improve the social determinants of health, promote the development of social capital, and create opportunity for expanding individual social networks. Potential action items related to the social determinants of health can include the following:

- Develop programs that encourage neighbors to check on the well-being of the ill and elderly on a regular basis, especially in preparation for community emergencies such as severe weather or excessive heat.

- Establish a volunteer telephone care program that can reach out to socially isolated individuals in an effort not only to check their wellness, but also to provide the feeling of connection to others that will in turn reduce stress and promote a sense of security.

- Encourage volunteer or faith-based community groups to walk through socially vulnerable neighborhoods to distribute health, safety, and disaster preparedness information and provide social services referral contacts.

- Host open houses at neighborhood fire stations to connect residents with local support organizations and establish new connections with geographically proximate neighbors.

B. FROM CASE MANAGEMENT TO CARE NAVIGATION

When describing the issues facing the U.S. healthcare system, particularly the challenges posed by high utilizers, terms such as fractured, complex, and inefficient are often used. The provider groups associated with an individual's care span the macro, mezzo, and micro levels of the system and often focus their work on a single aspect of care delivery. Unfortunately, ensuring that the team providing care to any patient is aligned in its mission is a non-trivial and often ignored undertaking. Isolated medical record and data systems, myopic leadership, fear of litigation, and privacy issues all impact the healthcare system's ability to fully treat the most challenging patients and contribute to the overall cost of care. In order to mitigate impacts on the healthcare

system created by the excessive utilization of services, intensive, individual-level case management—such as that implemented in Camden, New Jersey by Dr. Jeffrey Brenner—is required.

Case management staffs work within the social service, physician practice, and hospital environments to help patients understand prescribed care plans.[350] In the hospital, case managers and discharge planners will have multiple consultations with the patient and his or her family, if available, in order to prepare them for release and long-term home care. For the majority of patients, this case management approach effectively meets the needs of care plan implementation. However, for a patient with complex medical conditions and ineffective personal and medical support systems, a poorly planned discharge process can lead to hospital readmission or frequent emergency department visits. Applying social network analysis in the case management process can potentially improve patient outcomes by allowing planners to visualize the high utilizer's relationships. As a result, the planner would be better able to identify and address the patient's needs proactively and ensure systems are in place to strengthen his or her social network support structure.

Often excluded from the case management and discharge planning process is the integration of prehospital care providers such as fire and EMS responders. This healthcare force multiplier can help validate the patient's care plan; first responders can work collaboratively with hospital case management to ensure compliance with physician orders. Consider the following example of integrated case management in practice:

1. The hospital records management system identifies a high utilizer. Case managers complete a social network survey to establish the patient's key relationship components prior to discharge. This survey is used to analyze the patient's social network.

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[350] The Case Management Society of America (CMSA) defines case management as a collaborative process of assessment, planning, facilitation, care coordination, evaluation, and advocacy for options and services to meet an individual's and family's comprehensive health needs through communication and available resources to promote quality, cost-effective outcomes. "What is Case Management," Case Management Society of America, accessed August 13, 2016, http://www.cmsa.org/Home/CMSA /WhatisaCaseManager/tabid/224/Default.aspx.

2. Case managers give the patient a care plan, and offer a scheduled home visit within 12 to 24 hours from the local fire department or ambulance service provider.

3. Once discharged, the local fire department and EMS agency is advised that the individual has returned home and is in need of a coordinated follow-up. The closest fire station is notified and they are scheduled for a home visit.

4. Fire personnel arrive at the coordinated time, complete a home fire safety check, assess fall or trip hazards, collect any additional relationship information that would contribute to a more thorough social network analysis, and complete an initial assessment of care plan compliance.

5. The home visit report is sent to the hospital and is used to supplement the care plan.

By involving the local fire or EMS service in the case management process, the hospital verifies the initial plan is in place, and the public safety agency has the opportunity to complete important life safety education, deliver disaster preparedness information, and build community social capital. Fire crews and patients would both benefit greatly from a non-emergency visit at 2:00 p.m. rather than an emergency at 2:00 a.m. Public safety needs assessments such as these also have the ability to rapidly initiate social support agency referrals for problems identified within the home.

For case managers, adopting a social network perspective when evaluating a high utilizer's needs can yield unexpected benefits. Even an informal understanding of the patient's social support structure, neighborhood, and barriers to healthcare will add quality and value to the healthcare system and to the relationship between patient and case manager. Formal SNA can help the case manager ensure that primary network connections are involved in the care process, that they receive information, and that they are communicating the patient's needs back to the care team. For individuals with smaller, more isolated social networks, the ability to manage doctor appointments, arrange transportation, and complete financial documents can be a further challenge.

By implementing a care navigation concept—case management guided by social network analysis—healthcare providers would be able to help bridge network connection gaps in order to support the prescribed care plan and improve health. Integrating the local

fire department or ambulance service in this process can allow for after-hours notification of response, home safety checks, and emergency preparedness activities that ensure safety and reduce the demand on emergency services. Adding a well-informed and trained prehospital care navigation component creates a strong bridge to the community resources available to the socially isolated adult. Efforts to build the support network should be a mission of the case management staff and all agencies impacted by high utilizers, or that could be aided by implementation of the care navigation component.

C. MOBILE INTEGRATED HEALTH PROGRAM DEVELOPMENT

In an effort to repair the fractured healthcare system–high utilizer relationship and respond to changes in related care reimbursement, several innovative prehospital EMS providers across the nation have established Mobile Integrated Healthcare (MIH) programs.[351] MIH is defined as "the provision of healthcare using patient-centered, mobile resources in the out-of-hospital environment that are integrated with the entire spectrum of healthcare and social service resources available in the local community."[352] Ambulance transport services such as MedStar in Fort Worth, Texas, fire departments in the Mesa Fire and Medical Department in Arizona, and the San Diego Fire-Rescue Department in California have established MIH programs in an effort to mitigate the excessive utilization of fire and EMS resources and reduce the associated costs of care.[353] Successful MIH programs become an extension of the physician care team and help manage complex health conditions through in-home assessments and coordinated case management programs. Fire and EMS MIH programs are equipped to work in a collaborative environment with other care providers to improve data collection, provide social/health service referrals, and provide treatment options in lieu of the hospital emergency department. Figure 8 provides an overview of MIH components and steps for implementation and measurement.

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[351] Matt Zavadsky and Douglas Hooten, *Mobile Integrated Healthcare: Approach to Implementation* (Burlington, MA: Jones and Bartlett, 2016), 11.

[352] Ibid.

[353] Ibid., 135–141.

Needs Assessment → **Inputs & Resources** → **Outputs & Activities** → **Outcomes & Evaluations**

Identify the population health needs and service gaps

- Identify the stakeholders and the resources to invest
- Develop a medical direction
- Create strategic partnerships
- Identify the healthcare providers
- Integrate health records
- Look for sustainable funding
- Transportation and mobility
- Technology
- Training – Protocol and skill development

- Develop and Implement the action plan
- Identify the community and patients
- Decide services – Pre hospital & post hospital
- Preventive services
- Chronic disease management
- Immunization
- Patient education and advocacy
- Hospice
- Mental health
- Training

- Results
- When to evaluate?
- Frequency of evaluation
- Using evaluation tools
- Factors – Patient experience & Provider experience.
- Cost effectiveness
- Impact
- Setting performance goals – short, intermediate and long term
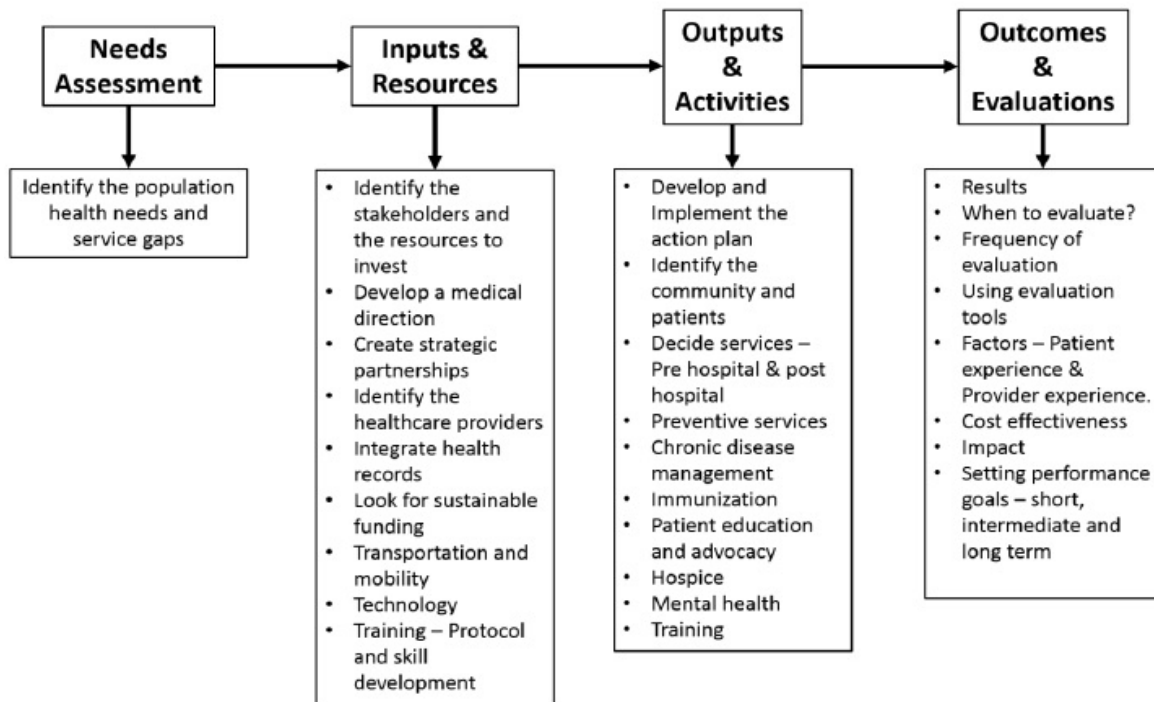
Figure 8. MIH Program Categories and Components[354]

MIH is a relatively new concept in the EMS industry, and implementing programs can expand service delivery for the nation's fire and EMS services; doing so, however, requires community-wide planning, coordination, and consideration of several important factors. To determine if MIH programs fit the needs of a specific geographic area, a community-needs assessment must be completed to understand if gaps in care actually exist and to identify the specific level of service required:

- Service delivery must be coordinated with other community providers such as hospitals, physicians, and nurse case managers to avoid duplicated services, added costs to care delivery, and additional fractures of the healthcare system.

- MIH programs that expand the scope of practice for prehospital care providers must ensure that proper training and education programs exist for fire/EMS care providers to ensure patient safety and quality care.

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[354] Source: Sreenivasan Ranganathan, *Fire Based Mobile Integrated Healthcare and Community Paramedicine (MIH & CP)—Data and Resources* (Quincy, MA: Fire Protection Research Foundation, 2016), 8.

- Data collection, reporting, and quality measurement practices are necessary in order to demonstrate program value and ensure patient satisfaction.

Successful MIH programs offer both urban and rural healthcare systems an effective tool for managing the high utilizer. Their implementation can extend a community's health and social support network and build new care connections between providers and patients. MIH program success relies on integration into the existing community care network; incremental program implementation is recommended to ensure the community gaps are effectively addressed in a collaborative manner without contributing to an ineffective care delivery system.

D. BUILDING INTEGRATED CARE TEAMS

A fractured healthcare delivery system poses difficulties with care coordination for the highest care utilizers. Visualizing the healthcare system would reveal a network of densely concentrated care provider groups disconnected from their peers, hospital systems, EMS responders, and many other ancillary health service providers. This fractured system represents a particular challenge to network development for patients with complex medical conditions. To address the issue of high healthcare utilization, the healthcare system as a whole must break rigid care paradigms in favor of adaptable care methodologies that include a total integration of care teams.

In his book, *Team of Teams: New Rules of Engagement for a Complex World*, retired U.S. Army General Stanley McChrystal challenges the norm of team command and control by promoting a more "interdependent" or networked model of teamwork.[355] McChrystal presents the acronym MECE, "mutually exclusive and collectively exhaustive," to describe the typical command-and-control organizational model.[356] An organization that is commanded in a MECE environment often becomes so large that the teams' "adaptability" is lost, trust deteriorates, and silos form that reduce operational

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[355] Stanley McChrystal, *Team of Teams: New Rules of Engagement for a Complex World* (New York: Penguin, 2015), 83.

[356] Ibid., 119.

capability.[357] The exclusive relationships formed within silos result in a high level of internal team cohesiveness and a perception that other teams are inadequate, resulting in mission priorities that are misaligned with command.[358]

McChrystal's proposed "non-MECE" solution, the "Team of Teams" concept, improves operational adaptability and overcomes organizational silos. Team members should "know" someone on other operating teams to create trusting relationships and to sustain a common mission among all agencies involved.[359] Relationship-building between the smaller teams reduces competition, establishes trust, and promotes a collaborative approach to mission success.[360] McChrystal developed this solution while working with military special operations teams in the Middle East, but its application can also help resolve fractured healthcare service delivery at the local level.

The healthcare delivery network is an enormous MECE system that functions in a hierarchical manner within established silos of care. Patients move from isolated provider group to isolated provider group, with interaction occurring in only the most sophisticated of healthcare systems. While aligning the entire healthcare system is a lofty goal, small steps to improve care coordination and impact the excessive utilization of services can be applied utilizing the Team of Teams concept.

First, community governance and healthcare leaders must agree on a common mission that reflects a desire to work collaboratively toward solving the issues of high care utilizers. Simply aligning with a mission to assume a new perspective of collaborative care can help direct-care teams build trust across the system's many service providers and ensure a patient-centered approach to care. Second, healthcare systems should develop integrated care teams that are able to navigate the complexities of care. Building a proximal, or virtual, team of healthcare, social services, mental health, and financial service providers can collectively improve the social network of high utilizers, reduce demand on emergency resources, and ensure patients are resilient to community-

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357 Ibid., 126.

358 Ibid.

359 Ibid., 128.

360 Ibid., 129.

wide disasters. Finally, an integrated care team should be developed that supports the prehospital response to high care utilizers. The creation of a 24-hour Community Health Integration Center could provide immediate support to public safety responders, healthcare providers, or the social services community in the event they are faced with a complex social service or unmet healthcare need. The ability to immediately refer a socially isolated individual to a central point of contact will reduce the existing gap between identification and response.

X.   CONCLUSION

In August of 2016, police officers in Rome, Italy, were called to investigate "crying and shouting" emanating from a small apartment.[361] When the officers arrived, they found an elderly couple distraught over the disturbing news stories appearing on television.[362] The police officers prepared a meal for the couple, who lived alone and lacked a responsive social network, then spent the remainder of the evening learning about the couple's life and many years of marriage.[363] While solutions for addressing the gaps in social and healthcare support exist at each level of the social and healthcare delivery system and within each community, a meal from local police is not an effective long-term solution to the elderly couple's social isolation. While this simple, cost-effective, and admirable moment of social connection between a public safety responder and a couple in need demonstrates the minimal effort required to positively impact a person's health and well-being, without supporting relationships beyond sporadic and temporary encounters, the couple will remain within an isolated network, further increasing their vulnerability to disease and exacerbation of existing illnesses.

Relationships, and the networks they represent, matter to every human being. Connections are especially critical for those who are becoming increasingly socially isolated, managing complex health conditions, and living with functional limitations. When healthcare becomes too great to effectively manage, the sickest, frailest, and oldest within our communities may no longer have the valuable social networks that were previously established through work, volunteer programs, or leisure activities. Social networks are dynamic, and the relational ties that connect them can weaken or disappear if not maintained. Therefore, steps should be taken to strengthen social support networks of those most vulnerable to isolation in order to improve their personal well-being while

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[361] Bianca Britton, "Police in Rome Dish out Love—and Spaghetti–to Lonely Couple," CNN, August 9, 2016, http://www.cnn.com/2016/08/09/europe/rome-police-italian-couple/index.html.

[362] Ibid.

[363] Ibid.

reducing excessive demands on finite care resources such as the fire department, ambulance service, or hospital emergency department.

Navigating the complex and fractured network of healthcare delivery systems in the United States is a barrier to well-being for those who cannot schedule a physician's office appointment, secure transportation to a clinic, or reach a pharmacy for vital prescriptions. Failure to complete these critical health maintenance activities can exacerbate disease and delay care to the point that it requires emergency response and hospital treatment. The link between social support and personal health is well established; it is essential for care providers to recognize the importance of social networking when addressing the needs of high healthcare utilizers and our most vulnerable populations.

Social network analysis can provide the means for physicians, case managers, and social service workers to better understand the hidden strengths and weaknesses within high healthcare utilizers' networks, and to target interventions that improve their well-being. Without visualizing the network, healthcare providers are blind to patients' essential needs and will fail to adequately improve their care, address their long-term needs, or reduce their financial burden. In addition to addressing the individual's needs, social network analysis is a valuable method for demonstrating the existing relationships among healthcare providers. In fact, it is the social network of healthcare providers, funders, and institutions that should be the initial focus of analysis in order to improve high utilizers' lives. Without an integrated care team, high utilizers will continue to find themselves struggling to navigate the complexities of healthcare.

Every element of care is connected and relies on the relationships between providers. Real efforts to improve national healthcare and the ineffective use of public safety resources rely on understanding the foundation of human connectedness at both the individual and the organizational level. It is this shared network of connectivity that is needed for cost-effective, comprehensive healthcare and emergency services to best support entire communities; undiscovered, the healthcare system will remain fractured and high utilizers will continue to present challenges to both themselves and to the wider community.

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