

# **ACHIEVING A SYSTEMIC UNDERSTANDING OF HEALTH EQUITY: COMPLEX HEALTH, SYSTEMIC ANALYSIS, AND WICKED ISSUES**

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## **Abstract**

### **Problem:**

Science is interpreted and validated, albeit from different analytical and theoretical orientations. Causal inference and analysis are more often expected in public health science. Public health science and its knowledge generation are expressed in a vernacular meant to describe wicked, value-laden structural health outcomes, divergent health statuses, and unpredictable health behaviors. Deviation from scientific expectations of reductionism can invite scrutiny and disregard. A taxonomy of public health establishes a shared, communal reality and imbues it with the perception of immutable, ordered certainty, while health remains a persistent uncertainty. Science shapes scientific conceptualization and analysis, and vice versa. When a narrow orientation to science leads exclusively to linear thinking, the opportunity to uncover the complexity of public health issues is missed. The gravity of health inequity leaves no room for missed public health opportunities or overly simplistic, restrictive reasoning.

### **Rationale:**

Strict reliance on discrete measurement and reductionism cannot provide a complete picture of the complex health disparities that undermine health equity. A hallmark of scientific research is a shared vocabulary and a respected scientific orientation. Systems thinking is not new, but its adoption in public health has been slow. Finding a shared, complexity-sensitive vernacular in public health equity that crosses disciplines and systems methods has been elusive.

### **Methodology:**

As with the adoption of causal inference, systems theories and methods have been rigorously applied with success in other fields and hold promise for innovation in public health. The importance of shared meaning in systemic health is explained using a novel network-based framework for health equity: the health-restricting and health-flourishing subsystems, as applied to health in under-resourced communities.

### **Results/Conclusion:**

Systemic frameworks enable reformed focus on health equity within health systems. Wicked reasoning provides a fundamental foundation, employing shared nomenclature and a holistic understanding to support health.

**Keywords:** systems science, systems thinking, public health, health equity, social networks

## **1 | Introduction**

A failure to recognize complexity overlooks systemic experiential health that emerges dynamically and holistically. Omitting complexity narrows the range of possible explanations for complex health outcomes. Reductionism is an analytical approach that breaks down rather than builds up understanding,

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relying on cause-and-effect statistics rather than systemic modeling. Reductionist measures and methodological choices are currently the gold standard. However, the type of analysis should align with the questions being asked. Systemic questions require what-if scenario building and systemic methods, not the commonly used counterfactual causal methods, to answer them (Giabbanelli & Page, 2024; Author, 2024). The implications of control over our world apply to scientific vernacular and meaning-making as well. Systems thinking helps make sense of the seemingly nonsensical, wicked, and resistant situations. The systemic forces and unequal effects must be uncovered using systemic and complexity paradigms (Author, 2026). The marriage of the reductionist and complexity vernaculars is the way forward for strengthening the arsenal to combat wicked public health problems. But a common language is required. Common language is not a full erasure but a melding that serves as a starting point for both causal and complex inquiries which in most cases should be paired. This may be easier said than done. But does reductionism or complexity bend to accommodate this necessary synergy? A concern in bringing together these schools of thought lies in which method is given primacy, into which the other is asked to fit within its boundaries. Combining causal and complexity elements in a public health question may be a path forward. For example, an updated complexity-inclusive reimaging of the World Health Organization's (WHO) definition of health policy adds complexity elements to the already accepted definition:

1. Interdependent, wicked social realities (complexity)
2. Epidemiological goals and measures that capture systemic causes and effects of morbidity and mortality (conventional with complexity update)
3. Emergent social goals, decisions, and actions taken toward systemic action for the betterment of society (conventional with the complexity update of the WHO definition)
4. Policy initiatives meant to solve wicked problems (conventional with complexity update)
5. Governance impacts on the healthcare system (conventional with complexity update)
6. Health-related, interdependent actions of agents (complexity)
7. Emergent ethics and morals as system attractors (complexity)
8. Dynamic and resistant political climates (complexity)

(Author, 2015)

While the World Health Organization does approach health policy systemically for orientation and process, the operational definition should also move beyond a set of governance principles and plans toward action (Author, 2015). How public health is defined influences how stakeholders with the capital shape the public's health, in the process of change. Scientific vernacular is a guidepost for action and sensemaking in science. If the terminology fails to capture complexity, complex situations will not be interpreted correctly. Complex problem situations may not be seen as complex.

It should be noted that there are instances where conventional terminology and its definitions are debated. To some systems thinkers, there is a lack of consensus on the definitions associated with the hard, objective systems' and soft, subjective networks' waves of thought; there is agreement that systems exist. Elements of systems thinking align with different traditions and paradigms. There are several waves of systems thinking; which is most appropriate to combine with reductionism? This is not an issue relegated solely to complexity; reductionism also offers several routes to answer specific cause-and-effect situations. But there should be consensus in the appropriateness of the method to a specific research question. Systems thinking has a myriad of methodological approaches analogous to the wide range of causal methods. It is a misnomer to assume the lack of diversity in complex methods and theories. Definitions and vernaculars are connected to the methodology. Ontology is the scaffolding for the measurement. But what comes first, the vernacular or the method attached to a socially held reality? Or is this relationship of words to explanation reflective? The question remains: can a discipline bound by interdependence and chaos find common ground with causal methods? A solution is to not dilute the methods but use a combination into a vernacular that amplifies complexity where it has been diminished (Jackson, 2019a). There is little disagreement about the basis and application of linear methods for

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answering certain scientific questions. The necessity of parity in methodological legitimacy is that complexity first gains entry into the arena of scientific inquiry as an equal. Relegate complex aims to complexity methods or to a mixed methodology with established causal methods. The first step is acceptance of systems thinking and methods before common ground can be found. What should not happen is that complexity is not fully realized as a full partner in scientific inquiry in public health. Those who control the articulation of science falsely act as if they control and own science's legitimacy. This fundamental quandary of perceived incompatibility in the vernacular stems from a wide schism in methodologies and approaches deemed discordant. There are instances where reductive reasoning is appropriate. The omission and blockage of complexity theory and methodology in addressing questions about complex problem situations are evident, and the automatic adoption of reductionism as a methodological choice is problematic. The lack of urgency about shared meanings across seemingly discordant worlds of thought is evident in the slow adoption of complexity-laden methods and approaches in public health.

### 2 | The Need for Common Complexity-Driven Vernacular in Health Equity and Public Health

Mental models make sense of our world. Mental models are messy but are useful for creating shared meaning. We make shared meaning through vernacular and value-based action. At the intersection of actions and values, people are influenced by mental pictures, both those created collectively and those created for oneself. Often, premature mental models of health can lead to misconceptions of the systems at play because mental models are broken into parts by people who, in turn, rely on linear thinking for meaning making and interpretation. Scientific words shape conceptualization and analysis. When these words lead exclusively to linear thinking, there is a missed opportunity to uncover the complexity of public health issues.

The way to engage and pronounce complexity in health equity is not without its supporters and critics. It is essential to understand the complexity of health equity and not limit health goals to resolving problems by pursuing health equality or maintaining the status quo. What should be pursued is health equity. Health equity is “a state in which everyone has a fair and just opportunity to attain their highest level of health” (Centers for Disease Control, 2024). A misstep in articulating the importance of these health differences to the framing of this injustice through reliance on computationally derived measures, which can appear exclusionary and protective to those who do not identify as at-risk or under-resourced. In fact, no member of society is untouched by the health of others. The use of the Centers for Disease Control's (CDC) opportunity-centered, rather than outcome-centered, framing of health equity does not come without its risks (Alberti, 2025). Alberti offers a reimagination of the CDC health equity definition: “Every community has and provides the basic vital conditions and services we all need to thrive” (Alberti, 2025, p. 957). The uptake of opportunity-based health services presents meaningful opportunities for change through public health initiatives.

Employing multimethodology, a critical approach to linking and integrating multiple methods to better understand complex phenomena, is suggested to break down barriers to answer complex questions and foster transdisciplinary cooperation (Jackson, 2019b, 2019a). Social epidemiology is useful in explaining how inequity arises with causal inference and measurement. For example, Tugwell and researchers propose the equity effectiveness loop (Tugwell et al., 2006). The loop is an epidemiological framework useful for assessing health equity causally, acknowledging a looping mechanism for assessing the effectiveness of interventions based on gradients in social determinants of health (wealth). The equity effectiveness loop is concerned with equity via understanding the “distribution of both risk and response across the wealth gradient” (Tugwell et al., 2006, p. 358). While the equity effectiveness loop is not a mechanism for discerning complexity in health per se, the findings move epidemiology closer to using more social-epidemiological approaches that could be connected to systems thinking and complexity. But

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this debate shows the different articulations and approaches to health, all vying to assess a socially constructed systemic reality (Author, 2021). Linearity in reasoning scratches the surface of a complex situation, but it is a reasonable method for some binary questions and the uncovering of disease states (Galea et al., 2010). According to Galea and colleagues, there are some important implications for missing complexity using conventional epidemiological methods:

1. Difficulty in taking into account the multi-level causes of disease,
2. Insufficient capture of reciprocal, bidirectional relations and feedback,
3. Difficulty capturing connections and relationships between causes. (Galea et al., 2010).

But in order for methods to be combined, there must be common ground on how and why they should reasonably be connected without losing reliability and validity. Will the phenomenon be appropriately captured with a shared vernacular? An overarching thread connecting causal reasoning and complexity in public health is the understanding of the state of phenomena that affect health outcomes. There is agreement on many levels. There is a revolution in epidemiology that incorporates complexity to identify causes of disease (Rod et al., 2023).

Attempts to standardize systems thinking and complexity methods are also underway.

A recent development is the LEVERAGE Guidelines, which extensively outline the questions to ask before embarking on research aimed at exploring public health issues using a systemic approach (Li et al., 2022). Framing implementation in systems yields answers that are sensitive to the true complexity of the public health issue. For instance, the LEVERAGE Guidelines pay specific attention to the life cycle of an intervention: development, implementation/delivery, and evaluation (Li et al., 2022). At every step of the iterative process, attention is given to how each step is systems-sensitive—whether it uses appropriate systems methods based on the desired understanding of outcomes, articulates implementation with systems accounted for, and involves stakeholders (akin to participatory research methods) (Li et al., 2022). The scientific machinery cannot be separated from the systemic theory that underpins our understanding of complex health equity.

In this paper, systemic health is explained using a novel taxonomy of complex health equity: the health-restricting and health-flourishing subsystems, as applied to the health of under-resourced patients. To address systemic questions in public health, a centralized corpus is needed to guide those investigations. Deeply rooted actions that reinforce health inequity require systemic paradigms and methods to address them. The goal is to advance implementation science in health equity by using shared, systemic vocabulary to guide implementation in health equity research. Thus far, the question has been how to share complex science that is amenable to public health research in a manner similar to shared analytical methods. There has been a lack of clarity about the systemic application of systems thinking and analysis in public health practice and implementation (Li et al., 2022).

### 3 | The Health-Restricting Subsystem, the Health-Flourishing Subsystem, and their Implications for Shared Meaning

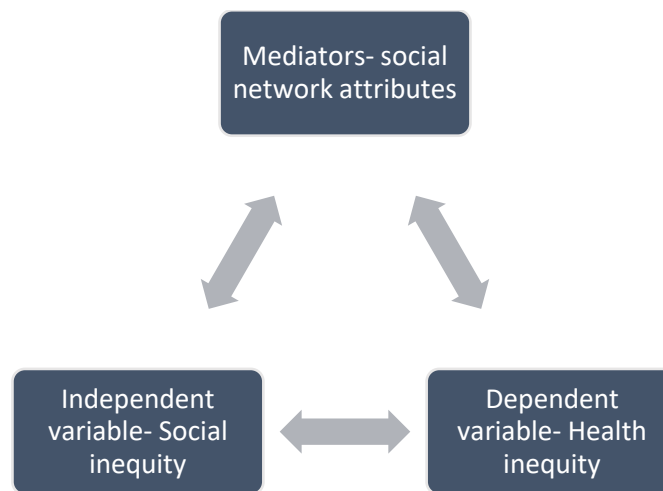
Health outcomes result from the systemic interaction of community-identified conditions that affect health-related risks, the development of these conditions, and social forces that sustain the influence of structural determinants. A key concept in understanding the complex relationship between community-determined conditions and health outcomes for under-resourced populations is the limited opportunity for those in need to fully participate in shaping their health. This restriction in shaping one's health future can be seen as a systemic decline in social engagement for individuals based on their membership in a social group, characterized by a shared social standing that diminishes power and social capital and restricts access to resources and opportunities. Patients with unequal access and influence may be part of a health-restricting subsystem. The term *health-restricting subsystem* implies an active, ongoing process where the local environment perpetuates social limitations and cycles through fewer resources and diminished social

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capital (Author, 2026). The opposite of a health-restricting subsystem is a *health-flourishing subsystem*, which is well-resourced to help its members access better opportunities for optimal health (Author, 2026).

Unequal access to resources for those with fewer means stems from a system still shaped by past social and personal actions, leading to varied healthcare outcomes. The system itself is not the root cause of social inequality. It has no intention of creating disadvantages; instead, it functions as a mechanism for mechanical change. Society's members, however, define and assign meaning to social differences and similarities, which then shape how the system operates. Consequently, both the systemic and practical effects of social marginalization and privilege are inherent parts of the social system. The health-restricting subsystem results from the interaction of community-defined conditions, internal forces that maintain social differences, and individuals who make decisions, take actions, or are influenced by others. Conversely, systems that promote health are designed to support social benefits, which can better foster optimal health (Author, 2026). In terms of health-restricting subsystems, factors inherent to these networks may indicate a lack of choice or restricted access to beneficial practices that individuals are expected to use in making informed decisions that support optimal health (Author, 2026). The adoption of choices by at-risk, under-resourced people requires autonomy and social support, which leads to the formation of different social networks based on adoption characteristics (DiMaggio & Garip, 2018). Social networks are not always beneficial, as some goods, practices, or services might not be available to others (DiMaggio & Garip, 2011). The lack of available resources can exacerbate social inequity (DiMaggio & Garip, 2011). Therefore, health-restricting subsystems can be characterized by their deficiency in accessible, supportive, and shared resources, which puts the under-resourced at a marked disadvantage (Author, 2026).

A health-restricting subsystem is rooted in shared health outcomes, influenced by social context, and may be structured differently from well-resourced systems that promote and support health. These health-restricting subsystems limit opportunities for improving an individual's health, which could lead to a mediator model, where the relationship between social and health differences is mediated or altered by attributes of the social system, as illustrated in Exhibit 1 (Keim-Klärner et al., 2023). In terms of feedback and adaptation in the health-restricting subsystem, the “status quo perpetuates social disadvantage and positive and negative feedback support a durable, active influence supporting the perpetuation of marginalization in the subsystem” (Author, 2026, p. 3). For those located in the health-flourishing subsystem, a cycle of advantage is in constant feedback loops, reinforcing and advancing positive social capital and healthful advantages (Author, 2026). In terms of systems attractors, beliefs are deeply ingrained in the overarching system; some are restrictive, and others are beneficial to different actors in said subsystems (Author, 2026).



**Exhibit 1. The Health-Restricting Subsystem Mechanism**

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The model explains mechanisms such as social factors and conditions that lead to social inequity (independent variable), which results in poorer health, represented as health inequity (dependent variable), and is partly or wholly influenced by the mechanisms of the attributes of the social network (mediators) (Keim-Klärner et al., 2023). The health-flourishing system may work similarly, but with the independent and dependent variables having opposite valence. Social networks do not always restrict health; therefore, it should not be assumed that every attribute of social networks restricts in every instance. However, if the measures reveal differential health outcomes, the intervention, which could be facilitated through social networks to combat any outcome, is a lost opportunity for health.

### 4 | The Place of Social Network Measures in Health-Restricting and Health-Flourishing Subsystems

People forming networks within subsystems based on social status may share advantages and disadvantages related to access to care, as well as differentials in power, social capital, and social advantage. Networks may consist of under-resourced members, increasing the likelihood that they share risk factors, thereby raising their risk of morbidity and mortality. Health-restricting subsystem networks may also limit opportunities to advance socially, leading individuals to connect primarily with others who share similar life experiences and opportunities; those in health-flourishing subsystem networks are advantaged (Author, 2026). For those lacking access to essential resources, social networks can serve as incubators for social stratification, potentially leading to a disproportionate concentration of social goods and information. Individuals with fewer resources tend to have less access than those with more. Health disparities faced by groups with varying resources may leave individuals who need community support within a social structure composed of separate networks, each offering different levels of social and health-related support and resources. However, social networks can also act as sources of positive social support, facilitate social mobility, and provide better health opportunities. People within social networks can also thrive collectively.

Evidence suggests that ongoing health concerns have a significant impact on patients' social networks and the support-seeking behaviors of under-resourced individuals within those networks (Craveiro, 2017; Keim-Klärner et al., 2023). Being connected to others in the same social situation can either limit or enhance access to external resources or compel the sharing of scarce resources. According to Link et al.'s presentation of the Fundamental Cause Theory's link between socio-economic status (SES) and health disparities:

“SES-related resources of knowledge, money, power prestige, and beneficial social connections (are) flexible resources that allow people to avoid risks and adopt protective strategies no matter what the risk and protective factors are in a given place or time.” (Link et al., 2008, p. 72)

This flexibility of resources has implications for health-restricting and health-flourishing subsystems in gaining a health advantage by leveraging social connections within networks, which in turn positions under-resourced people with better chances of improving public and private health outcomes (Link et al., 2008).

People, known as nodes in social network analysis (SNA), make up social networks. Nodes engage in relational interactions characterized by ties within broader social systems that include both health-restricting and health-flourishing subsystems (Author, 2026). In a network, nodes may connect through shared risk factors in addition to dyadic relationships. There may be overlapping and bridging nodes across the health-restricting and health-flourishing subsystems; however, the impact of social differences varies depending on the risk factors for adverse health outcomes. SNA concepts related to health services and patient outcomes are less common because many SNA studies in this field are primarily descriptive and not readily applied in practical settings (Braithwaite et al., 2018; Cunningham et al., 2012). There is a gap in the literature regarding the application of SNA to understand patients' experiences, which could improve the quality of care and address health disparities and suboptimal outcomes that could be targeted. Exploring the collective experience within social networks of under-resourced and resourced patients

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provides perspectives not usually accessible to providers and policymakers. This approach focuses not just on individual patients but on a broader, more comprehensive view of how social health differences, influenced by social structure, may affect the specific needs of all patients. Gaining a more detailed understanding of the complex health experiences of these patients has direct implications for the care they receive and should receive.

For instance, homophily may lead to less healthy outcomes, which can be predominantly associated with others of the same health status, thereby fostering an environment that is less innovative in health behavior and one based on shared suboptimal health chances (Centola, 2011). The cumulative collateral effects on the health of other people can influence an individual's health within the same network (Christakis, 2004). In other words, people are affected by other people's health. Individuals who are under-resourced, often characterized by homophily, tend to experience limited resourced networks (Gauthier et al., 2021; McPherson et al., 2001). Under-resourced individuals may remain in homophilous networks without reaching a tipping point of resource-rich environments, or a bridge to health-flourishing networks where more resources are available. In terms of reciprocity, there is an intentionality and a presence of mutual benefit, as well as a reciprocal sharing of resources (Xu et al., 2021). The dynamics of sharing resources, such as social capital, is typified by this homophilous state, which fosters the sharing of resources among members of a shared network, such as the health-restricting network (Xu et al., 2021). A patient can only share and reciprocate beneficial resources and personally benefit if they themselves possess resources that support well-being.

Consequently, systems may house different networks with varying resources and life opportunities. McFarland et al. noted that the social environment does not adapt, for instance, to changes in societal relationships (McFarland et al., 2014). People transform the social environment through “(mobilization) to change institutional structures, practices or rules” (McFarland et al., 2014, p. 1090). The implication for health differences is that inequality cannot exist without a changing social system altered by people and the presence of a proximal social environment that supports it. Likewise, health-flourishing subsystems are tied to changing social structure predicated on human action and inaction. People interact with and within the environment, sometimes in ways that reinforce social positions. Thus, the health-restricting subsystem does not rely solely on personal choice and health behaviors for adverse health outcomes. However, the societal environment embeds disparities for some and advantages for others in optimally resourced, flourishing subsystems (Author, 2026).

### 5 | Conclusion

There is potential to transform health through a complex adaptive, network-based vernacular to improve health services and related health outcomes. This is only accomplished by normalizing complexity and systems science within a collectively understood public health vernacular. For example, social networks are crucial in this bottom-up strategy because social networks highlight that people within social structures are central, not peripheral, to our understanding of healthcare. This bottom-up orientation approach sharply contrasts with traditional top-down methods and orientation, where policymakers and healthcare leaders—often disconnected from the provision of clinical care—make unilateral, linear decisions that influence patients' experiences and the care they receive. Complexity is fundamentally sensitive to the bottom-up, rooted in social structures and the complexities of human relationships, which should inform health services.

Populations, especially those that are under-resourced, require health interventions and policies that address their unique health needs and social realities. Health is not separate from its effects on individuals and those with whom they are socially connected. Therefore, understanding the relationship between health and social structure is essential for articulating community needs and turning them into effective health interventions. In doing so, the vocabulary used to describe these phenomena matters, especially when reductionism and complexity do not align. Vernacular missed the complexity when the gold-standard corpus ignores its existence. The compatibility is there but is unfortunately underutilized.

## 6 | Recommendations

1. Educate for public health research and practice, assuring that systems thinking and complexity are also discussed and affirmed as legitimate.
2. Start choosing mental models that possess widespread agreement in public health and offer complexity as a multimethodological approach to epidemiology and other accepted public health research methods.
3. Convene systems and complexity thinkers to devise a shared understanding of complex public health phenomena.
4. Convene complexity and conventional methodologists together to work on building a shared understanding of complexity in public health.
5. Advise and involve public health professionals in the development of the shared vernacular to ensure that the words suit the realities in the field.

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