Walking the talk on multi-level interventions: The power of parsimony

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A B S T R A C T

There is strong consensus regarding the need for multi-level interventions (MLIs) to address today’s complex health problems. Several longstanding social ecological frameworks are commonly referred to in guiding MLI development. The specificity and comprehensiveness of these frameworks unwittingly suggest that the totality of included influences are important in all health contexts. Not surprisingly, when viewed as requiring intervention at all levels of influence, MLIs are often considered to be infeasible due to sizeable cost and logistical barriers. Thus, efforts to develop and evaluate MLIs have been extremely limited, and comparatively few examples are found in the health literature. We argue that operational frameworks to identify which levels matter in which contexts—henceforth, referred to as parsimony—could accelerate the field towards broader use of MLIs. We suggest a hypothetical operational framework informed by complexity theory and pragmatic approaches that could enable us to conceptualize, design and evaluate MLIs to consider where reflexive and recursive process mechanisms that cross levels should be targeted by MLI. The approach also emphasizes sustainability of MLIs.

Without developing parsimony-based operational frameworks to move us forward, we fear that little will change, and we will simply continue to talk, without proceeding to the walk.

1. Introduction

The greatest public health burdens globally (e.g., chronic and infectious diseases) derive from a mix of causal and contributing factors and are inherently complex, operating interdependently and reflexively over time. These factors span a continuum from influences at the macro-societal level, through to those at the individual level, through to processes at the cellular and molecular level. Beginning with the large community-based heart health trials of the 1980s, for decades multi-level interventions (MLIs) have been recognized and exemplified in widely referenced social ecological frameworks, as the gold standard for addressing this complexity.

Current conceptualizations of what it means for an intervention to be multi-level vary, with some arguing MLIs comprise two or more levels and others arguing for three or more (Paskett et al., 2016; Taplin et al., 2012). Alternatively, a MLI could be judged based on which levels of influence are considered (e.g., whether it includes a higher-level influence or not), rather than the number of levels targeted. Common in these conceptualizations is the assumption that MLIs comprise a well-defined package of strategies occurring concurrently or consecutively in a specified time period. For the present purposes, we define MLIs to be interventions that address contributing factors operating at three or more levels of influence, and with intervention elements targeting lower and higher levels of influence. By contrast, uni-level interventions target a single level of influence. Accordingly, community-based interventions would be considered as MLIs only to the extent that they intentionally define and target at least three levels of influence.

Uni-level interventions have for some time dominated the field of public health (Scholmerich and Kawachi, 2016; Richard et al., 2011). Indeed, for many years public health interventions have largely been focused at the individual level, emphasizing individual risk behaviors (e.g., tobacco use, sedentary behavior) that have important proximal influences on health outcomes. Rightly, these interventions have been criticized for greatly underestimating larger contextual opportunities and barriers that shape these behaviors and for inadvertently blaming the victim. Other levels of influence (organizational, community, and macro-societal) have more recently become a focus. Given the long-standing and consistent evidence amassed over decades to demonstrate the fundamental influences of structural factors on health outcomes, some argue that macro-level interventions, such as economic or policy interventions, have such consequential health impact to be sufficient as uni-level interventions (Cavazos-Rehg et al., 2016; Bor...
We contend that although macro-level interventions alone may be more effective at improving population health than individual-level interventions alone, the wicked public health problems we face compel us to pursue the gold standard of MLIs. We and others (Paskett et al., 2016; Scholmerich and Kawachi, 2016; Glass and McAtee, 2006) base this contention on complexity theory, holding that public health problems are underpinned by a chain of nonlinear and recursive steps (e.g., process chains) that are embedded in social systems and networks (Aarons et al., 2011; Pawson et al., 2005). These systems are highly adaptive such that small changes and events can lead to an unpredictable series of consequences and compensatory responses, or ripple effects. These rippling effects may have unintended and potentially negative consequences. For example, reductions in traffic density resulting from COVID “stay at home” orders have been accompanied by significant increases in traffic speeds on interstate highways of Los Angeles and the Bay Area of California. Well-designed and conceptually-based MLIs are necessary to reduce the likelihood of iatrogenic ripple effects of uni-level interventions.

Our pitch for the importance of MLIs rests on the idea that interventions at one level of influence often have limited impact and/or negative consequences. For example, reductions in traffic density resulting from COVID “stay at home” orders have been accompanied by significant increases in traffic speeds on interstate highways of Los Angeles and the Bay Area of California. Well-designed and conceptually-based MLIs are necessary to reduce the likelihood of iatrogenic ripple effects of uni-level interventions.

Consistent with complexity theory, there are innumerable examples of interventions targeting tobacco cessation, poor diet, drug use, and many other health risks. In these contexts the health impact of interventions at one level of influence often had limited impact and/or contributed to health inequities as a result of changes at another level of influence. For example, early efforts in tobacco control were focused largely at the individual level, emphasizing personal responsibility for accessing treatment. This resulted in a sharp socioeconomic gradient in tobacco cessation. Recognizing the failing of this individually-focused approach, local, state, and federal policies were implemented that raised tobacco taxes and restricted public smoking. Overall smoking prevalence in the US dropped dramatically, but with relatively little impact on smoking among lower income groups. It was not until some state Medicaid programs began providing free comprehensive smoking cessation treatment, and resources and campaigns were put in place to increase smokers’ awareness that treatments were available, that there were significant reductions in smoking among low income populations (Land et al., 2010). Despite this progress, social gradients in tobacco remain, particularly in states that have not addressed the cost of and access to treatment. Sustained and equitable achievements in tobacco control have required the combination of interventions at the individual- and macro-societal levels, with specific consideration to groups with fewer resources. If the cost of and access to evidence-based treatments had been considered earlier and consistently across states, significant suffering could have been avoided.

Growing understanding of the role of food deserts in obesity among low income populations led to significant efforts to increase the number of supermarkets in communities with limited supermarket access. Yet, increased neighborhood supermarket availability and increased access to healthy food in small groceries modestly increased perceptions of food access (Cummins et al., 2014). There also was limited evidence of an impact on fruit and vegetable intake, healthy food purchases, or reduced BMI (Cummins et al., 2014; Jilcott Pitts et al., 2018a, 2018b).

Buprenorphine has been a landmark success in treating opioid use disorder (OUD), and multiple federal policies have sought to enhance access through increasing physician-based buprenorphine prescribing (Johnson, 2016). When appropriately dosed, buprenorphine reduces overdoses and risks of HIV, hepatitis C, and other blood borne infections. Unlike methadone, it can be prescribed by physicians and dispensed by pharmacists in the US. Unfortunately, many pharmacists refuse to dispense buprenorphine or choose to rate it because of stigmatizing professional and community attitudes about people who use drugs and about medications to treat OUD. Reskin notes the interconnected nature of social systems and their influence on inequality, suggesting that efforts to increase buprenorphine use would need to consider not only prescribing, but also the impact of other stigmatizing social systems (Reskin, 2012). Reskin’s work illustrates that interventions on one system alone will likely always be insufficient because of compensatory processes from the other interlocking systems.

Interactions across levels can also be observed in interventions designed to improve economic conditions. The Great Smoky Mountain Study was a longitudinal natural experiment in North Carolina in which Native American households received additional income linked to the opening of a Casino. There were significant health impacts of this extra income on the health of adolescents, including declining rates of anti-social and aggressive behavior (Costello et al., 2003) and reduced risk of psychiatric disorders in adolescence that carried through to young adulthood (Costello et al., 2010). Income supplements were also associated with increased rates of high school completion, reduced incidence of minor criminal offenses in young adulthood, and the elimination of Native American versus white inequities for both of these outcomes (Akee et al., 2010). However, negative effects of the income supplements were also apparent, and included an increase in accidental deaths during the months that households received the income supplement, presumably linked to increases in vehicular travel and substance use (Bruckner et al., 2011). The supplements were also associated with increased adolescent obesity in families whose incomes were low at baseline, with no effect for those whose income was high (Akee et al., 2010). These findings suggest the importance of a comprehensive MLI approach that would combine the income intervention with individual- and family-level interventions to minimize risks associated with substance use and unhealthy nutritional patterns.

MLIs can play a crucial role in promoting distributive justice. There is abundant evidence to support the inverse care law, holding that public health programs and interventions – regardless of the targeted level of influence – benefit some groups more than others (Ceci and Papierno, 2005). This has been evidenced consistently in the context of health care delivery (Braveman et al., 2011). Tehranifar and colleagues note that there are few disparities in mortality between blacks and whites in cancers when there are few prevention or treatment options (Tehranifar et al., 2009). As treatments for specific cancers are developed, disparities increase significantly, reflecting the reality that interventions that provide better control of a disease may be more accessible to those with more socioeconomic resources (Tehranifar et al., 2016). This phenomenon has recently been noted related to lung cancer screening, where the availability of lung cancer screening facilities is lowest in regions of the country that are largely rural, with the highest prevalence of smoking and highest lung cancer burden (Wiener and Rivera, 2019; Kale et al., 2017).
Also notable is that lung cancer screening programs must provide access to cessation programs in order to be eligible for reimbursement through CMS (Kale et al., 2019). The pattern in which medical discoveries lead to health disparities has repeated itself over time, and is likely only going to be redressed with concerted efforts to develop MLIs that target the underlying barriers to access that inevitably occur. Yet health care advances and contexts will have idiosyncratic challenges where maximizing feasibility of MLIs must be considered.

Phibbs and colleagues (Phibbs et al., 2018) raise these considerations in the area of interventions to remediate effects of natural disasters – heat waves, hurricanes, earthquakes, and most recently COVID. These events occur amidst entrenched structural inequity. Consistent with the inverse care law, in all of these examples and often despite our best intentions, those most in need of services are least likely to receive them. Moreover, disasters disproportionately impact the poor and disadvantaged. MLIs that consider the complex ecosystem of policies, community and organizational responses and individual need are critically important in these settings. Yet, resources are finite making it incumbent that consideration be given to which levels of influence an MLI must address. Indeed, we argue there is no universal set of levels that must be considered by every MLI, but the importance of considering context in selecting levels to target cannot be overstated (Hawe et al., 2009).

Operational frameworks that build on implementation science, complexity theory, intervention mapping frameworks are needed to guide public health practitioners and researchers in deciding at which levels a MLI is likely to have the most impact.

Social ecological models of multi-level influences on health are abundant (Glass and McAtee, 2006; Flay and Petrakis, 1991; Bronfenbrenner, 1999). Common across frameworks is the comprehensiveness of the contributors they include. These heuristics unwittingly suggest that the totality of influences are important in all health problem contexts. Moreover, many of these frameworks depict graduating levels of influence as concentric circles with neither porous boundaries, specified mechanisms of cross-level influence, nor directionality. The relative infrequency of MLIs suggests that such comprehensive frameworks have not been especially useful in guiding MLI development when faced with the appreciable barriers suggested earlier.

Broadening the field towards MLIs will benefit from a parsimony-focused operational framework to guide intervention and program developers to explicate which cross-level mechanisms should be targeted (conceptual clarity), guide selection of pragmatic study design (methodologic pragmatism), and articulate how sustainability will be defined (conceptual clarity), guide selection of pragmatic study design (methodologic pragmatism), and articulate how sustainability will be defined (conceptual clarity). A parsimony-focused framework would be guided by questions addressing the many barriers to MLIs, including changing context, costs, and varying values and perspectives of stakeholders at different levels. To follow our own advice, we engaged in an exercise to develop a hypothetical framework.

The framework draws from well-developed concepts suggested in several lines of thought where the push is to integrate “real world” thinking into intervention development. Our focus in this exercise is on considerations that could foster parsimony in selecting which levels are most likely to enable or undermine intervention effectiveness. These include: 1) conceptual models that address complexity (Hawe et al., 2009); 2) pragmatic methods for practice translation (Glasgow, 2013); and 3) implementation science (Brownson et al., 2018), as highlighted in Table 1.

While conceptual clarity is strongly encouraged for interventions generally, it is essential for planning MLIs. Taken at face value, these ecological frameworks appear to suggest that every level matters in all contexts. Yet, the realities of public health research and practice limit the resources that can be expended. We and others (Hawe et al., 2009) have suggested complexity theory as one example of a conceptual model to guide visioning for how MLIs might lead to bi-directional and synergistic influences on targeted health outcomes that could be capitalized on for maximal benefit. We borrow from complexity domains enumerated in the “realist” framework presented by Pawson et al. (Pawson

<table>
<thead>
<tr>
<th>Table 1 Example intervention mapping process for planning multi-level interventions (MLIs).</th>
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<tr>
<td><strong>Assumptions</strong></td>
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<td>Conceptual clarity: Realist Framework of Complexity Considerations (Pawson et al., 2005)</td>
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<tr>
<td>Interventions must be underpinned by theory</td>
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<tr>
<td>Interventions operate through chains of steps and processes that involve actions of people as influencers, individuals and groups</td>
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<tr>
<td>Process chains are embedded in social systems and are reciprocally linked</td>
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<tr>
<td>Interventions occur in open systems and effects can be influenced through learning</td>
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<tr>
<td>Disparities occur at each level of influence that limit equitable intervention benefits (Huskin, 2012; Williams and Purdie-Vaughns, 2016)</td>
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Methodologic pragmatism: Pragmatic Methods Frameworks (Shelton et al., 2020)

| Testing intervention effectiveness in ‘real world’ context increases the generalizability of findings | Real world context comprises messiness that can both augment and undermine efforts to validly test intervention effectiveness | Across the targeted levels of influence, what background factors must be considered in evaluation of the MLI to enhance the generalizability of effectiveness findings? |
| Importance of parsimony in specifying process chains targeted by MLIs | Potential for context at one level to augment or undermine intervention strategies at another level (Kemp et al., 2019) | What qualitative and quantitative data (ideally brief, broadly applicable and sensitive to change) could be used to assess whether MLI had expected (or unexpected) influence on process chains? How might existing data and new data collection be harmonized to give insight into how process chains would have evolved without the MLI intervention? |
| MLI evaluation can be challenged by: impossibility of randomization, difficulty of finding comparators, and limited power. | How to apply accepted pragmatic study designs, measures and metrics to test MLI’s effects on process chains | What resources would be required at what levels of influence to sustain MLI effectiveness? |

Sustainability Evaluation: Implementation Science (Hallekamian et al., 2019)

| MLI sustainability is a key element for judging effectiveness | Defining what level of sustainability and at what levels of influence is the goal. | What resources would be required at what levels of influence to sustain MLI effectiveness? |

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et al., 2005). When considering which levels of influence might be most important, this framework calls upon MLI designers to clarify assumptions about the chains of mechanisms (i.e., process chains) that must be influenced for an MLI to be effective and anticipate complex system processes such as emergence (i.e., unexpected beneficial and harmful responses to an intervention) and weathering (i.e., tendency to become desensitized to interventions). As shown in Table 1, key assumptions of complexity theory compel MLI development considerations and inform questions for developers to pose in specific contexts.

Through the lens of the inverse care law, MLIs must be conceptualized to acknowledge that inequities at different levels of influence are likely to restrict benefits accrued to structurally marginalized populations and may become part of the marginalizing process (Reskin, 2012; Williams and Purdye-Vaughns, 2016). Links across levels that perpetuate these inequities must be considered as they can induce metaphenomena that impede intervention effectiveness. For example, the link between everyday experiences of discrimination, such as residing in segregated, unsafe neighborhoods and living under criminal justice policies that are imposed differentially – all elements of discrimination – will likely reduce the impact of an MLI if not carefully considered (Reskin, 2012). Thus, a step in the conceptual process is to ask “at which levels of influence are linkages in inequities important to consider to make an intervention maximally effective for those who typically get the least benefit?”

Deciding on optimal methods for testing the impact of a MLI on targeted health outcomes is also vital to planning. Pragmatic approaches have gained acceptance for assessing impact when context does not enable experimental control, such as randomization (Glasgow, 2013). An advantage of pragmatic approaches is the assumption that MLIs are inherently more “real-world” and as such, results will be more broadly generalizable (Table 1). Relatedly, context includes inherent messiness that can augment or undermine efforts to validly test a MLI’s effectiveness, while also enhancing the generalizability of effectiveness findings. In addition, given the practical challenges and complexity of intervening at multiple levels in ways that leverage the process chains that are embedded within and across social systems, pragmatic approaches that fit with the implementation context are most likely to be sustained (D’Angelo et al., 2020; Coronado et al., 2017; Harden et al., 2018).

Implementation science thinking also will be essential in the MLI planning process. Implementation efforts are often large-scale, can involve interventions at multiple levels, and are conducted across multiple sites simultaneously (Huynh et al., 2018). Further, the use of implementation strategies has become increasingly sophisticated, and often target multiple levels of influence within organization or around an organization. Field theory would suggest that implementation activities across levels may be more likely to lead to incorporation of implementation strategies within organizations in ways that may maximize their sustainability (Kozlowski and Klein, 2012). Glasgow et al., define sustainability as “the extent to which an evidence-based intervention delivers its benefits over an extended period of time after external support from the donor agency is terminated” (Glasgow et al., 2013). For MLIs, the considerations include the need to define the goal for sustainability, at what levels of influence it must be evidenced, how different implementation strategies might influence sustainability, and what resources would be required. Considering implementation science in the context of social science frameworks such as the inverse care law is important to considering how health inequities might limit sustainability (Senier et al., 2019).

3. Conclusions

In this Commentary, we argue that if we are to increase the application of MLIs to promote both population health and health equity, it is imperative that we develop and apply parsimony-focused operational frameworks to increase the feasibility of this pursuit. We suggest one hypothetical framework guided by emerging lines of thought to select context-specific levels of influence that should be targeted. Parsimony is supported when we can conceptualize, design and evaluate MLIs that can exploit linkages across levels of influence, recognizing where the impact of reflexive and recursive process chains of mechanisms that cross levels are most influential in differing contexts. Without doing so, we fear that little will change, and we will simply continue to talk, without proceeding to the walk.

References

Ceci, S.J., Papirer, P.B., 2005. The rhetoric and reality of gap closing: when the “have-nots” gain but the “haves” gain even more. Am. Psychol. 60 (2), 149-160.