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Integrating network theory into the study of integrated healthcare

Lawton R. Burns [a,*], Ingrid M. Nembhard [b], Stephen M. Shortell [c]

[a] The James Joo-Jin Kim Professor, Professor of Health Care Management, The Wharton School, University of Pennsylvania, 3641 Locust Walk, Philadelphia, PA, 19104, USA

[b] Fishman Family President's Distinguished Associate Professor of Health Care Management, The Wharton School, University of Pennsylvania, 3641 Locust Walk | 207 Colonial Penn Center, Philadelphia, PA, 19104-6364, USA

[c] Blue Cross of California Distinguished Professor of Health Policy and Management Emeritus and Professor of the Graduate School, School of Public Health, UC-Berkeley, 2121 Berkeley Way, Berkeley, CA, 94704, USA

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ABSTRACT

Healthcare policy in the United States (U.S.) has focused on promoting integrated healthcare to combat fragmentation (e.g., 1993 Health Security Act, 2010 Affordable Care Act). Researchers have responded by studying coordination and developing typologies of integration. Yet, after three decades, research evidence for the benefits of coordination and integration are lacking. We argue that research efforts need to refocus in three ways: (1) use social networks to study relational coordination and integrated healthcare, (2) analyze integrated healthcare at three levels of analysis (micro, meso, macro), and (3) focus on clinical integration as the most proximate impact on patient outcomes. We use examples to illustrate the utility of such refocusing and present avenues for future research.

1. Introduction

Partly spurred by the 1993 Health Security Act and 2010 Affordable Care Act, research on integrated healthcare has mushroomed since the 1990s as the antidote to fragmentation and a strategy for addressing: (1) patients with multiple chronic illnesses requiring coordinated care, (2) patients "falling through the cracks" during handoffs, (3) professional specialization adding more providers per patient, (4) proliferation of care sites (ambulatory surgery centers, retail clinics, accountable care organizations or ACOs), and (5) social determinants of health and coordination of medical with social services (housing, education, etc.). Policymakers and researchers assert that integration can address these issues and ultimately lower cost, increase quality, and improve population health, patient experience, and clinician work experience (Berwick et al., 2008; Bodenheimer and Sinsky, 2014).

"Integration" is defined by the World Health Organization (2016) as "… an approach to strengthen people-centered health systems … delivered by a coordinated multidisciplinary team of providers working across settings and levels of care." This suggests that integration and coordination are interrelated. The management and healthcare literatures have long defined "integration" in terms of "coordination" (cf. Lawrence and Lorsch, 1967; Gillies et al., 1993; Okhuysen and Bechky, 2009; Kerrissey et al., 2021) and often treated them as interchangeable (Fig. 1), a view we adopt here.

Researchers have articulated several integration typologies and how they link to cost and quality. For example, Shortell et al. (2000) proposed that "functional integration" (coordination and shared support activities) across hospitals fosters "physician-system integration" (economic linkages or employment), which fosters "clinical integration" (coordination and shared clinical services). Most recently, Singer et al. (2020) proposed five types of integration (structural, functional, normative, interpersonal, process) that are causally linked and culminate in clinical integration, which impacts cost and quality. Some types of integration (structural, functional, clinical) have been extensively studied; others (e.g., normative, interpersonal, process) await more research. Existing studies indicate that empirical support for the causal chain linking structural, functional, and clinical integration is weak (Burns et al., 2022) or mixed (Colla et al., 2020; Fisher et al., 2020), suggesting that integration is not a "miracle cure" (Blumenthal, 2020).

We suggest that it may be time for a new approach to examining integrated healthcare. This paper seeks to *redirect* research on integrated healthcare in three ways. First, we propose the use of social networks, network theory, and network concepts as a useful lens, given the centrality of interactions and communication in integration. We thus emphasize the processual over the much-studied structural approach to integration. The structural approach emphasizes mechanisms such as

* Corresponding author.
E-mail addresses: burnsL@wharton.upenn.edu (L.R. Burns), ingridn@wharton.upenn.edu (I.M. Nembhard), Shortell@berkeley.edu (S.M. Shortell).

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physician employment, ACOs, clinical practice guidelines, and electronic health records (EHRs). The processual approach focuses on interactions among actors, including patterns of collaborative decision-making and information sharing. Adopting the processual approach acknowledges integration as fundamentally a relational endeavor (a) that can provide insights not captured by other approaches and (b) whose neglect may hamper improvements.

Second, we propose using a network perspective of integration at three levels of analysis (Fig. 2): the individual patient and provider care team, the organization within which individuals and teams are embedded and interact, and the inter-organizational community in which the prior two levels are embedded. These three levels have been labeled *micro*, *meso*, and *macro*, respectively, and can interact with one another to influence outcomes. Research across industries indicates that processes that contribute to network performance occur within a multi-tiered ecosystem (Burns and Rea, 2018; Harrison and Shortell, 2021; Burns, 2021).

Third, while researchers examine several types of integration, we focus here on clinical integration i.e., efforts to coordinate patient care across people, functions, activities, sites, and time. This focus is appropriate given its centrality in most typologies and its proximate impact on patient outcomes. We recognize that there are other types of integration but want to direct more attention to the type that is most closely related to patient care.

We begin by discussing the advantages of the processual (over the structural) approach to integration, and attention to social networks and relational coordination. We then briefly review the network literature and identify major concepts that might be applied to integration. We next provide examples of what integration through a network lens looks like at different levels of analysis. We conclude with a discussion of some directions for future research.

2. A new perspective: network analysis of integration

2.1. Traditional, structural approach to integration

Early management research conceptualized coordination as "information processing." March and Simon (1958) contrasted coordinative-information processing by programming (structural) versus feedback (processual). Thompson (1967) similarly distinguished three types of coordination: standardization (of processes, outputs, worker skills), scheduling, and mutual adjustment. Most organizations rely on Thompson's first two types, using structural tools such as vertical information systems, routines, and programs. Indeed, Galbraith (1973) defined Thompson's standardization and scheduling modes as the "integration solution" to the "differentiation problem." These structural solutions foreshadow many healthcare strategies to promote integration such as physician employment, practice guidelines, and EHRs. These strategies have been embedded in organizational forms ranging from traditional functional departments to service lines (Charns and Tewksbury, 1993) to integrated delivery networks (IDNs) and ACOs. Research suggests that structural solutions to integrated healthcare have had little effectiveness (Kim et al., 2019; Burns et al., 2022). At the same time, it is important to note that some structural arrangements such as shared meetings, shared protocols, and boundary spanners can be used to support relational processes, suggesting that the two can influence each other (Bolton et al., 2021; Lawrence and Lorsch, 1967).

2.2. Processual approach to integration

The processual approach is exemplified by "relational coordination," the "mutually reinforcing process of communicating and relating for the purpose of task integration" (Gittell, 2002: 300). Research on relational coordination in healthcare spans two decades, but its relevance to integrated care is perhaps underappreciated. Relational coordination has seven dimensions, including communication that is frequent, timely, accurate, and problem-solving in nature, and relationships characterized by sharing of goals, knowledge, and mutual respect (Fig. 3). We highlight the importance of relational coordination for its relevance to integrated care, consistent with the more recently developed concept of "social features of integration" that emphasizes aligned norms and interpersonal collaboration (Kerrissey et al., 2021; Singer et al., 2020).

Research suggests that relational coordination improves patient outcomes, quality of care, patient safety, patient engagement, provider experience, efficiency, and clinical integration (Foy et al., 2010; Bolton et al., 2021; Kerrissey et al., 2021). Theory also suggests that relational

Author(s)	View of Coordination and Integration
Lawrence & Lorsch (1967)	Integration rests partly on the "emergence" of integrative "devices" (e.g., coordinators and liaisons, cross-functional teams, integrative subsystems), which are coordinative devices.
Galbraith (1974)	Integrating mechanisms help increase the firm's ability to process information and "permit coordinated action".
Gillies et al. (1993)	The extent to which services are coordinated across people, functions, activities, and sites over time so as to maximize the value of care delivered to patients.
Leutz (1999)	Three levels of integration exist: linkage, coordination, and full integration. Coordination encompasses explicit structures and individual managers. Coordination is thus a structured form of integration.
Okhuysen & Bechky (2009)	Coordination is a process that integrates a set of interdependent tasks. Coordination mechanisms create integrative conditions for coordinative activity.
Solberg et al. (2009)	Integration is the ability to coordinate functions and activities across operating units.
Kodner (2009)	"Coordination" and "integration" are used interchangeably, although a slight difference in focus: coordination applies more to patient-level and clinical care, while integration applies more to organizations and management.
Barth et al. (2019)	Care coordination is a key component of integrated, whole-person care. Care coordination focuses on individual client needs, goals, and preferences. Care coordination refers to coordinating and managing care and services across the continuum of care.
Ross & Greenberg (2020)	The collaborative care model identifies care coordination as an especially important component of integration.
Singer et al. (2020)	"Integration seeks to combine organizational parts into *a unified, synergistic whole*, while coordination aims to adjust parts in order to facilitate their intersection".
Kerrissey et al. (2021)	"Integrated care, that is, care that is continuous over time, coordinated across providers and settings, and inclusive of patient and family needs and preferences"

Fig. 1. Defining Integration vis-à vis Coordination (Barth et al., 2019; Galbraith, 1974; Kodner, 2009; Leutz, 1999; Ross and Greenberg, 2020; Solberg et al., 2009).

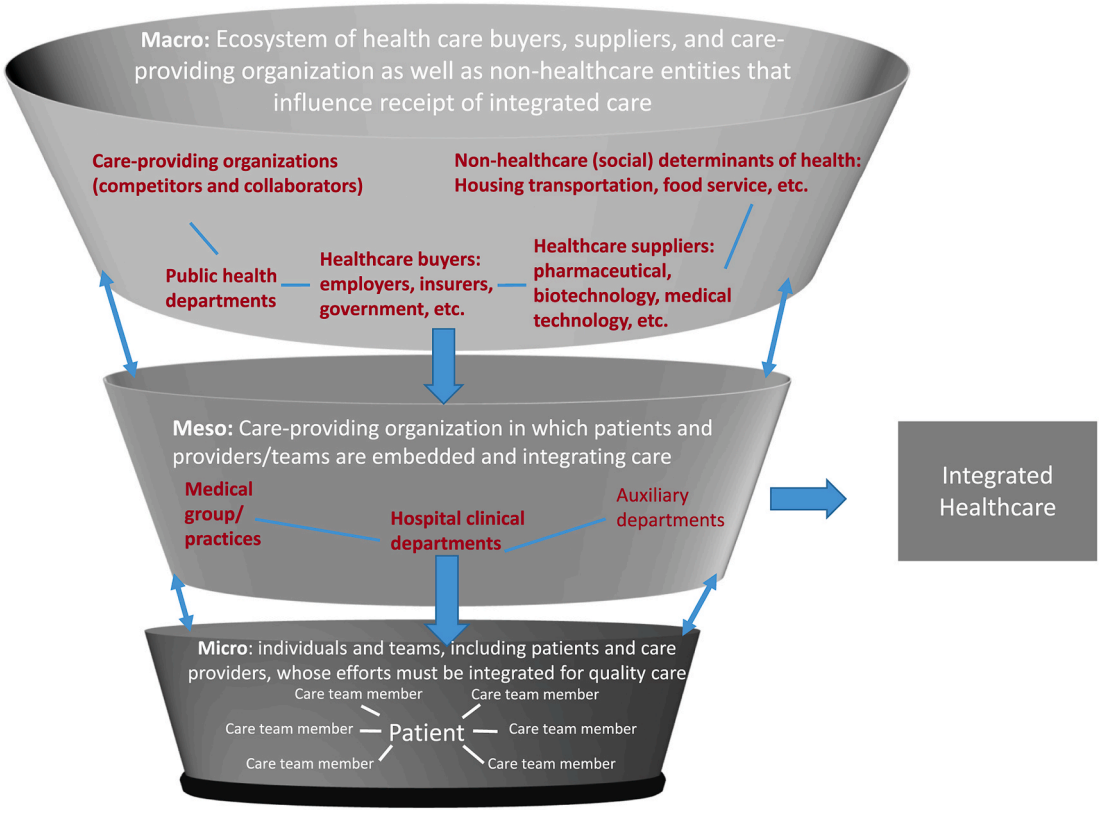

Fig. 2. A multi-level model of integrated care: Micro, meso, and macro.

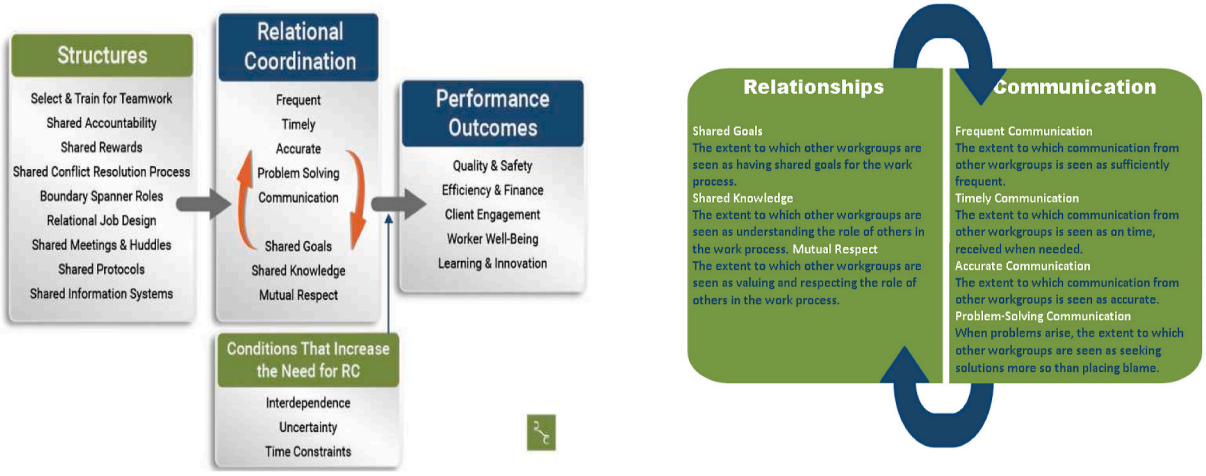

Fig. 3. Relational coordination process model. Reprinted with the permission of Jody Gittell, on behalf of the Relational Coordination Collaborative.

coordination is influenced by micro-level structures such as shared meetings and protocols, job design, information systems, accountability, and reward structures. These can be used to support and sustain networks of relational coordination (Bolton et al., 2021) consistent with structuration theory (Gittell, 2016). Work under the label of social features of integration similarly finds that interpersonal integration, reflected in collaborative processes, moderates the effect of functional integration, which derives from structural integration (Kerrisey et al., 2021). Notably, this evidence and theory on relational coordination relates to micro-level structures, whereas the traditional, structural approach to theory and much of the empirical investigation described in Section 2.1 centers on macro-level structures like ownership and employment, which are loosely-coupled with micro-level structure and process (Burns et al., 2022).

2.3. *New frontier in the processual approach: social network analysis*

The relational perspective, as embodied in relational coordination research, uses social networks to better understand integrated healthcare. Analytically, relational coordination is measured by the strength of

connections (i.e., ties) and integration-facilitating content in connections (shared goals and knowledge, mutual respect, frequent/timely/accurate communication) (Bolton et al., 2021). Researchers conceptually link relational coordination with network theory, arguing that network analyses are (1) not just to display organizational structure but useful to explain coordination, and (2) appropriate when network activities span multiple organizational levels (Gittell and Weiss, 2004).

Despite integration's reliance on ties and networks, however, little integration research has applied network theory. Reasons might include the difficulty in accessing large-scale data on providers and patients, measuring ties and their content, and changing social networks and behaviors within them. Yet, we suggest that network analysis is critical for improving our understanding and practice of integration.

3. A brief review of networks

3.1. The concept of a network

Building on Granovetter (1985), a social network is defined as a set of actors connected by a set of social ties (Kadushin, 2012). Network analysis includes not only the *structure* of ties (i.e., who is tied to whom or not) but also the *content* of ties (i.e., what ties them together). This can be illustrated by returning to the distinction between structural and processual integration. A structural tie exists between two or more parties in a relationship. By contrast, a content tie includes information exchanges, resources flows, influence, shared knowledge and goals, mutual respect and trust, beliefs, and social support that are embedded in structural ties. Social networks serve to build trust and accountability between members, constrain social actions, and facilitate or undermine outcomes of importance to members (Burt, 1992). They can also improve their collective performance (Kim et al., 2019).

3.2. The utility of the network perspective for integration analysis

The network perspective offers several important insights for integrated care. First, it affirms that relationships among actors have a structure that is consequential. Second, it highlights the importance not only of the structure of social relationships but also their content. Networks function as *flows* of information, influence, resources, actions, and support. Third, it reminds us that interactions are dynamic: ties can evolve and deepen over time or become weaker and disappear. Given that network analysis examines such changes, it helps to capture real behavior among stakeholders (e.g., between patients and providers as they interact). Fourth, it reveals properties of social relationships that influence outcomes directly or indirectly. We highlight six such network properties and then describe their utility for examining integrated care.

3.2.1. Network properties

Network size, centrality, tie strength, density, embeddedness, and structural holes (with brokerage) are highly discussed concepts in the network literature (see Kadushin, 2012 for fuller review) applicable to integrated care. As Fig. 4 shows, some of these properties describe the position of actors in the network; others characterize the network in its totality.

Network Size: Network size refers to the number of actors, and may include the degree(s) of separation among them. The larger the network or degrees of separation, the lower the density of the network and, thus, the higher the effort needed to link actors. However, larger networks can also generate opportunities to access resources to accomplish varied tasks and minimize dependence on a specific actor.

Network Centrality: Centrality is the extent to which an actor occupies a central position in the network by virtue of having ties with many others. One's network position often dictates opportunities to interact, reach out to, and mediate relationships between others in the network. Centrality encompasses the idea of popularity and access to many resources. In addition to actor centrality, networks can vary in their centralization i.e., degree to which network relationships are channeled through few central actors or are more widely dispersed.

Tie Strength: Tie strength is a function of time, intimacy, emotional intensity, and reciprocity. Researchers distinguish weak ties (casual acquaintances) from strong ties (family and long-standing relationships). Strong ties may be beneficial for implementing innovation and

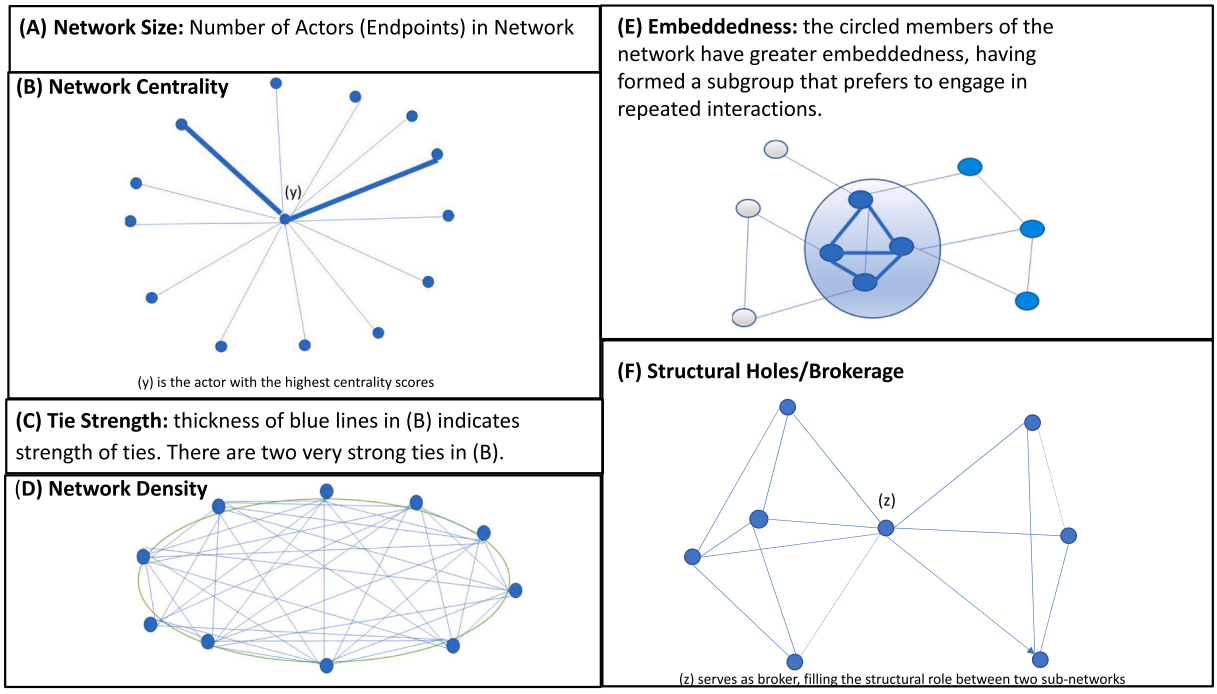

Fig. 4. Six network properties relevant to integrated care.

change. Weak ties bridge network cliques or network clusters; they can also provide access to new information and actors. Thus, they can be useful for generating new ideas and innovation.

Network Density: The density of a network refers to the number of connections between actors compared with the maximum possible number of connections that could exist. The higher the proportion between the existing ties and the overall number of possible ties, the more dense the network. Greater network density may result in greater network cohesion and perhaps a higher capability for collective action.

Embeddedness: Embeddedness brings together tie strength and other network concepts regarding the number and arrangement of ties (network size and density). Actors are embedded within a network to the extent they show a preference for transacting with those in the network and repeating such transactions (Uzzi, 1996). Network-based ("embedded") ties outperform "arms-length," market-based ties in trust, information transfer, and problem-solving capabilities. At a granular level, sub-networks within larger networks, which have greater embeddedness, may achieve superior exchange outcomes because they do not need to develop connections among all network members.

Structural Holes/Brokerage: Structural holes are gaps in the network between actors who occupy distinct positions and are interdependent (Burt, 1992). Such holes are "fault lines" that exist among and between actors and organizations. Brokerage entails the extent to which the focal actor spans other actors who are themselves not connected with each other but need to be, and facilitates their necessary exchange. In this manner, the broker "fills a structural hole" and greatly affects its functioning.

These six properties characterize network *structure providing a foundation for the examination of clinical integration.* We focus on structure as a starting point but recognize that content flows (e.g., conveying information on patient treatment) are also important but under-researched (Yuan et al., 2020), and therefore highlight the need for further research in this area.

3.2.2. Network properties' relationship to conditions for integration

The six network properties influence the presence and depth of the three critical conditions for coordination/integration: accountability, predictability, and common understanding (Okhuysen and Bechky, 2009). *Accountability* exists when it is clear who is responsible for each element of the interdependent task. This is a role-clarifying condition enabled by ties that reduce uncertainty about who must do what, including who will integrate the parts. *Predictability* exists when it is clear what the elements of the task are and when they should happen. This condition provides confidence to parties about when they should perform their activities and expect others to perform theirs, which enables integration of efforts. *Common understanding* exists when parties in an interdependent activity share knowledge of the work to be done, goals of the work, how the work should occur, and how individuals' work contributes to the integrated whole.

All six network properties likely shape each condition. For example, as network size and structural holes increase, accountability can be more challenging and more important. Greater embeddedness and tie strength should increase predictability. Networks characterized by centrality and density should promote common understanding. Each condition, in turn, facilitates accomplishing one's own work and integrating that work with appropriate others in the right way at the right time. This mitigates uncertainties of interdependent work, and thus supports effective integration at the various levels of organization.

The next four sections show how network properties and analysis can be applied to analyze clinical integration at each level (micro, meso, macro). Our aim is not to offer propositions to test (although they can be derived) but instead to demonstrate understanding of how network properties can impact clinical integration.

4. Network analysis of care at the micro individual and team levels

Healthcare is delivered by individuals and care teams (including the patient) and is shaped by their perceptions and behaviors and the interactions occurring among them. Interactions between parties can be rare (e.g., a one-time consult), episodic (e.g., a medical assistant at one office scheduling a patient test with a laboratory receptionist), or repeated frequently (e.g., a cardiologist who refers to a cardiac surgeon regularly). Individuals can serve on ongoing teams (e.g., primary care team) or temporary teams for addressing an issue (e.g., in emergency rooms). In the parlance of network theory, when each interaction occurs between individual care providers or care teams, a tie is formed. That tie and the amalgamation of ties created by caring for patients yield a network, or rather multiple networks extending from each individual (patient or care provider) and team.

4.1. Applying network properties

Networks formed at the micro-level function as structures of constraint and opportunity (Burt, 1992) that dictate the strength of the foundation for clinically integrated care for and by individuals. Consider Mr. K, and his primary care physician Dr. Press, who Mr. K has seen regularly for routine care for many years, until one day when diagnostic testing indicates cancer (Press, 2014). Over the next 80 days between when Dr. Press informed Mr. K of his cancer diagnosis and the tumor resection, 11 additional clinicians became involved in Mr. K's care (e.g., oncologist, pathologist, surgeon, social worker). Mr. K had five procedures and eleven office visits, none of them with Dr. Press, yet Dr. Press was central in the care-team network that formed around Mr. K. Dr. Press communicated with other clinicians 40 times (by e-mail and phone) and with Mr. K. or his wife 12 times. Since Dr. Press did not initially have relationships with most of Mr. K's other clinicians, he reached out to them to establish connection and close loops. Most patients do not have a physician "quarterback"; they try their best to assume this role. They are sometimes aided by family, organization-provided care coordinators, or navigators.

Mr. K's care, however, is a useful example of the value of network analysis for understanding how clinical integration can be fostered or hindered at the micro-level. Applying a network lens to his experience, Mr. K's care *network size* grew from two (Dr. Press and Mr. K (and his wife)) to 12 members in 80 days, a relatively large increase in size that made integration more important and more challenging but not unusual. Studies have found that primary care physicians interact annually with 229 other physicians across 117 practices when providing care to their patients (Pham, 2009) and patients with multiple chronic conditions may visit as many as 16 different physicians in a year (Pham et al., 2007); the integration challenge at the micro-level is formidable. In Mr. K's case, *embeddedness* was not high at the start of care as neither he nor Dr. Press had a prior relationship with most other care-team members. Thus, there were no norms for (productive) interaction to facilitate integration. *Network density* was seemingly low too in that the number of ties between care providers that existed compared to the number possible was low. Network theory suggests that integration is facilitated by the opposite, greater network density, meaning more ties among network members, which enables collective action. Instead, *structural holes* were also prevalent in the care-team network as there were gaps between providers. Although their work in caring for Mr. K was interdependent, no direct tie existed between many of them to buttress integration. Dr. Press became a *broker,* filling structural holes between Mr. K's other care providers through his communications. In serving as a broker, Dr. Press was "boundary spanning," a role and activity that research suggests can yield more effective knowledge exchange and coordination (Gittell, 2002; Olabisi and Lewis, 2018; Tushman and Scanlan, 1981). By connecting often with other clinicians in Mr. K's network, Dr. Press built *tie strength* and thus, "mutual accountability" for

integrating care (Press, 2014: 491). This benefitted Mr. K and likely future patients of Dr. Press's needing care from these providers. Strong ties are particularly important for transferring complex knowledge, a process requiring integrating expertise from multiple specialties. Dr. Press became central in the network, alongside Mr. K. Their *network centrality* was high. The network's centralization was also high due to few central actors. Having few central individuals mediate information flow can help to integrate care.

From network analysis of Mr. K's and Dr. Press's experience, we might surmise that care teams with optimal size, embeddedness, strong ties, density, centralization, and few structural holes that are filled ultimately by brokers are more likely to provide integrated care, as are those networks in which the absence of some of the properties are compensated by others (e.g., weak ties compensated by having a central actor). The possibility of equifinality of network properties for integrated care at the micro-level suggests the importance of research with this focus to provide greater insight about when and how network properties and dynamics among individuals and teams are helpful and harmful for integrated care.

Though limited in number, network studies have provided insight about key integration-related issues such as mobilizing knowledge, receiving useful information, and managing temporary care-teams. For example, Currie and White's (2012) three-year network analysis and field study of kidney care teams showed that "knowledge brokering" mediates knowledge mobilization. Higher-status professionals often resist changes that increase cross-boundary knowledge mobilization; teams can overcome this predicament if team-level, network structures are developed that encourage cross-boundary sharing. Tasselli (2015) further found that receiving *useful* information depends on clinicians' network position *and* individual characteristics. Those who occupy more brokerage positions *and* have legitimacy because of other characteristics (e.g., being a manager) receive more useful information. This is often a small number, which explains why many team members do not have useful information to integrate care. Examining team temporality, Valentine and Edmondson (2015) showed that an emergency department's implementation of "team scaffolds" – giving a bounded set of roles collective responsibility for a patient case – supported coordination: people worked with fewer partners during each shift and shared more patients with each partner. These changes reduced patient care time by 40% without increasing patient mortality, showing that changing team structure and thus team size and tie strength (network properties) can shorten intervals between care steps, consistent with integrated care.

4.2. Select integration strategies explained using a network lens

Care Coordinators. Care coordinators (often nurses) are tasked with helping patients to receive needed care as seamlessly as possible by facilitating communication among care team members and with the patient, arranging follow-up visits, and removing barriers to care. They can be effective in promoting integrated care but that is not always the case (Conway, O'Donnell, and Yates (2019). A central question is then: how should these coordinators be positioned on care teams to achieve desired aims, and what team-network features shape their effectiveness? Much of their role is "filling structural holes." That suggests that they generally must become central in their patients' care teams to be effective, and maintain both strong ties (for navigating difficult situations) and weak ties (for accessing varied care resources). Further, network theory portends that the less dense the patient's network, the more critical they become as broker-integrators and boundary spanners.

Information Systems. Information systems such as EHRs can support clinical integration via shared team charting, messaging features, and standardized, evidence-based clinical pathways. Nevertheless, implementation of such systems fails frequently (Heeks, 2006). Why? Network theory suggests a neglected consideration is social networks. Implementation is a social process in which individuals communicate with others in their network. Studies now show that centrality, behavior of central members, density, and shared network beliefs influence information system use while overall beliefs do not (Yuan et al., 2020).

Improvement Teams. Improvement teams are frequently used for problem-solving in healthcare, yet little research has focused on their design, beyond noting that they should be multidisciplinary to facilitate effectiveness (Nembhard et al., 2015). The network lens suggests that when teams need to move information across the network, individuals' reach beyond immediate ties becomes important. This makes brokerage and membership in dense networks important criteria. If elements required for integration improvement require personal reinforcement, selecting members from dense networks becomes more important. If the team needs to access new ideas for integration, individuals with a large network of weak ties should be prioritized. Having strong ties to influence others who are ambivalent to change increases the probability of successful change, whereas strong ties to resistors can be a liability (Battilana and Casciaro, 2013). Applying such theory-derived principles enables formation of teams positioned to lead improvement (Meltzer et al., 2010).

5. Network analysis of care at the meso organizational level

Healthcare delivery by individuals and teams occurs within complex organizations that include hospitals, physician practices, and post-acute care (PAC) facilities, among others. The challenge is to scale care coordination/integration that occurs at the micro-level of individuals and teams to achieve the organization's goals.

5.1. Applying network properties

For integrated care *within* their organizations, leaders need to decide on the strength of ties between and among subunits, size of subunits, role of central units or "actors," and the extent to which and how structural holes among interdependent units requiring coordination should be filled. In the case of hospitals, network theory would suggest that organization size and patient diversity should influence these decisions. In small hospitals (<100 beds), more direct ties between and among units such as laboratory, radiology, pharmacy, and medical/surgical units may be sufficient. In larger hospitals, there may be a need for more indirect ties that work through intermediate levels of the organization such as centers of excellence established for specific care such as heart or cancer. The ties in smaller organizations may not need to be as strong as those in larger organizations where ties may be more indirect. In smaller organizations ties may be more informal, while in larger organizations they may be more formal and facilitated by coordinating mechanisms such as care coordinators, patient ombudsmen, and clinical councils. The relative strength of relationships may also depend on the variety of patients seen. Extrapolating from network theory, the greater the variety, the more likely that stronger ties between subunits are needed to coordinate care. This will be reflected in frequent exchange of information face-to-face and dedicated resources to supplement standardized guidelines and protocols. When conditions are more homogeneous, it may be easier to rely on guidelines and protocols to coordinate care, and allow weaker ties between subunits.

Size and patient diversity will also influence network centrality. In small hospitals with a more homogenous patient mix, a central person in the network such as a Chief Medical Officer may be adequate to ensure coordination. In large hospitals with more diverse patients, several different networks may be needed with multiple people occupying central roles to deal with coordination. It is also in such cases that structural holes may develop that affect coordination. For example, a patient's cardiologist and oncologist may each be connected to and exchange information with the patient's primary care physician (PCP) but not with each other, as was the case for Mr. K. This structural hole may be filled by the organization's hospitalist who oversees all of the patient's inpatient care, communicates relevant information to the cardiologist and oncologist, keeps the referring PCP apprised of the

patient's condition, and connects them with one another. Implementation of EHRs may also fill structural holes by centralizing information for use in coordinating patient care.

5.2. Some integration strategies explained using a network lens

Veterans Health Administration (VHA). In 1996, the fragmented VHA system of 125 hospitals was reorganized into 21 Veteran Integrated Services Networks (VISNs). The reorganization established strong ties within geographic regions among facilities providing a platform for exploring collaborative partnerships. In 2005, the importance of these ties was tested by Hurricane Katrina in New Orleans. The hurricane damaged two VHA hospitals but patients were able to receive care from a third hospital in the network. By establishing stronger ties among its facilities, combined with a common EHR system and performance management system focused on quality, the national VHA created a tightly networked organization and rapidly improved its quality of care. For example, mammography rates and the percent of patients with acute myocardial infarction who received beta-blockers upon discharge each increased significantly (Jha et al., 2003). Reorganization into VISNs also enabled the VHA to explore several care coordination innovations. Among these was the embedding of specialists and care managers into primary care clinics to better address veterans' psychiatric needs (Leung et al., 2018). Strong ties created between mental health specialists and primary care providers resulted in improved access to mental health services (Reiss-Brennan, 2013).

Comprehensive Primary Care Practices (CPCPs). The U.S. Centers for Medicare and Medicaid Services (CMS, 2017) developed a multi-year, primary care demonstration project as part of their value-based payment and care delivery reforms to improve quality of care and reduce emergency department (ED) visits. Evaluation of practices scoring in the top 20th percentile of performance in ED use and inpatient utilization revealed several shared behaviors including engaging physicians, co-locating engaged teams, and discussing performance feedback data in team huddles (Marriott and Finkel, 2020). Using a network lens, engaged physicians served as a central node in interactions with staff, thereby increasing the overall density of the network. Co-located teams permitted strong ties to develop among team members through daily huddles and helped to fill structural holes in knowledge among staff that did not previously interact with each other. Discussing performance feedback in daily huddles reinforced existing ties and served to eliminate past "holes" in information available to team members. Tiered huddles – which occur from the frontlines of care to middle management to the C-suite, increasing the density of ties via information flowing upwards and downwards – are now used successfully by many hospitals to address Covid-19 decision-making (Nembhard et al., 2020). As a group, these network-leveraging practices demonstrate how care can be designed to promote desired outcomes associated with more clinically integrated care.

Middle Managers and Boundary Spanners. Middle managers and boundary spanners play a key role in filling structural holes that exist between and among units at different levels involved in coordinating patient care. These roles typically include the relational coordination properties of providing frequent, timely, accurate, and problem-focused information; synthesizing and helping people understand the information; helping frontline caregivers to implement organization-wide priorities and strategies as they impact the involved unit; motivating peer performance; and addressing concerns that arise (Birken et al., 2012; Engle et al., 2017). As such, these individuals serve as the central node in communication and care-giving networks facilitating both sequential and reciprocal workflows. They also serve a pooling coordination function for the top level of the organization. In general, network theory suggests, the more complex the organization and more diverse the patient population, the greater the importance of structuring middle managers and boundary spanners to be in central positions and fill structural holes between units involved in patient care.

6. Network analysis at the macro level (within the healthcare sector)

Healthcare provider organizations exist within a larger ecosystem of healthcare players that serve as buyers (e.g., public/private payers), suppliers (e.g., drug companies), and competitors. Increasingly, the integration and coordination of care involve these inter-organizational relationships (IORs).

6.1. Applying network properties

Unlike IDNs, IORs lack structural mechanisms of coordination. Instead, they use informal relationships to build network ties, social cohesion, and cooperation. They often share patients. Variation in patient sharing is often reflected in tie strength, embeddedness, and network density within the IOR. Furthermore, IOR networks may coordinate by sharing personnel (e.g., staff exchanges and co-location), which facilitates a different type of embeddedness. Some IORs involve sharing dependence by virtue of concentrating exchanges with a limited number of trading partners. This promotes network embeddedness, tie strength, and density. Finally, some IORs, particularly those that fill structural holes between acute care and public health, involve sharing patients and information to promote clinical integration and improve population health. We highlight several examples of this challenging work.

6.2. Some integration strategies explained using a network lens

Physician Networks. Studies of patient-sharing networks classify the network's structure by whether physician interactions during patient episodes are more within or across-specialties (Dugoff et al., 2018; Kim et al., 2019). The former ("assortativity") suggests a lower degree of clinical integration (fewer interactions across specialties); the latter ("disassortativity") suggests greater clinical integration. Disassortativity has a statistically significant and beneficial impact on cost and quality of care. Moreover, such informal clinical integration exerts a stronger impact than structural mechanisms of clinical integration (e.g., ACO membership) (Kim et al., 2019). Network analyses further reveal that patients whose providers rarely share patients (low density networks) have a higher risk of not receiving integrated care as evidenced by being prescribed overlapping and interacting drugs (Ong et al., 2016, 2017). These studies suggest the importance of sharing patients (network density, tie strength, embeddedness) and concentration of patient visits within a network.

IDN-PAC Networks. The post-acute care (PAC) sector (e.g., home healthcare agencies (HHAs) and skilled nursing facilities (SNFs)) is a continuum that serves patients discharged from hospitals for follow-up care in less-intensive, more appropriate, and lower-cost settings. IDN-PAC networks form when hospitals contract with a narrow subset of PAC providers with more cost-effective care with whom they have established relationships. Such relationships often include patterns of cooperation that facilitate patient transitions between care sites. Such networks can promote clinical integration and quality care. There is evidence that concentrating PAC services rendered to Medicare Advantage enrollees in a smaller number of PAC provider sites reduces both hospital readmissions and intensity of PAC utilization compared to the Medicare FFS population (Huckfeldt et al., 2017). This suggests the importance of network size, embeddedness, tie strength, and density in IDN-PAC relationships. By contrast, structural approaches to IDN-PAC integration that rely on organizational linkages – vertical integration or contractual relationships – do not exert significant impacts (Konetzka et al., 2018).

Local Health Departments (LHDs). LHDs, as public health agencies, may foster linkages with other players in their market, fill structural holes in coordination efforts, and improve clinical integration. After emergency responders, network ties with hospitals and physician

groups are the second and third most prevalent linkages for LHDs, involving information exchanges, meetings, and shared resources or personnel. Mays (n.d.) examined local public health systems in 360 communities serving 100,000+ populations between 1998 and 2014. They quantified the LHDs' network role in terms of (a) scope: availability of 20 recommended population health activities; (b) network density: degree to which multi-sector organizations contribute to each activity; and (c) network centrality: presence of a central actor (public health agency) to coordinate. They found that only 32.7% of communities were served by "comprehensive public health systems" that scored highly on all three dimensions. Such communities exhibited significantly lower levels of mortality and morbidity than other communities.

7. Network analysis at the macro level (across sectors)

7.1. Applying network properties

As one moves outside of the healthcare sector to work with organizations involved with the social determinants of health - food, housing, education, transportation - weaker ties emerge as a focal consideration. Weaker ties enable healthcare organizations (HCOs) to more nimbly and quickly accumulate relevant information to decide with whom closer relationships might be developed. They also enable HCOs to explore where missing holes (resources, information, etc.) exist and identify cross-sector organizations best suited to address them.

A central issue in establishing cross-sector partnerships is developing the trust needed for effective collaboration. Network theory suggests that the movement from weak to strong ties depends not only on the degree to which the focal organizations have prior experience and knowledge of each other but also on whether there is a central organization such as Area Agencies on Aging (AAAs) that can act as a broker between the HCO and the other sector organizations to fill structural holes and facilitate trust among the groups involved. The importance of having brokering agencies to address such gaps was identified in Provan and Milward's (1995) seminal research on mental health networks and recent work by Brewster et al. (2020), who found that strong ties with AAAs reduce patients' nursing home utilization, seemingly due to more integrated, better care. Other research on HIV agencies' cross-sector networks and relational coordination suggests the importance of greater density for integrated care as well (Khosla et al., 2016). Extrapolating from network theory, it may be that ties between organizations in early stages of embedded relationships should be stronger than those in the later stages to build trust needed to launch collaborative work, whereas later-stage ties can be weaker because they are more peripheral to the core work of the network.

7.2. Some integration strategies explained using a network lens

Community Care Network (CCN). One of the first systematic, large scale network initiatives to improve population health was the CCN program, multi-year grants to 25 public-private partnership organizations in 20 states in the 1990s (Bazzoli et al., 2003). The goal was to improve population health by having an explicit focus on community health, developing a seamless continuum of care across healthcare and social service agencies, managing within resource constraints, and implementing transparent measures for community accountability. Fig. 5 illustrates what a CCN might look like involving LHDs. The more successful cross-sector partnerships to address social determinants of health were those that moved more quickly from weak to strong ties, reached out to create political ties to local and state leaders, became more dense and built more embedded networks by broadening membership; and had a central "driver" organization within the network typically providing financial and grant-making knowledge and expertise (Shortell et al., 2002).

OECD Initiatives. A review of 15 integrated care and population health initiatives from nine OECD countries provides further evidence of the utility of the network approach. Across programs, researchers observed a continuum of ties ranging from 'weak' as reflected only in patient/client referrals, to 'moderate' as seen in sharing some infrastructure and joint task forces, to 'strong' as observed in pooling of

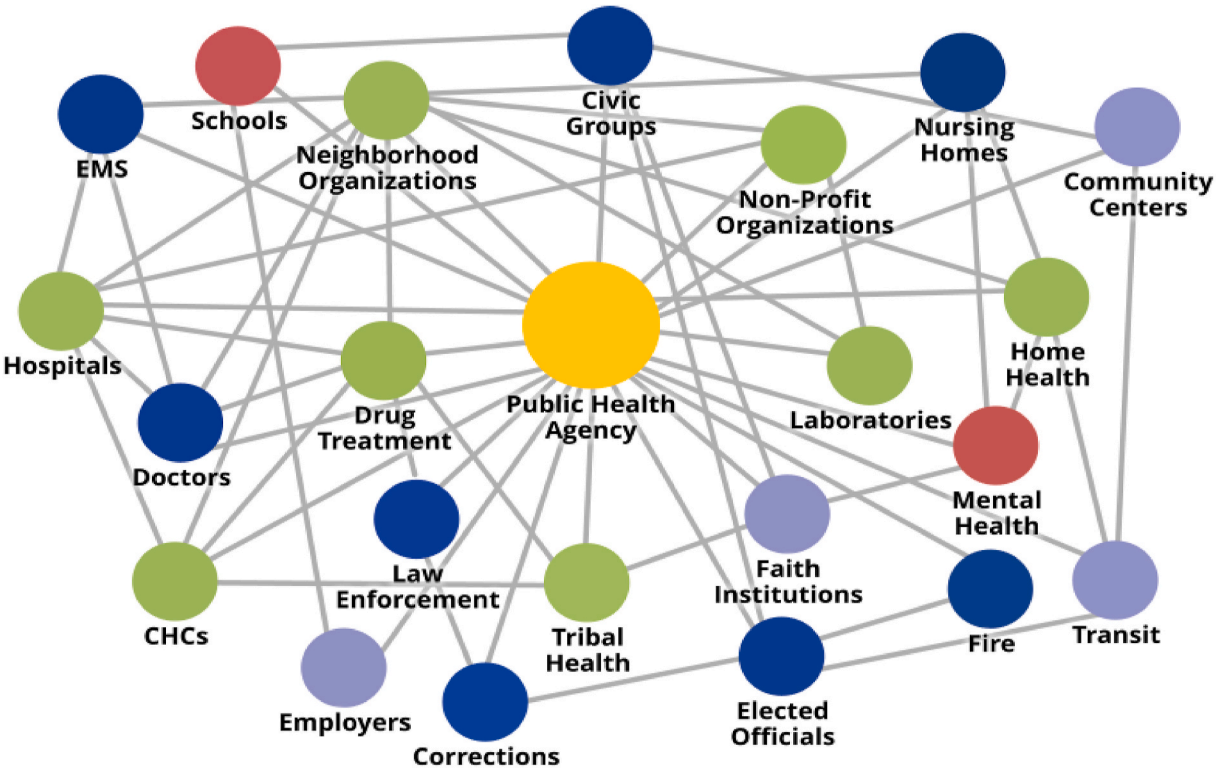

Fig. 5. Network for public health agency.

budgets and resources overseen by a central organization (Farmanova et al., 2019). Moreover, they found that stronger ties were associated with better care coordination (Curry et al., 2013).

COVID-19 Response Teams. The COVID-19 pandemic exposed weaknesses of the fragmented U.S. healthcare system. Ironically, the challenge of dealing with it has been made unusually difficult because we now live in a tightly interconnected world in which "network phenomena are the new reality" (Lobdell et al., 2020). The lack of effective relationships between country leadership, the Centers for Disease Control and Prevention (CDC), hospitals and health systems, suppliers, LHDs, and community groups hampered the country's ability to respond and mitigate the spread of the virus. A major lesson learned is the need for stronger ties among all HCOs. Organizations such as the CDC should be central in the network with strong ties to state and local health departments. Hospitals and health systems with weak ties to each other in competitive markets need to shift quickly to strong ties to share beds, equipment, and staff, and learn from and with each other quickly (Nembhard et al., 2020).

8. Discussion

Given the limited success of the structural approach to achieving integration, we propose adding a processual, relational perspective that leverages network theory and focuses on clinical integration at multiple levels. This approach recognizes the reality of clinical integration as a social process dependent on relationships and communication among a set of actors that form a network (Bolton et al., 2021). We recognize that improving clinical integration may be further enhanced by combining social network analysis with macro- and micro-level structural approaches, institutional field-level forces such as value-based payment, and knowledge of team and organizational behavior.

The examples and studies presented highlight the potential utility of using a network lens. Future research might investigate:

- *Constellation(s) of network properties that optimize clinical integration.* The possibility of equifinality of network properties for integration suggests the importance of understanding when and how networks impact integrated care. For example, when are more dense care networks better or worse for integrated care? How strong do ties need to be? And under what conditions? Answers may explain why some individuals, care teams, and organizations succeed at clinical integration while others struggle.
- *Content within ties that impact integration.* Network theory argues that the structure and content of ties are important (Kadushin, 2012). Content is rarely studied empirically, beyond communication, and particularly with respect to integration. Different content (including processes for managing task agreement, conflicts, and decision rights) may be best situated in different positions/ties in a network. It might also be that certain content is facilitating or hindering integration at different times, and requires certain network structure (e.g., embeddedness) for integration.
- *Dynamism of networks and ties.* Temporal changes to networks and ties are under-explored generally, and specifically with respect to clinical integration. This is true despite the temporality of many care teams, high provider and patient turnover rates, and potential for such "network churn" to alter network effects. Yuan et al. (2019) found that the effect of peer beliefs (tie content) on individual beliefs about the usefulness of one integration strategy (EHRs) is stronger in more stable networks and weaker in less stable networks. This may be true for other content and properties too.
- *How network properties related to clinical integration interact with other forms of integration.* Research has delineated different integration types, proposed relationships among them, and their impact on outcomes. Research should now explore whether these and other types of integration impact outcomes depending on network properties. Effects of non-clinical forms of integration may exist only for specific network structures. Moreover, structural integration might still promote clinical integration if one considers relational network properties as moderators of the relationship. The field would benefit from greater understanding of when and how the design of macro-level structures, micro-level structures, and processual integration support each other in networks. Relational coordination studies have provided some insight. Network analyses can facilitate more understanding of the interplay and relative impact of each in integrated care.
- *Interventions that leverage network analysis insights.* Network analysis provides actionable knowledge for designing interventions. It can indicate where to intervene or leverage existing relationships. Future research should design and evaluate integrated care interventions drawing on network knowledge. Network theory suggests the importance of key roles such as brokers. However, it does not indicate how to design these roles and train people to play them in a reliable way, rather than have them emerge informally in ways that are not replicable, sustainable, or scalable. Research should complement position-informed intervention with process-design thinking.

In adopting a network lens to study clinical integration and its relationship to patient outcomes, researchers will benefit from addressing seven questions:

1. How should the network be defined? Who is in- or out-of-network? How are the boundaries to be determined?
2. Does answering the research question require multi-level analysis? If so, how might network analytic models be applied across the multiple levels?
3. What network properties (e.g., centrality) are of greatest interest or relevance?
4. From where should network data be obtained? To what extent do surveys, EHRs, and claims data need to be complemented by field interviews and ethnographic approaches to accurately measure and understand the network properties of interest?
5. What is the appropriate timeline for analysis of the network and its effects? Existing studies often use at least one year of data and incorporate qualitative and/or archival data to develop a richer understanding of the networks. Longitudinal studies will be needed to assess network effects of specific interventions and changes in public policy intended to affect care delivery and, in turn, their reciprocal impact on networks. Studies should consider the interaction and sequencing in structural and processual integration, and therefore document structures and processes at baseline to better understand their interaction and evolution.
6. What are the content flows in these networks and how do they interact with the network's structural properties?
7. How do interventions and changes in public policy change the shape of networks?

While we recommend a processual network approach to integration, our examples suggest that changes in structures of accountability, job design, information systems and more can be used to change the effectiveness of networks. Future efforts should work toward designing structures that support the networks needed for care integration at multiple levels and designing/altering networks to support integration. Answering the questions that we pose for future research above should further help to build a more comprehensive model of integrated care that reflects the networked, multi-level nature of this process. Providing a conceptual model of this process is beyond the scope of this work. This work provides a foundation and catalyst for model development. While potentially challenging to pursue the expansion, and thus shift, in research and practice that we describe here, we believe that the insights to be gained from a network perspective for advancing integrated care are worth the investment.

Credit statement

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