

Essay

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Essay

Connecting the Dots: Applying Network Theories to Enhance Integrated Paramedic Care for People Who Use Drugs

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Abstract: The evolving role of paramedics presents a unique opportunity to enhance care for people who use drugs, a population disproportionately affected by systemic barriers and inequities. With today's healthcare systems often fragmented and difficult to navigate, paramedics are well-positioned to bridge gaps in the care continuum through enhanced system integration and models of care, such as social prescribing and harm reduction initiatives. This theory-driven commentary explores how Network Theory and Actor Network Theory provide valuable theoretical underpinnings to conceptualize and strengthen the integration of paramedics into care networks. By emphasizing the centrality of paramedics and their connections with both human and non-human actors, these theories illuminate the relational dynamics that influence effective care delivery. We argue that leveraging paramedics' positionality can address gaps in system navigation, improve patient outcomes, and inform policy reforms. Future directions include exploring the centrality of other actors, enhancing paramedic advocacy, and addressing systemic barriers to integrated care for people who use drugs.

Keywords: substance use; integrated care; drug use; paramedicine; drug policy; health policy; Network Theory; Actor-Network Theory; harm reduction; social prescribing

Introduction

The paramedic profession is undergoing significant transformation. With roles evolving to better match the increasingly complex needs of patients and the health care system, paramedics are moving beyond traditional emergency response roles to include practices such as community paramedicine, advanced clinical care, and integration into primary health care settings [1,2]. Given their frequent interactions with people who use drugs (PWUD), paramedics are positioned to bolster system navigation and strengthen connections within the healthcare network [3–7]. This positioning, defined by network theories as "centrality" (See Table 1.) allows paramedics to engage in translation, aligning the needs of PWUD with the goals of diverse actors within the healthcare network to create coherent care pathways. This positioning further highlights the importance of academics adopting

new ways of thinking about paramedic practice to complement this rapid pace of change [8]. This is particularly true in thinking about the care of people who use drugs (PWUD), whose needs are complicated by an increasingly toxic drug supply, and a fragmented, often inaccessible healthcare system. Portrayals of difficult health and social system navigation are common amongst PWUD, who disproportionately experience barriers transitioning between services [9,10]. As a result, substance use research has emphasised the need to modernise care delivery by augmenting service integration that prevents PWUD from seamlessly accessing care [11]. Efforts to enhance integrated systems that dismantle traditional silos and foster collaboration between services has become an urgent policy priority [12–14].

In the context of paramedicine, which is defined as a specialised domain of practice encompassing various settings such as emergency and primary care [15], efforts to overcome barriers to care for PWUD have been implemented inconsistently across the globe [16]. This inconsistency is further compounded by the limited resources, training, and guidelines paramedics typically have to support their care of PWUD. For instance, many paramedics receive minimal education on harm reduction strategies or how to navigate the complex social and health needs of PWUD, leaving them underprepared to provide comprehensive and effective care in this context [4,15]. However, in areas where these barriers are being addressed, there has been growing exploration of innovative care delivery approaches [17,18]. These efforts have led to the development of novel integrative models of care, enabling paramedics to socially prescribe, and step beyond their traditional roles (e.g., initiating opioid agonist therapy, participating in referral programs). These models, however, are not well described within the literature, and prevailing responsive and reactive models of paramedic care continue to dominate [16]. The extent to which these models of care are effectively integrated into the system for PWUD remains insufficiently understood. Addressing these knowledge deficits requires a closer examination of *how* paramedics can bridge gaps and facilitate integration of care services.

The care continuum for people who use drugs (PWUD) is often fragmented, with significant gaps in coordination and integration across services [19]. These gaps hinder the ability of healthcare systems to meet the complex needs of PWUD effectively, leading to poor patient outcomes and missed opportunities for meaningful policy reform [20]. Addressing these challenges requires innovative approaches to understanding and leveraging the roles of healthcare providers within these systems.

Building on our previous systems-theory approach to understanding the systems of practice of paramedics [21], Network theory (NT) and Actor Network Theory (ANT) offer a novel lens to understand and potentially leverage paramedics' central role as actors within such systems. This perspective opens opportunities to strengthen the care continuum for PWUD, improve patient outcomes, and drive meaningful policy reform. Recent applications of NT and ANT have explored the complex interplay between actors in integrated care, highlighting how networks can enhance collaboration and improve care outcomes [22,23]. By conceptualizing paramedics as central actors in care networks, this commentary explores how they can drive enhanced coordination and help address gaps that currently exist within the care continuum for PWUD.

Addressing Systemic Barriers to Care

People who use drugs (PWUD) experience profound health and social challenges that are exacerbated by difficulties navigating the healthcare systems [24]. Conceptualising the healthcare system for PWUD is not an easy undertaking, and varied descriptions exist within the literature [25]. These variations reflect the complex nature of the challenges faced by PWUD, underscoring the need for a nuanced understanding of how systemic factors influence their care experiences. Structural barriers (e.g., stigma, discrimination, social injustices) disproportionately impact PWUD, restricting their access to timely and comprehensive care [26–28]. These barriers are further magnified for marginalised communities (such as racialized groups and 2SLGBTQ+ individuals) who have historically been poorly served or harmed by emergency services responses [29,30]. Recognizing that these identities often intersect with PWUD is essential, as these groups face compounded negative

outcomes and systemic inequities that must be addressed to ensure improved care for all community members [31]. These inequities are further compounded by broader social determinants of health, such as housing instability, poverty, and food insecurity which undermine positive health outcomes [32]. Entrenched power hierarchies within healthcare and social systems perpetuate these barriers, fostering environments that marginalize PWUD [33].

Addressing these systemic challenges demands a fundamental reimagining of care delivery models that prioritise equity and accessibility [34,35]. As such, ecological models are often employed to conceptualise health care systems for PWUD as they emphasise the influence of systemic factors across multiple levels, including societal attitudes and policy environments [25,36–41]. While systems and networks are distinct—systems provide the overarching framework of resources, institutions, and policies, while networks describe the relationships, interactions, and flows within that structure—they are deeply interrelated and evolve together [42]. For the purposes of this commentary, the discussion emphasizes their mutual inclusivity to reflect how they collectively shape the healthcare landscape for PWUD.

Ideally, the care continuum should support PWUD across a trajectory that spans acute intervention, harm reduction, primary and social care, and long-term support. In practice, however, transitions between these stages are frequently poorly coordinated, creating critical gaps where information is not adequately passed from service to service, and people '*fall through the cracks*' [43]. Approaches to augment transitions between acute and community care settings were explored in a 2023 scoping review by Krawczyk et al (2023) which identified several inconsistencies of strategies between services, and the need for standardisation and enhanced collaboration between acute and community care providers. These varying approaches have contributed to what has been described as a "black box" of transition strategies, characterized by heterogeneity in practices, communication breakdowns, and ineffective linkages with community-based care [24].

Paramedics represent a pivotal yet underutilized resource in addressing such systemic deficiencies. In many instances, paramedics serve as an obligatory passage point within the care continuum, particularly during acute crises (e.g., drug poisonings), where they are uniquely situated to support and navigate PWUD to appropriate post-crisis support services, and potentially prevent future crises. Positioned at the nexus of acute and community care, paramedics possess the potential to facilitate smoother transitions, ensuring continuity of care. However, realizing this potential necessitates a structural understanding of the relationships between paramedics, people who use drugs, and other actors within the system.

Paramedics' positionality within the care continuum, particularly in bridging gaps between acute and community care, highlights the need for a deeper understanding of how their interactions within healthcare systems can be optimized to improve outcomes for PWUD. Achieving this requires a framework that can illuminate the relationships, dynamics, and structures underpinning these systems. Network Theory (NT) and Actor Network Theory (ANT) provide valuable lenses for exploring these complexities, offering tools to analyze and leverage paramedics' central roles as key actors within care networks.

Table 1. Key Concepts and terms.

Concept	Definition
Network Theory	A framework for analyzing the connections, relationships, and flows within a system, focusing on human and non-human interactions [44]
Actor-Network Theory (ANT)	A sociological approach emphasizing the equal importance of human and non-human actors in shaping outcomes [45]
Social Network Theory (SNT)	A theory commonly used to study the interpersonal networks of people, focusing on the spread of behaviors, resources, or influence [44]

Human Actors	Individuals, such as paramedics, patients, or policymakers, who interact within a network [46]
Non-Human Actors	Entities such as policies, technologies, or guidelines that shape or influence interactions within the network [46]
Degree Centrality	A measure of the number of direct connections an actor has in a network [47]
Weighted Degree Centrality	A measure of both the number and intensity of an actor's connections within the network [47]
Betweenness Centrality	A measure of an actor's role in connecting other actors within the network, acting as a bridge between disparate groups [47]
Resilience	The ability of a network to adapt to damage or stress while maintaining functionality [48]
Sociomateriality	The interplay between social dynamics and material elements in shaping outcomes [49]
Flat Ontology	An ANT concept that emphasizes the equal importance of all actors, whether human or non-human, within a network [50]
Interessement	The process by which actors are drawn into a network, aligning their interests with those of the network [23]
Translation	The process of aligning actors' goals, interests, and actions to form a coherent network [23]
Obligatory Passage Point	A critical juncture within a network through which all actors must pass to achieve a desired outcome [51]
Alignment	The process by which actors' actions and goals are synchronized within a network [52]
Heterogeneous Actors	A mix of human and non-human actors whose interactions and relationships define the network [46]

Network Theory vs Actor Network Theory

While both NT and ANT focus on understanding connections within systems, they approach these connections from different perspectives, emphasising distinct aspects of how networks function and interact (See Table 2.). ANT is useful for unpacking *how networks are formed and sustained*, including the roles of non-human actors, and can be better viewed as a conceptual lens for the more structural network theory, which serves to identify key actors within the network and the *strength and influence of their connections* [22]. In this sense, ANT may be seen as the 'qualitative understanding' of interactions within the system (e.g., the role of policies or paramedics as actors within the network), and NT can 'quantitatively analyse' the structural properties of said actors (e.g., the centrality of policy or paramedic roles in system integration). Network theory typically conceptualizes connections as unidirectional or bidirectional, focusing on how resources, influence, and information flow between actors within a system [23]. Whereas ANT highlights how relationships within networks are multidimensional, with actors influencing and being influenced by others in dynamic ways. The concept of interessement, defined as the process by which actors are drawn into a network, aligning their interests with those of the network [22] is particularly relevant here, as it captures how paramedics have untapped potential to engage harm preventing services into collaborative networks, aligning their goals to address gaps in care for PWUD.

In ANT, sociomateriality refers to the dynamic relationship between social and material elements within a given context. In healthcare for PWUD, this concept emphasizes how interactions between social factors (e.g., stigma, community trust) and material resources (e.g., harm reduction supplies, practice guidelines) shape care outcomes [22,53]. For instance, a safe consumption site designed with input from PWUD (material) can foster trust and inclusivity (social), improving access to care. Conversely, the absence of take-home naloxone kits (material) due to restrictive procurement policies may hinder paramedics' ability to provide harm reduction services, thereby exacerbating

social inequities. These examples highlight how the availability or absence of material elements directly influences social dynamics and healthcare accessibility for PWUD.

Table 2. Comparison of Actor Network Theory and Network Theory.

Aspect	Actor-Network Theory (ANT)	Network Theory (NT)
Definition	Explores the dynamic relationships between human and non-human actors within a network. Emphasizes sociomaterial interactions and the co-construction of networks [46]	Focuses on the structural properties and connections within networks, including resource flows, influence, and interactions between human actors [54]
Focus	Interplay between actors and material elements. Examines how relationships are built and sustained [22]	Structural relationships, identifying key actors, and analysing connectivity and centrality [23]
Centrality	Less focused on centrality in traditional terms, more on the influence of interactions and relationships [55]	Analyses actors' importance through measures like degree, betweenness, and closeness centrality [23]
Role of Non-Human Actors	Central; non-human entities like policies, technologies, and objects are treated as equally significant actors [56]	Non-human actors are less emphasised, often secondary to human interactions [57]
Ontology	Flat ontology: all actors are equally important and interdependent in shaping network outcomes [56]	Hierarchical perspective: human actors often hold primary influence in networks [57]
Applications	Qualitative analysis of sociomaterial systems, focusing on how networks are formed and stabilised. [22]	Quantitative analysis of network structures, focusing on influence, flow, and connectivity [57]

Leveraging Network Theories to Advance Integrated Care for PWUD

Network theories offer a powerful lens for analysing the dynamic web of relationships and interactions within complex systems, making it highly applicable to healthcare networks for PWUD. By conceptualising healthcare as a network of interconnected human (e.g., paramedics, peers, outreach workers) and non-human actors (e.g., policies, guidelines, technologies), network theories allow us to explore connections that are either strong and efficient or weak and fragmented [22,23,58]. In this context, human actors facilitate direct care, system navigation, and social prescribing, acting as pivotal connectors within the network. Meanwhile, non-human actors shape the structural environment, influencing *how* care is delivered and accessed, often dictating the efficiency of these interactions.

ANT suggests that both human and non-human actors should be treated as equally significant within the network, emphasizing a "flat ontology." This approach recognizes that the interactions and relationships between these actors are interdependent and equally critical for shaping outcomes, rather than privileging one type of actor over the other [22]. For paramedics, this means considering the role of policies, technologies, and guidelines alongside human interactions in care delivery. NT allows us to explore the influence each actor has within the network through various forms of centrality, which refers to the influence of a specific actor within the network. For PWUD, central actors within the healthcare system play a pivotal role in supporting system navigation [23]. NT further introduces the concept of resilience which, through conceptualising the strength of connections within the network, allows us to predict the ability of the network to adapt to stressors (e.g., toxic drug crisis) [59].

Despite these rationalisations of network theories in the context of integrated care, these explorations remain underrepresented in existing literature [22]. Articles describing NT and ANT in the context of care for PWUD are scarce, and to the authors' knowledge, network theories have not been used widely to describe the role of paramedics within the healthcare system. Whilst network theories address the important relational aspects of the system, this approach has some limitations. Distilling the complexities and barriers faced by PWUD into one theoretical lens fails to incorporate the structural and systemic injustices which perpetuate harms and marginalization. As such, network theory should only be viewed as one important aspect of health system understanding.

Operationalising Network Theories in Paramedicine

The relevance of network theories in paramedicine exists within their positionality (centrality). Due to the nature of paramedic services (e.g., 24/7 accessibility, mobile and dispersed, free at point-of-care, diverse range of services) they may be the first and sometimes only point of contact with the healthcare system for PWUD [16]. This level of proximity demonstrates the high influence paramedics have within the system. Within health care networks, paramedics may exhibit both high degree and high betweenness centrality, along with elements of weighted degree centrality.

Degree centrality reflects the number of direct connections an actor has within the network [59]. Paramedics, due to their frequent interactions with PWUD, emergency departments, and allied health and social care professionals, are uniquely positioned to establish high degree centrality. Translation is central to this process, as paramedics bridge the disparate goals of various network actors and transform them into actionable care pathways. Weighted degree centrality adds an additional layer by capturing the frequency and intensity of these interactions, which highlights the importance of the repeated and often critical encounters paramedics have with PWUD. However, paramedics' current lack of consistent and purposeful engagement with essential services such as harm prevention sites, treatment centers, mental health services, social support programs, and other culturally appropriate, and trauma informed services limit the realization of their full potential within the network. Betweenness centrality further demonstrates how paramedics act as bridges between siloed or weakly connected services. For example, paramedics administering buprenorphine and conveying to an OAT clinic following a drug poisoning, or linking those with mental health needs to community supports.

Despite the emergence of novel models of care for PWUD facilitated by paramedics, these initiatives remain inconsistently applied and insufficiently understood [16]. While the role of paramedics in resuscitation is well-recognised, their potential to implement harm-reduction-oriented programs is less clearly defined. Although there is a broad consensus on the need to adopt preventative approaches into paramedic practice, there remain significant gaps in evidence and guidance on how to 'connect the dots' to operationalise these efforts effectively. Leveraging network theories and concepts like centrality thereby provides a powerful framework for understanding where paramedic efforts should be prioritised. An evolving concept in the paramedicine literature in recent years is paramedics (and in particular, those working in community-based roles) as 'system navigators'. By examining the relationships between central actors within the system, this role as connectors and navigators between poorly integrated services can be explored. Furthermore, reconciling weak relationships that exist between paramedics and other human and non-human actors can support prioritisation efforts. This reconciliation reflects the process of alignment, where paramedics may act to synchronise the actions of various actors, ensuring cohesive care delivery.

The unmet health and social needs of PWUD often culminate in crises driven by intersecting inequities (e.g., limited access to OAT, housing instability). These systemic gaps underscore the critical need for upstream interventions that address the root causes of disparities in health outcomes [60,61]. Paramedic-led social prescribing, which may involve for example linking PWUD to services like housing assistance, food banks, and peer support programs, exemplifies an integrative care model [62]. However, weak connections and poorly coordinated services often hinder such efforts, limiting the effectiveness of social prescribing. Strengthening cohesion within care networks is

essential to address these gaps, yet evidence supporting paramedic capabilities in care coordination remains underdeveloped. This gap demands further critique to understand why paramedics are uniquely positioned to fill roles traditionally unmet within the existing system.

Policy Implications

Policy dictates the rules of play by which relationships within the network function, and itself serves as a central non-human actor within the network for PWUD [22,63,64]. The enhanced integration of paramedics into care networks for PWUD requires targeted and informed policy support, leveraging insights from network theories to address system challenges. Drawing on Actor-Network Theory (ANT), Dányi et al. (2018) illustrate how drug policies are relationally constructed through interactions between human and non-human actors [65]. This perspective underscores that drug policy itself often becomes an obligatory passage point, enabling (or hindering) access to services and creating (or removing) opportunities for actors to influence care trajectories through strategic policy engagement. By focusing policy efforts on areas within the system that appear to have gaps, we can further build resilience within the network, protecting it from future disruptions.

How drug policy has historically perpetuated inequities and structural barriers towards PWUD has been well described and long critiqued [5,63,66]. Existing literature supports the shift from punitive and/or biomedical models to psychosocial, equitable, and justice-oriented programs. Despite this, a gap between what is advised and what is enacted continues to dominate government landscapes [67]. There is an observable disconnect in how evidence is used - and more specifically, not used - in the face of entrenched interests and political will when developing 'evidence-based' drug policies [68,69]. Network theories address this tension by focusing on the dynamic process of building alliances, negotiating interests, and mobilising resources required to achieve policy change; further emphasizing social constructions of change through networks of human and non-human actors [70].

Future directions

Future research that delves into the centrality of other key actors within the healthcare system is required. Peers (people who have lived or shared experiences of substance use) often play a vital role as first responders, providing care, advocacy, and support for PWUD [71]. Thus, their role in supporting the patient's journey through the healthcare system requires further exploration.

Another area for future exploration includes the role of outreach workers who also have considerable influence in bridging gaps for PWUD. Understanding their interactions (or potential for future interactions) with paramedics and other actors can illuminate further opportunities for refined integrated care efforts. Addressing research gaps in this context is of high urgency, particularly in examining how paramedics integrate into the broader care continuum for PWUD, beyond acute crises [16]. A comprehensive exploration of their role in harm reduction, social prescribing, and system navigation will provide essential insights into optimizing their contributions.

On a global scale, comparing healthcare systems and networks can offer valuable lessons on best practices and strategies to overcome system fragmentation. By contextualising these insights within different sociopolitical environments, researchers can identify models of care as well as the strategies required to enact them. This includes further interrogation as to why poor integration between services exists, and how policies that underfund evidence-based programs contribute to this.

Advocacy by the paramedic profession itself is also imperative. Paramedics are uniquely positioned to act as policy advisors, leveraging their firsthand experience to inform and drive reforms that address systemic inequities [72] - but they must choose to do so. Downstream work - provision of paramedic services - is demanded of the profession. Upstream work - shaping policy and strategic direction - is a choice that must be made. A concerted effort by the profession to integrate paramedics into policy-making processes will not only advance the profession but also enhance the overall resilience and inclusivity of healthcare networks for PWUD. This dual focus on research and

advocacy is essential to foster meaningful change. Unfortunately, efforts to connect practice with policy remain largely underdeveloped and lack visibility within the profession. Beyond a handful of annual publicized events in federal and provincial parliaments, there is little formal infrastructure to support paramedic-led policy advocacy. Given the profession's growing scope of practice and the complex needs of populations like PWUD, scholars and leaders in the field must prioritize building paramedic leadership capabilities in policy advocacy. These efforts should be embedded in future career framework modeling to ensure that advocacy skills become a core competency of the profession, positioning paramedics as influential stakeholders in shaping health policy and driving systemic improvements.

Conclusion

Paramedics are well positioned to enact integrated care and strengthen the care continuum for PWUD; however, the strength of connections between them and other actors within the system remains poorly described and understood. As a result, any approach to integrating them further requires a fundamental reimagining of the ways in which paramedics support the health and social needs of PWUD. By exploring the strength of connections within the system, we can identify gaps and leverage the centrality of paramedics to develop and support new models of care to close the gaps. This approach enables focused efforts on meaningful initiatives, strengthening the case for expanded paramedic capabilities. Enacting the continuous evolution in paramedic roles will require focused research attention and policy change.

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