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Research paper

"With a PICC line, you never miss": The role of peripherally inserted central catheters in hospital care for people living with HIV/HCV who use drugs

Adrian Guta[a,*], Melissa Perri[b], Carol Strike[b], Marilou Gagnon[c,d], Soo Chan Carusone[e,f]

[a] School of Social Work, University of Windsor, Canada
[b] Dalla Lana School of Public Health, University of Toronto, Canada
[c] School of Nursing, University of Victoria, Canada
[d] Canadian Institute for Substance Use Research, Canada
[e] Casey House Hospital, Canada
[f] Department of Health Research Methodology, Evidence, and Impact, McMaster University, Canada

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ABSTRACT

Background: People who use drugs (PWUD), and especially those who inject drugs, are at increased risk of acquiring bloodborne infections (e.g., HIV and HCV), experiencing drug-related harms (e.g., abscesses and overdose), and being hospitalized and requiring inpatient parenteral antibiotic therapy delivered through a peripherally inserted central catheter (PICC). The use of PICC lines with PWUD is understood to be a source of tension in hospital settings but has not been well researched. Drawing on theoretical and analytic insights from "new materialism," we consider the assemblage of sociomaterial elements that inform the use of PICCs.

Methods: This paper draws on n = 50 interviews conducted across two related qualitative research projects within a program of research about the impact of substance use on hospital admissions from the perspective of healthcare providers (HCPs) and people living with HIV/HCV who use drugs. This paper focuses on data about PICC lines collected in both studies.

Results: The decision to provide, maintain, or remove a PICC is based on a complex assemblage of factors (e.g., infections, bodies, drugs, memories, relations, spaces, temporalities, and contingencies) beyond whether parenteral intravenous antibiotic therapy is clinically indicated. HCPs expressed concerns about the risk posed by past, current, and future drug use, and contact with non-clinical spaces (e.g., patient's homes and the surrounding community), with some opting for second-line treatments and removing PICCs. The majority of PWUD described being subjected to threats of discharge and increased monitoring despite being too ill to use their PICC lines during past hospital admissions. A subset of PWUD reported using their PICC lines to inject drugs as a harm reduction strategy, and a subset of HCPs reported providing harm reduction-centred care.

Conclusion: Our analysis has implications for theorizing the role of PICC lines in the care of PWUD and identifies practical guidance for engaging them in productive and non-judgemental discussions about the risks of injecting into a PICC line, how to do it safely, and about medically supported alternatives.

Introduction

North America is over two decades into a public health emergency characterized by growing rates of opioid use (prescription and illicit), injection as the route of administration, overdose and death (especially from fentanyl and fentanyl analogues), and ongoing system-level failures (Kolodny, 2020). Increasing rates of injection drug use are associated with a resurgence of human immunodeficiency virus (HIV) and hepatitis C virus (HCV) in many jurisdictions (Levitt, Mermin, Jones, See, & Butler, 2020) and related hospitalizations for people who inject drugs (PWID) (See et al., 2020; St-Jean et al., 2019). These hospitalizations often necessitate aggressive intravenous antibiotic regimens to address soft skin tissue infections, infectious endocarditis, and septicemia (Libertin, Camsari, Hellinger, Schneekloth, & Rummans, 2017; O'Callaghan, Tapp, Hajkowicz, Legg, & McCarthy, 2019). The risk of infection increases when using and sharing injection equipment, which is more likely to happen in contexts of poverty, housing insecurity, and low access to harm reduction supplies and primary healthcare

* Corresponding author.
E-mail address: aguta@uwindsor.ca (A. Guta).

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(Suzuki, Johnson, Montgomery, Hayden, & Price, 2018). Due to barriers accessing primary healthcare experienced by many people who use drugs (PWUD), hospitals have been identified as an important site to address immediate health issues (e.g., injury or infection), initiate substitution treatment (e.g., methadone or buprenorphine), or provide links to drug treatment services (Fanucchi & Lofwall, 2016; Kimmel et al., 2020; Wakeman, Metlay, Chang, Herman, & Rigotti, 2017). For PWUD living with HIV and/or HCV (henceforth HIV/HCV), hospitalizations may offer much needed opportunities for initial or re-engagement in the continuum of care, which has been shown to improve health outcomes, reduce mortality, and produce broader public health benefits (Critchley et al., 2020; Young et al., 2018). However, people living with HIV/HCV who use drugs have reported avoiding hospitals except as a last resort because of past negative experiences (Chan Carusone et al., 2019). Due to pervasive societal stigma towards PWUD, including within health systems and from individual healthcare providers (HCPs) (Morley, Briggs, & Chumbley, 2015), hospital admission may create new risks and challenges for already marginalized patients.

When admitted to hospital PWUD are often labelled "challenging, manipulative, drug-seeking, and demanding" by HCPs (Haber, Demirkol, Lange, & Murnion, 2009) who are not adequately trained, unwilling (due to personal biases), or unable (due to policies and care cultures) to meet their needs (Biancarelli et al., 2019; Horner et al., 2019). Abstinence-based approaches to drug use typically required in hospitals do not reflect the realities of substance use and especially opioid use (e.g., the profound impact of withdrawal) (Voon et al., 2018). A retrospective cohort study found that amongst PWUD, 43.9% reported having used drugs not prescribed to them during admission (Grewal et al., 2015). Drug use may result in conflict between clinicians and patients and also between clinicians (e.g., physicians and nurses) (Strike et al., 2020). PWID have reported receiving poor care and being subjected to surveillance, harassment, and neglect during hospital admissions, which increased the risk of discharges against medical advice (DAMA) (McNeil, Small, Wood, & Kerr, 2014). In turn, DAMA leads to failed treatment, readmissions, increased resource utilization, morbidity, and mortality (Vallersnes, Jacobsen, Ekeberg, & Brekke, 2019). In response to this emerging evidence-base, there have been calls for harm reduction in hospitals (Grewal et al., 2015; McNeil, Kerr, Pauly, Wood, & Small, 2016; Rachlis, Kerr, Montaner, & Wood, 2009). In the Canadian context, this is evident in strategies ranging from the provision of harm reduction supplies (Miskovic et al., 2018) to on-site supervised injection (Dong, Brouwer, Johnston, & Hyshka, 2020). Whilst promising, most PWID (and PWUD more generally) remain without harm reduction options in hospitals, and many related aspects of care have not been considered. In this article, we explore the use of peripherally inserted central catheters (PICCs) for treating complex infections among PWUD, which we understand to be a "wicked problem" due to its inherent complexity and the ethical issues it raises (Lee, 2018). We build on earlier research that has applied the "risk environment" framework (Rhodes, 2002) to hospitals in Canada (McNeil et al., 2014). Canada is often recognized as a leader in substance use and harm reduction research and programing (see recent innovative examples Kennedy et al., 2020; Mayer et al., 2020). However, PICCs remain underexamined and theorized in the harm reduction literature in Canada and beyond.

Whilst recognizing the relevance of the risk environment framework to the study of substance use in hospitals (Strike, Guta, de Prinse, Switzer, & Chan Carusone, 2014; Strike et al., 2020), we struggled to make sense of complex PICC related narratives in our data. In response, we turned to empirically oriented "new materialism" (Fox & Alldred, 2017) to account for the complex and relational dynamics between human (PWUD, HCPs) and non-human (viruses, antibiotics, illicit drugs) and human/place interactions which produce the kinds of health-related "dis/advantages" we sought to understand (Fox & Alldred, 2021; Fox & Powell, 2021). In the following sections, we explain what PICCs are, how they have come to constitute a problem and for whom, and then present a theoretically informed reading of empirical findings from a program of research about substance use in hospitals. This paper offers both theoretical and applied insights into the management of PICCs and their potential use as a clinical harm reduction strategy.

Peripherally inserted central catheters (PICCs): Solution & Problem

PICCs are 50-60 cm tube-like structures made of polyurethane or silicone which are inserted into the middle to upper arm to access central veins as a direct conduit to the heart (Sandrucci & Mussa, 2014). Insertion kits include the PICC line, needles of varying gauges, 10mL syringes, guidewire, dilators, introducers, a small blade, local anesthetic, suture material (to hold the PICC in place), and a sterile dressing kit (Gonzalez & Cassaro, 2020). PICCs typically have one to three "lumens," where infusions are administered and which requires periodic "flushing" to prevent clogging and blockages (Gonzalez & Cassaro, 2020; Quinte Health Care, 2016). PICCs can either be valved (pressure-sensitive slits) or non-valved, with valves keeping the exterior tube of the PICC closed, unless it is being used to transfer fluids into or out of the body (Gonzalez & Cassaro, 2020; Quinte Health Care, 2016). PICCs are used to deliver a range of medications (e.g., antibiotics and antifungals) and treatments (e.g., chemotherapy) in hospital and community (e.g., outpatient parenteral antimicrobial therapy (OPAT)) (Billick, 2017; Suzuki et al., 2018). PICCs can be used to administer fluids and treatments and collect blood samples, thus offering two-way access (Duwadi, Zhao, & Budal, 2019). PICCs are considered effective, but owing to their position outside/inside the body may lead to persistent infections at the insertion site, mechanical complications, cellulitis, catheter bleeding, discomfort, and accidental removal (Gao et al., 2015; Krein et al., 2019; MacKenzie, Rae, & Nathwani, 2014; Moran et al., 2014). More severe complications include the occurrence of venous thrombosis and central line-associated bloodstream infections (Moran et al., 2014; Sheth, Trifan, Feterik, & Jovin, 2017).

Despite reported efficacy and decades of routine use in clinical and community settings, there continues to be widespread controversy about offering PICCs to patients with a history of injection drug use (Billick, 2017; Suzuki et al., 2018). This concern stems from PICCs being indicated in situations where the substance being injected is too caustic for regular intravenous injection (bypassing smaller veins and going directly to the heart), the healthcare team is unable to access the patient's veins (e.g., for infants), and if there is a need for frequent access (e.g., for daily medication and frequent blood draws). With these benefits for both patients and providers in mind, there is concern about PICCs being 'misused' (e.g., being used to inject illicit drugs by patients who are unable to access their veins because of damage caused by past injecting), non-compliance with care instructions (especially in outpatient programs where patients are returning to their homes and may not be able to follow disinfection protocols), patient and staff safety, and perceived legal liability in cases where the patient has a documented history of injection drug use (Billick, 2017; Suzuki et al., 2018; Tan, 2017). Despite these concerns, Billick (2017) has stated that "While [injection drug users (IDU)] have higher rates of infective endocarditis, abscesses and septicemia, there is no substantial body of evidence that PICC lines in IDUs result in more serious infections, increased overdoses or increased morbidity or mortality." As a team of substance use researchers, including with clinical experience, we understand how these seemingly benign and inexpensive 50-60 cm plastic tubes significantly factor into life-or-death decisions for PWID (Buchman & Lynch, 2018). Yet, the PICC literature remains focused on whether to give PWUD a PICC without consideration for what comes before, with, and after such a decision, from either the HCP or PWUD perspective. Recognizing the limitations of dominant approaches to health research rooted in positivist science that often fails to capture the complexity of human experience, and the focus in the PICC literature on attitudes and outcomes and not *the thing* at the centre of the debate, we sought out alternative ways of thinking

about PICCs which we discuss next and apply throughout our subsequent analysis.

Why do PICCs *matter?*

In this paper, we draw on techniques from "new materialism" (NM), an approach to social inquiry that recognizes the interconnectedness of diverse forms of matter (*human and non-human*) with the aim of moving beyond the Cartesian privileging of cognition over the natural world (Davies, 2018; Fox & Alldred, 2017; Gamble, Hanan, & Nail, 2019). Across NM approaches, traditional understandings of matter as inert and waiting for human intervention are rejected for a "posthuman" (Braidotti, 2010, 2019) orientation which recognizes *everything* as material, interconnected, vital, and in a process of becoming (Coole & Frost, 2010; Tuin & Dolphijn, 2012). NM borrows concepts from the writings of Gilles Deleuze and Felix Guattari, and especially "assemblage" which is used to account for how complex social and natural formations are constitutive of interconnected phenomena and matter (Deleuze & Guattari, 1987). Applying assemblage thinking to conventional interview data about substance use, Duff (2014, pp. 128-129) shows how it can be used to consider "the full range of bodies, forces and spaces assembled in each event of consumption" and the "constitutive role of spaces, bodies and affects in the formation and reformation (territorialisation and deterritorialisation)" of multiple assemblages. In choosing to focus on assemblages, we do not discount the role of dominant power hierarchies in relation to drug use (Fraser et al., 2017) or the larger political economy of matter (Coole & Frost, 2010) in which drug use is located and produced. Rather, we, like others, are interested in how assemblage thinking might help researchers and clinicians move beyond binaries (Moore, Pienaar, Dilkes-Frayne, & Fraser, 2017) and locate key actors (PWUD and HCPs) within interconnected sociopolitical, relational, embodied, and material effects that produce different kinds of health and drug use (Duff, 2014). For example, Dennis (2017) transcends conventional public health risk discourses to examine the "injecting event" as a complex and fragile assemblage of human and non-human elements, related contingencies and forms of becoming.

Whereas 'context' is increasingly understood to be an important mediating factor impacting medical and public health outcomes, the research about the role of place and space maintains distinctions between the physical and social (Fox & Powell, 2021). In respect to drug use, mainstream approaches often concern themselves with risk factors (e.g., the availability of sterile injection equipment in the context of high viral loads) (McClelland, Guta, & Gagnon, 2020) without considering how sociomaterial assemblages affect human capacities and produce opportunities and constraints (Fox & Powell, 2021). A NM approach invites us to consider *all* of the human/non-human elements within the primary (hospital) risk environment and between community health centres, private homes, shelters, and other spaces (e.g., a park beside the hospital where people buy, sell, and consume drugs). Based on previous work, we are interested in the complexity of how bodies move within and between spaces, their myriad intersubjective and material entanglements, and how they produce dis/advantages for people living with HIV/HCV who use drugs (Strike et al., 2014). We further consider the temporal relationship between matter and how past, present, and future intersect (Deleuze, 1994; Williams, 2011) to influence PICC-related clinical encounters and healthcare outcomes. Reflecting on this theory and experience in the emerging field of clinical harm reduction, we turn to a discussion of our data.

Methods

This paper combines n = 50 qualitative interviews collected across two related studies within a program of research that sought to understand how substance use impacts hospitalization from the 'patient' and the HCP perspective. Both studies followed the same basic methodological, ethical, and analytic approaches and were in dialogue with each other through the kinds of questions asked of patients and providers (for further details about the design and methods used see Chan Carusone et al., 2019; Strike et al., 2020). We conducted semi-structured interviews with n = 26 HCPs (11 physicians, 6 nurses, 4 social workers, 4 pharmacists, and 1 registered dietician) and a further n = 24 persons living with HIV/HCV with lived experience of drug use and at least one hospital admission in the last five years (for demographic information see Strike et al., 2020). All participants were recruited in Ottawa and Toronto, Canadian cities which have concentrations of PWUD, people living with HIV/HCV, and related harm reduction and clinical services. Our focus on the intersecting experience of people living with HIV/HCV who use substances reflects our respective research and practice interests and because this population has exceptionally high rates of hospitalization (Jaworsky et al., 2018; Navon, 2018). Our community advisory members with whom we consulted throughout the study phases explained that having an HIV/HCV diagnosis increased the likelihood of being admitted instead of being deemed 'drug-seeking' and ignored (for further details about our community-engagement strategy see Switzer, Chan Carusone, Guta, & Strike, 2018). We also received support from several AIDS service organizations that helped us recruit PWUD.

HCPs recruited in this study (mean age 45, range 29-60) provided hospital-based care to people living with HIV and/or HCV with co-presentations of substance use. They were asked questions related to their scope of practice, with a focus on opioid prescribing for physicians, and issues that arise in caring for PWUD. Interviews included discussions of examples specific to HIV/HCV (e.g., adherence for HIV and HCV treatment) and PWUD more broadly (e.g., conflict between HCPs and patients about behaviour within the hospital). Patient participants were living with HIV/HCV and self-reported substance use during a hospital admission in the last five years (mean age 49, range 33-56). We use 'patient' to differentiate from 'provider' in the context of hospital care but recognize people living with HIV/HCV who use drugs as more than passive recipients of healthcare. Indeed, PWUD have lived expertise and care for each other (e.g., supporting each other to stay well, including during hospital admissions). Patient participants were asked about their healthcare and substance use needs at the time of their admission(s) and their interactions with HCPs. Not all patient participants identified as PWID, but the majority described being assumed to inject regardless of whether they were actively using, what substances they used, and how they used. Our stimulant using advisory members described being routinely labelled 'drug seeking' for opioids when presenting with severe pain.

Research ethics clearance for all related studies was received from the University of Toronto Human Subjects Review Committee and relevant partner review boards. Interviews were audio-recorded, anonymized and transcribed verbatim by a professional transcription service and uploaded to NVivo 12 qualitative data management software. We adapted the constant comparative method (Charmaz, 2006), and research team members collaboratively reviewed transcripts and iteratively developed a coding scheme and identified core themes. Results are presented using pseudonyms or codes which identify whether the interview was conducted with a Toronto (TO) or Ottawa (OT) based participant, and in the case of HCPs if they were a physician (MD) or registered nurse (RN).

Following a conventional approach to analyzing the qualitative data collected for both studies, we turned to theoretical and analytic insights from NM and the DeleuzoGuattarian approach we described earlier to help us surface new patterns, actors, and relations that were not initially apparent. This process involved taking the coded data from both studies related to PICCs and re-reading them with attention to the material elements invoked in narrative accounts. This process often led us back to the full interviews. Through this re-reading we noted multiple instances where we had to clarify with participants about whether they were still sharing a PICC-specific example ('Sorry, is this the same person who had the PICC from earlier?'). We initially attempted to code down/out the complexity but rectify this by including longer quotations. From there,

we used situational mapping techniques (Clarke, Friese, & Washburn, 2015) to identify the various human and non-human elements and considered how they were in dialogue with each other (or not) and what was absent. This process also benefited from interdisciplinary collaboration and discussion amongst the authors with the goal of mobilizing our respective theoretical, research, and clinical knowledge. This includes direct experience with managing PICC lines in clinical settings and working in a context where PICCs are routinely provided, including to PWUD with complex health needs. In keeping with expectations within NM to consider the researcher within the "research assemblage" (Fox & Alldred, 2015a, 2015b) and post-qualitative debates about the limits of method, data, and representation (Fullagar, 2017; St. Pierre, 2019), we have included coded empirical data and insights gained during the entire research process.

This project shares the limitations of all qualitative research related to issues of replication and generalizability. However, these were not our goals. Rather, the more relevant limitation is that we did not organize these projects around DeleuzoGuattarian concepts or emerging NM approaches which might have taken us in different empirical and analytic directions. We acknowledge these limitations, but as theoretical pluralists believe qualitative data can be read and used in multiple ways. In our experience with past HIV and harm reduction research, including considerations over the types of research typically supported by biomedically oriented funders, a post hoc engagement with theory can be tremendously helpful for advancing our thinking about the care needs of people living with HIV/HCV who use drugs.

Results & discussion

We remind readers that PICCs are a medical device inserted into the arm to enable medications and other treatments to be administered or to draw blood through multiple access ports. PICCs are contradictions: they rest inside and outside the body; enable powerful antibiotics to be administered but can lead to infection; are painful to insert and remove but can be used to administer powerful analgesics; are deemed efficient but also risky because of their proximity to the heart; and are clinically managed but subject to 'misuse' and 'abuse.' When we started examining the healthcare needs of PWUD living with HIV/HCV over a decade ago we became aware of PICCs as an important issue through discussions with our larger research team and community advisory members (including the occasional in-patient advisory member who joined us with the telltale bandaged arm covering their PICC insertion site that linked them to an external IV bag). In interviews with individual HCPs, the PICC question evoked sighs and long pauses. During dissemination activities, conference rooms buzzed in response to our sharing of results and led to heated discussions. In what follows, we describe the presence and absence of PICCs in our interviews and attempt to trace how they serve as an entry point into a multiplicity of diagnoses, patients, HCPs, medications, spaces, and strategies within and outside of clinical settings. In the following integrated presentation of results and discussion we start with one PICC in one body and move outwards to data from HCPs and PWUD we heard from.

Stephanie is a pseudonym for a woman who lent her time and knowledge to this program of research as an advisory member and interview participant. Stephanie was a woman living with HIV, a person who used drugs, and someone who managed complex chronic illness and disability in the context of a healthcare system she viewed as oppressive. Over the course of several conversations Stephanie described her experiences with PICCs, what having one meant in terms of her health and access to health care, and how she learned to use it for her own purposes:

> *"Well, getting an easy port, but I also knew not to overdose. If I overdose, the game is over, right? I like using drugs too much to overdose. I mean, I'm sure I could have a heart attack and things like that, but I could have a heart attack running downstairs. I've had PICC lines, and it made my drug use easier. It meant I didn't get any open wounds. That's my team's concern about me, is I get wounds. And, I mean, pretty big ones. The first time I had a PICC line, I was miserable at it. So what I did was, the people doing my PICC lines, I started to ask questions, like, 'How do you get antibiotic into that, when you flush it?' I wanted to know how I'd get the cocaine in, when I flush it. And I was really clean about it. Like, I used the clean syringes, without the tip on the end."*

For Stephanie, access to the same port through which she received antibiotics provided a means to use her preferred substance and to reduce her risk of wounds and abscesses, which she understood to be a greater concern than her drug use. Stephanie's account evokes the risk of overdose and juxtaposes it with her expertise and embodied knowledge. However, Stephanie's view was not shared by her healthcare team, and she described having a PICC removed and her subsequent anger over not being able to access her own body while others used the port freely: "You're putting something in it. It's in my body!" Stephanie's account of injecting cocaine through her PICC line led us to think about how PICCs represent, in DeleuzoGuattarian terms, a point of rupture within a complex multiplicity of semiotic, material, and social flows: infections, ports, flushing, heart, wounds, cocaine, clinicians, antibiotics, syringes, risk, pleasure, hygiene, hospital, etc. In what follows we map these interconnected elements within a larger assemblage.

Who needs/gets a PICC?

In this section we describe and discuss what HCPs and PWUD told us in response to our questions about giving/getting a PICC line. Our initial understanding of who needs a PICC line is reflected in an Ottawa-based physician's question: "Like, is it clinically indicated for the medical problem? And if it's clinically indicated, then they need the PICC, end of story" (OT-MD24). However, in the context of hospital care for patients who use (or are perceived to use) drugs, we heard that the decision to provide, maintain, or remove a PICC is based on a complex assemblage of factors (e.g., infections, bodies, drugs, memories, relations, spaces, temporalities, and contingencies) beyond whether parenteral intravenous antibiotic therapy is *clinically indicated*. In turn, patients described how decisions about drug use, including whether to use a PICC to inject drugs, was part of this same larger assemblage of factors. Following Dennis (2017), we frame the PICC (its insertion, medical and non-medical use, and removal) *not* as something which happens to a pre-determined individual or "body" but as an *event* comprised of human and non-human matter, processes and contingencies full of intersubjective possibilities.

In decisions about whether to prescribe a PICC line, all the HCPs discussed the medical and psychosocial complexity of substance-using patients living with HIV/HCV whom they had encountered. However, HCPs typically weighed patient's needs against clinical and hospital protocols and the spectre of drug use risk (past, current, and future). This tension is well articulated in the following two examples. First, a physician contrasts the needs of patients with deep-seated infections against their risk of use:

> *"We oftentimes have to contemplate PICC lines…in our inpatients who have either very severe soft tissue infections that have gone down to either involve bone or underlying structures or who have infected heart valves. And they're going to need recurrent or large doses of antibiotics, some of which you can't even really give through an IV because they're hard on blood vessels. But patients then leave, come back hours later and they're plugged up. Or they leave and they never come back. And it becomes a little frightening…Most of us will give people one shot, the benefit of the doubt. But if they were to come back with clear evidence of having misused their PICC line or had a history of it in the past, I'd be reluctant putting another one in." (TO-MD04)*

This is followed by a nurse who framed the use of PICCs as a difficult decision despite their potential benefit because of past patients tampering with their PICC lines:

"And obviously, it's a difficult decision whether to use a PICC line or not. But unfortunately, when they have been using IV drugs for a long period of time, IV access is very limited. Their veins are extremely poor. And when they're hospitalized, it's because they need either IV fluid continuously or IV meds, especially if they're in detox… You know, it happens, they need meds and they've tried some funny things with their PICC line, injecting, you know, crushed meds and stuff like that. It's pretty dangerous. Block the PICC lines too, which then have to be replaced." (TO-RN22)

With PICC line insertions typically viewed as risky and the last resort, some HCPs preferred trying sub-optimal second-line treatments:

"You're often not very keen to put a PICC line into somebody, if you're concerned that they're going to use that line for drug use. You can't make a decision about one part of their care without weighing all the other parts. So, sometimes, you have to pick second line treatment, but, the overall better outcome is served by not giving them an opportunity to have an infected line and develop endocarditis because they're using their line." (OT-MD16)

"We have had situations, we have spoken to the attending physician and some of them have not even ordered [a PICC line], even though they're getting wicked IV antibiotics that are bleach to your veins and they really should have either a port or a PICC line, and the doctors just won't." (TO-RN09)

Many of the HCP's accounts reflected stigmatizing discourses about PWUD as reckless, irresponsible, and untrustworthy: jamming illicit drugs into their PICC lines. For many HCPs we heard from, giving someone who uses/has used/is assumed to use drugs a PICC line with central access was to condone illicit drug use and contribute to their 'inevitable' PICC 'abuse.' While the HCPs we heard from understood patients to be very medically complex (heart and bone infections, unsuppressed HIV/HCV, dehydrated, experiencing unmanaged detox) these factors were often weighed against considerations about substance use and workload.

Following our interviews with HCPs, we expected to hear accounts from PWUD about injecting into PICC lines and related issues like managing blockages. Our advisory board members and participants in previous studies were open about their substance use in hospitals, how they used, how they accessed and stored drugs, etc. However, contrary to the opinions expressed by HCPs, most of the PWUD we heard from who received a PICC line during a hospital admission said they did not use it for non-medical purposes. Many described being too ill to obtain and use drugs during hospital admissions that required a PICC line. In the accounts we heard, these health emergencies ranged from methicillin-resistant *Staphylococcus aureus* (MRSA), pneumonia, endocarditis, and, in one case, coma following an overdose. As one participant shared:

"The PICC line was because my CD4 counts were eleven, and I needed some really heavy-duty antibiotics that in a regular IV would just kill my veins. So yeah, no, it wasn't, actually drug involvement at that point in time." (OT-PAT38)

Several participants shared that they did not know it was possible to inject into their PICC line until it was brought to their attention. This information typically came with threats about what will happen to them if they are caught interfering with the PICC line:

"I didn't know you could do that, until they told me. I had no idea you could do that with a PICC line. Wow, okay…they were just saying 'Don't do it. Because you can be criminally…' like, I don't know, some kind of criminal charges or something. I'm like 'Well, I don't know about that'." (OT-PAT35)

Others said they knew about the access PICC lines provided but were concerned about the risk: "I know friends of mine who had [a PICC] and done it, and I just didn't want to take the chance" (OT-PAT033) and others said they were "too scared" (TO-PAT16). A participant recounted their first experience with a PICC line and expressed frustration about being subjected to what they described as discriminatory treatment because of other patients:

P: "Well, they were worried I was going to go home and shoot up, cause I had a, whatever they call, ah -

I: A PICC line?

P: Yeah, a PICC line to my heart. I said, 'I would have never even thought of that.' I said 'I haven't shot up in such a long time.' [They said] 'Well, people have done it'." (OT-PAT42)

Several patients reported being refused a PICC line because of past or assumed ongoing drug use with HCPs opting for other treatment options. A woman living with HIV contrasted her experience at an HIV specialty care setting, which routinely gave her a PICC line, with experiences at hospitals where HCPs opted for intravenous and oral treatments: "They'll try and try and try and watch my veins blow as soon as they put the IV in." In one instance she required hospitalization and already had a PICC line in place which was immediately removed: "Because I'm a drug user, I was an ex-drug user and they thought that I was going to use…They're just like, 'Well, due to your drug history, we're not giving you a PICC line. Sorry. Like, unless you're dying in bed…' But I was too sick to argue, right?" (TO-PAT26). She described being given oral antibiotics and an electrolyte drink when pregnant and fighting an infection, to the dismay of her community nurse.

We heard a few accounts of open PICC use and HCPs who permitted or ignored use. A notable example is provided by the following patient who described receiving PICC lines and openly using them during multiple admissions, including an instance where he left the hospital and kept his PICC line for a week. Here he describes being caught using his line:

"I: So what happened when they caught you?

P: Nothing. I just told them 'Shut the door.'

I: And they didn't engage in a conversation afterwards?

P: No

And later leaving with his PICC line:

P: I've left with PICC lines in me (laugh).

I: Okay. So what led to that, 'I have to get out of here'?

P: 'I'm never going to get another abscess' (laugh) you know? My, veins are exceedingly hard. I have a hard time hitting. With a PICC line, you never miss" (TO-PAT24)

From the participants and advisory members who described using their PICC lines to inject, it offered them a stable injection site and reduced the harms of injection. Beyond that, it gave them some semblance of control of their health, body, and substance use in the context of severe illness. Patients who used their PICCs described wanting to inject safely in ways consistent with PICC hygiene and maintenance protocols. Finally, there were mixed views about whether HCPs ignoring PICC line use, and drug use in general, was supportive ('they let me do my thing') or reflected disdain ('they really did not care'). None of the patient participants we heard from described receiving any education about how to manage their PICC lines besides general care.

PICCs in context / What does this have to do with PICCs?

Having previously considered tensions between clinical presentation and concerns over current/past/assumed drug use, we now locate PICCs

in relation to a myriad of other factors within and beyond hospitals. As we mentioned earlier, the PICC-related examples shared with us were often embedded in long and complex accounts which centred them as vital parts of complex embodied and sociomaterial systems and processes. In keeping with NM and posthuman approaches, we treat PICCs as having agentic qualities in that they 'move' (metaphorically, but also literally) within and between risk environments and produce powerful effects in the world.

Inside/outside tensions

As we have discussed elsewhere, hospitals were often the last place that PWUD with complex health issues and lives wanted to go, and especially for extended stays (Chan Carusone et al., 2019; Strike et al., 2020). Many described stigmatizing encounters and discriminatory treatment:

> *"I broke my shoulder. It was horrific. They left me on a stretcher for eleven hours. They were terrible to me, like, considering, I'd been traumatized by my partner, who broke my shoulder, right? It was horrible." (TO-PAT27)*

However, hospitalization was often necessitated by complex health issues related to poverty, HIV/HCV, and substance use. PICC lines represented invasive procedures and long stays, and the potential for conflict with HCPs: "When I was hospitalized, I had a big infection in my leg. It was [from] HIV. And they cut [it] open, to remove the fluid, and then they put me on a PICC line" (OT-PAT37). Patients described feeling discriminated against by HCPs and missing their friends, intimate partners, family, pets, and homes. In a pages long transcribed account that followed a question about PICCs, a patient participant shared how a severe lung infection necessitated a PICC line, time in hospital, managed and un-managed pain, the role of a sibling who provided consent on his behalf, concerns about whether his cats were being fed properly by a friend, getting clean socks and underwear, inadequate home care and conflict with his care team who thought he "was going to go shoot up coke or something" (OT-PAT42). Some participants described being labelled drug-seeking (including harming themselves to get re-admitted) but not allowed to leave because of their PICC line when they asked. One participant, frustrated by not being able to leave to attend to responsibilities at home, removed their own PICC line:

> *"They asked me to not leave the property with a PICC line in. I said 'Okay.' So, I had to go and get my clothes, and I took the PICC line out, and I give it to them, in a newspaper and I said "All right. I'll be back in an hour." You know? Like, it was funny (laugh)." (TO-PAT24)*

HCPs were similarly attuned to the assemblage of biological systems and structural factors that create health dis/advantage for patients. The 'outside' (non-clinical) world, and especially patients' homes and street involvement, were described as dangerous and antithetical to PICCs:

> *"The concern personally that I have is not that they'll overdose. A lot of people who are using drugs on the outside know what they're doing. They know how to inject. This just makes it a little easier. My big concern is infection and sepsis and that can bring on death so much faster, especially if we're treating them for a lymphoma or anything like that. And we're knocking their counts right out, then, and they need the line. Then we have been known to put a PICC in and take a PICC out and put PICC in." (TO-RN06)*

> *"Usually, the patient who can go home with home care has to have a permanent address. And most of the people with substance abuse are homeless. And that's also another challenging thing. Then, if we can't get home care, and the patient needs IV antibiotics, sometimes, they just end up in the hospital for a very long time, like, eight weeks or twelve weeks." (OT-MD17)*

Following the account of the patient who had their PICC line removed when transitioning between care settings, this Toronto-based nurse describes subjecting a patient to multiple insertions and removals because of concerns about their drug use and where they lived:

> *"We actually had issues with an oncology patient…she was known to live in a crack house. And she was here with lung cancer. And, she would get her PICC line for her chemo, and every time, she would go, we would remove the PICC line." (TO-RN08)*

Recognizing that within a NM framework *everything* is matter and can effect other forms of matter, we are struck by how in addition to past individual drug use, past patients (imagined or real) jamming crushed pills into their PICC lines and 'crack houses' (imagined or real) impacted the care patients received and whether they might be subjected to multiple PICC insertions/removals or pull out their own PICC line in a moment of frustration.

Power, surveillance & control

In using assemblage thinking to complicate the discourse about PICCs, we include forms of medical, psychiatric, and carceral power. Within institutions like hospitals, various forms of power can be mobilized and justified to govern PWUD (Strike et al., 2014). Those who received PICC lines described having their movements within the hospital monitored and restricted:

> *"They wouldn't let me go outside just to have a smoke with my friends. And (it) was like 'You shouldn't smoke.' I said 'No, no, I'm not going to smoke. I'm just going to go sit with my friend while he has a smoke.' And I didn't smoke the whole time I was there. But they thought I was going to jump in a cab, and take off, and just go get shot up." (OT-PAT42)*

The following is an excerpt from a longer discussion with a nurse about how PICCs are managed on their unit. PICC management included drug testing and "forming" patients wherein their legal right to leave the hospital is suspended following a psychiatric assessment:

> *"…if they need to be formed, then they're forced to stay in and we've got security that sits, at their door twenty-four seven. It's not very easy to form someone. But if we know that they medically, in order to stabilize them [need a PICC] then the psych team has to assess them and then form accordingly. Or, if we don't get a form, we could always get a sitter. We call them a sitter, they just sit out of the room and they watch and make sure the patient doesn't leave the room. But then if they leave and we have a feeling that something's going on, we can always drug test them as well, which we have done in the past, obviously, with their consent."(OT-RN22)*

Some HCPs described involving the police in situations where patients left with their PICC line:

> *"Usually, I try to focus on their health, trying to explain to them what would be the consequence of them not following our medical care plan and try to negotiate. And so if that does not work, then we'll go up to the attending level and sometimes still does not work and the patient left against medical advice. And if the patient left with the PICC line, without home care arrangement, we call the police." (OT-MD17)*

> *"You know, we, that's a medical intervention that is of danger to them, because you know, those things can get infected and clot off and so on. So we actually usually call the police. They're found and brought back, have the PICC line removed, if they want to discharge themselves and then discharge them." (OT-MD23)*

Finally, there was talk across physicians and nurses about their fear of the liability related to PICC lines and allusions to a supposed case of someone losing their license:

> *"Yeah, the whole Ontario, 'Don't put a PICC line into a user' kind of thing. I guess there's somebody that went to jail here (laugh) or some doctor lost their license. The first time I ever heard of this was when I came to Ontario. In (previous location), we used to put lines into people*

all the time. They used to leave AMA, with lines. We would call the street nurses and say 'Hey, there's someone with a line in. You know, they probably need to take it out to be safe.' It wasn't a big deal. We didn't get the cops involved." (OT-MD24)

In addition to holding societal biases about PWUD, and especially PWID, HCPs were susceptible to peer influence and concerns about retribution from senior colleagues, licensing bodies, and the courts. The past jammed PICC line, the 'crack house,' and the colleague who lost their license come together to create complex dis/advantage for people living with HIV/HCV who use drugs.

PICC as clinical opportunity?

A minority of HCPs inverted the untrustworthy reckless drug user trope and recognized the embodied knowledge and expertise of PWUD. Here the PICC becomes an HCP recognized tool for preventing infections and offers opportunities for education, dialogue, and harm reduction. The following two physicians discuss educating patients to inject safely into PICC lines:

"I mean, from my perspective, if you teach someone to inject safely, you can teach them to inject safely through a PICC. The nurses do it all the time. If they're a user, they're not going to stop, well, you just gave them a PICC. Like, they're not dumb. They're probably going to use it, right? … And then you're like 'Well, look. Don't be a dummy. Use clean water. This is how you do it.' That's between you and me (laugh)." (OT-MD24)

"You know, I think it's a harm reduction intervention. I hear that all the time, 'So and so has a PICC and they're going to leave AMA. What should I do?' It's a clean site. It's been inserted by a professional, and rather them inject into that then into a dirty, you know, extremity. So I think there's nothing wrong with it. I wouldn't insert it for the purpose of injecting but if they're, if it happens to be there, I wouldn't, you know, intentionally remove it, out of fear of them using it for their addiction." (TO-MD05)

A few physicians supported patients to remain in the hospital and reduce potential infections by dose matching with pharmaceutical-grade opioids. PICCs are simultaneously used to address patients' medical needs (the presenting infection) and their substance use needs. An Ottawa-based physician recounts the case of a patient who was street-involved, living with HIV and HCV and admitted with a heart valve infection and subsequently tested MRSA positive. They weighed their need to use against their need to be isolated for six weeks with a PICC line and provided substitution dosing:

"Well, we certainly can't let somebody go out in the real world with a PICC line if there's any concern they're going to be manipulating it… She was more of a street user, so not on methadone or anything like that. And when she came in, I mean, the basic idea with my team was 'We need to treat her for six weeks. Let's make sure they're stopping abuse, as we give it to her, you know, kind of under supervision.' And, you know, do the best we can to understand that she's a bit of a victim of all of this as well." (OT-MD23)

The PICC both necessitated alternative approaches ('we need to do something to keep them here') and offered a mechanism through which to provide lifesaving antibiotics and substitution dosing to stave off withdrawal and keep patients comfortable, serving both medical and non-medical purposes. However, we only heard a few examples of HCPs working in this way because of numerous interprofessional (diverging views between physicians and between physicians and nurses) and organizational (hospital policies and cultures) barriers:

"When I was starting internal medicine training, I felt the same thing. But I've been surrounding by people who do a lot of harm reduction programs and (they) taught me that it's okay to send a patient home with IV access for their optimum care. It's challenging, because infectious diseases does not own a patient in the hospital. So we're just consultants and it's hard if internal medicine does not buy-in." (OT-MD17)

Finally, one physician considered the potential for an in-hospital supervised injection site (SIS) to reduce the burden on staff tasked with replacing damaged PICC lines. Most SIS are found in community settings and provide a sanctioned space in which drugs can be injected using new supplies under the supervision of clinicians or peers to prevent or revert overdoses:

"Maybe if there was a site in the hospital. Because I imagine if you have this available on the floors, the number of people you have to train would be way more people. If you have a site, you know, where people go down there, or wherever, the floor, and use the drugs and come back. (But), like, imagine to train all the nurses at (hospital name) to use these harm reduction approaches." (TO-MD32)

During the interviews and our subsequent dissemination activities with HCPs (e.g., conference presentations and workshops), we heard claims of wanting to work in patient-centred ways, but being restricted by hospital cultures and external systems that limit options in the care of PWUD.

A DeleuzoGuattarian inspired NM approach has necessitated that we identify the range of material (*human and non-human*) elements in our data. The goal of this paper is to complicate dominant understanding, including our own when we started this work, of PICCs as benign medical technologies administered based on clinical presentation. Rather, who needs a PICC and who gets a PICC are influenced by a range of material factors; real and imagined; past, present, and future. They are too many to re-list, but include; ports (open and blocked), charts, viruses, veins, syringes, abscesses, hearts, bones, drugs (illicit and licit), dirt, sepsis, lymphoma, chemotherapy, hospitals (rooms, floors, doors, written polices), physicians, nurses, diagnostics, doors (open and closed), home, friends, families, pets, the street, and security and police forces. PICCs are not benign; *they do things*. Their presence incites action and contributes to affective milieus where fear, shame, guilt, pleasure, and pain coalesce with myriad material elements and create dis/advantage for PWUD (e.g., being able to inject and never miss while receiving lifesaving treatments vs. being 'cut-off' pain meds, receiving ineffective second-line treatments, and being subjected to forced PICC removals). Our understanding of PICCs as having agentic qualities is especially evident when they moved between clinical and non-clinical spaces which brought in considerations from HCPs about external risks: the PICC line contra imagined 'crack house.' Our NM informed analysis has us rethinking stigma, which dominates the substance use literature but has limited explanatory value beyond identifying discriminatory practices and the need to redress knowledge deficits (i.e., the common refrain that stigma can be addressed through more education and training). In addition to recognizing stigma as a manifestation of medical power (top-down), our data points to the role of inter/intra-professional dynamics and conflict, workload, and reputational management. Moreover, stigma has material precedents and effects based on the spectre of (real/imagined) cases of people who have injected and blocked their PICCs lines, and other HCPs (real/imagined) who lost their medical licenses. The patient participants we heard from desired to use drugs, but also to be treated with dignity and to get well enough to leave the hospital and to return to their lives. While many were too sick to use their PICC lines, some did and wanted to keep them because of what they offered in terms of pleasure, health, and wellness. We are left with a new appreciation of PICCs as both a technology and metaphor; they bring together the heart (viewed as biomechanical pump and sociocultural symbol of care) and seemingly oppositional states (sick/well, pleasure/pain) and spaces (sterile and controlled hospital versus 'dangerous' and 'risky' drug-using spaces) in an assemblage.

Conclusion

We did not title this paper "With a PICC line, you never miss," because it reflects a general experience amongst the PWUD we heard from. Indeed, most did not use their PICC lines for non-medical purposes. Rather, the statement is imbued with potentialities and has resonated with both PWUD and HCPs during dissemination activities. For some it offers the promise of getting well and for others it presents the imminent risk of infection and overdose. A "new materialist" approach has invited us to consider these perspectives, on their own, and together in the constitution of a complex health assemblage. Assemblage thinking enables more nuanced understandings of what leads to positive (PWUD are supported to stay in hospital until they recover from a serious systemic infection), negative (the same person leaves against medical advice and is forcibly returned to the hospital), and myriad permutations therein that create dis/advantage. We have used NM to move beyond the reductionist problematization of PICCs as a matter of risk which pervades the literature and promotes binary framings of PWUD as 'reckless' and 'untrustworthy' compared to HCPs characterized as rational expert decision-makers. Whilst certainly not the only approach we could have used to theorize our data, NM offered a way to make sense of the complex material (human and non-human) elements in our data, towards providing a holistic understanding of what PICCs *do* in complex medical relations.

Drawing on patient and provider perspectives, our data has applied and theoretical implications. Our findings point to complex assemblages of bodies, relations, affects, technologies, and temporalities along the continuum of care for people living with HIV/HCV who use drugs. As our advisory members noted, having an HIV/HCV diagnosis could facilitate their hospital admission, but did little to improve their treatment or overall engagement in care. Within the continuum of care, hospital admission was considered a last resort and often disrupted their ability to use safely (e.g., obtaining drugs from known sources and injecting in planned ways vs. haphazard and rushed). Following a hospital admission, being denied a PICC line because of concerns over 'misuse' created one set of challenges in terms of sub-optimal second line treatments. However, receiving a PICC created a complex series of disadvantages and restrictions on PWUD who were threatened, surveilled, had PICCs re-inserted, were prevented from visiting with friends and family, and were even followed into the community and 'retrieved.' The use of threats and increased surveillance related to PICCs created hostile risk environments and reduced opportunities for effective care (McNeil et al., 2016; McNeil et al., 2014). PICC insertion/removal procedures for PWID should focus on autonomy, accessibility, beneficence and conceptions of harm that recognize the protective function of substance use in some peoples' lives (Billick, 2017). Instead of denying PICC lines because of concerns over access to material resources and unsafe living conditions (what happens outside of the hospital), the focus needs to be on ensuring these conditions are in place. Some HCPs were connected to community providers, but these resources were typically only utilized after early discharges and a breakdown in the therapeutic relationship. The conflict over PICCs and substance use, when it leads to discharge, police retrieval, and forced PICC removal is a failure of the healthcare system. In moving towards more inclusive and effective protocols for PWUD with serious or chronic infections, care teams should incorporate harm reduction strategies and education. Hospital policies that promote consistent care (and not the views of who is on call and which department 'owns' a patient as we heard), and support for complex health issues are needed (Kiepek, Jones-Bonofiglio, Freemantle, Byerley-Vita, & Quaid, 2021). As are on-site and accessible hospital-based supervised consumption services (Kosteniuk et al., 2021). This will require system-level change, but as we heard from HCPs and PWUD in our research and dissemination, change can start with micro shifts in culture at the level of individual hospitals and units.

Reflecting on Stephanie's vignette one last time, we consider it against important advancements in HIV care and the response to the opioid crisis since we started our research. Specifically, the growing interest in long-acting injectables for HIV and HCV (Philbin et al., 2021; Verma et al., 2020) and so-called 'smart' pharmaceuticals (Abbasi, 2018; Ellsworth et al., 2021), all of which raise new questions about the human/non-human. Notwithstanding the complex ethical concerns around these technologies and what they mean for already marginalized and criminalized communities (Guta, Voronka, & Gagnon, 2018), they are increasingly promoted as necessary interventions that reduce the burden on patients, providers, and health systems. As well, in Canada, 'safe supply' programs are providing pharmaceutical-grade options to PWUD to reduce the risk of overdose from drugs acquired in the illicit market and increase engagement with harm reduction and healthcare (Csete & Elliott, 2020; Ivsins, Boyd, Beletsky, & McNeil, 2020). In this context of scaled-up biopharmacological and technological interventions, we consider the possibility of a model of clinical harm reduction that includes PICCs as a patient-controlled mechanism through which to inject drugs. Put simply (although provocatively), why not permit someone like Stephanie to inject medical-grade drugs into their PICC line to support their ability to stay hospitalized and reduce drug-related harms? Building on Donna Haraway's (1985) cyborg assemblage, we consider this *more than human harm reduction PICC assemblage* as a heuristic to reflect on the limits and potential dis/advantages of harm reduction and what is medically, legally, ethically and socially possible. Our modest study cannot address all the relevant considerations. The data we presented are from a subset of PWUD who were also living with HIV/HCV and most reported being too ill to use their PICC lines in non-medical ways when they were hospitalized. We call for future research to engage more deeply with the issues we have identified related to PICCs and substance use, including from the perspective of PWUD receiving outpatient care in the community. Future research should examine how diverse PWUD use their PICC lines, and related preferences and safety considerations, towards developing at least guidance and policies for providers, if not a pathway to patient supported use.

Finally, our study has implications for the current context of the COVID-19 pandemic where PWUD have been profoundly impacted through disruptions to the availability of drugs and harm reduction programs (Bonn et al., 2020; Jacka, Phipps, & Marshall, 2020). The pandemic, in combination with concurrent calls for racial justice, addressing gender-based violence, and growing class inequities, necessitates new ways of *thinking about* and *responding to* the material dimensions of healthcare, ethics, and justice for marginalized groups (Guta, Gagnon, & Philbin, 2020). Such efforts should be epistemologically centred in the experiences and knowledge of the oppressed (Guta et al., 2018). However, the relational focus in assemblage thinking makes space for a relational ethics of care attuned to the needs of both PWUD and HCPs and their respective dis/advantage (Braidotti, 2019; de La Bellacasa, 2017). Thinking through the heuristic of the more than human harm reduction PICC assemblage may provide a point of discussion, debate, and co-production around which to do the challenging work required in a period of rapid change.

Declarations of Interest

None.

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