

# Mutual Shaping of Telehealthcare in Northern Saskatchewan: Community Experiences of the Socio-Technical and Spatial Dimensions of Care

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*Abstract: Telehealth is offered as a technological solution for challenges with accessing care across Canada's more remote communities. Telehealth technologies can bridge healthcare access gaps by connecting patients and providers; however, there are notable utilization and structural constraints that potentially challenge long-term sustainability. This article contributes a snapshot of community perspectives and experiences from Northern Saskatchewan on the use of telehealth technologies. Specifically, this article locates the strengths and barriers for telehealth use within northern and remote Indigenous community contexts and draws attention to the importance of community collaborations and place-based considerations. Drawing on theoretical insights from Science and Technology Studies (STS), it is argued that understanding the social and spatial contexts in which telehealth is experienced is critical especially as technologies continue to play an important role in delivering healthcare. The analysis reveals how users and technologies, along with their mediated environments and situated contexts, mutually shape telehealthcare practice and experiences. In the context of this study, a mutual shaping approach provides insight into the factors shaping technology use – it uncovers how socio-spatial and human factors (users) shape technology design, implementation, and utilization, and simultaneously how technologies shape healthcare practices and experiences associated with telehealth and the socio-technical space of the clinic.*

*Keywords: Mutual Shaping, Telehealth, Health Technologies, Indigenous Communities, Place-Based Experiences*

## Introduction

Northern and remote Indigenous communities in Canada face well-documented challenges to accessing healthcare. These challenges are largely associated with geographic remoteness and long distances from urban centres, physician shortages, limited resources, and higher costs for service delivery (McBain and Morgan 2005; Mikkonen and Raphael 2010; Romanow 2002; Schwamm 2014; Sevean et al. 2008). Telehealth, or the means of delivering healthcare services and information across distance, is increasingly relied upon to bridge healthcare service gaps. However, despite its role in connecting patients and providers, telehealth in the Northern Saskatchewan context is marked by a series of implementation and utilization barriers, and structural constraints from limited human resources to technological and spatial factors that challenge utilization and long-term sustainability (Muttitt, Vigneault, and Loewen 2004; Peddle 2007). While existing research on the potential of telehealth for increasing healthcare access, efficiency, and cost-effectiveness is abundant and a valuable starting place, less is known about the role of users, and how well health technologies serve northern and remote Indigenous communities in their situated contexts. Therefore, a greater understanding of how telehealth shapes healthcare practice for communities with limited healthcare access and how users shape telehealth in their local contexts is needed to draw a more complete picture of telehealth use and what it means for northern communities.

In attending to these gaps, this article uses empirical findings from a community-based project in collaboration with four Northern Saskatchewan communities that draws attention to community perspectives on telehealth use (Leader 2020). Driving this research is the following question: *What does telehealth mean for northern and Indigenous communities from the perspectives and experiences of telehealth users?* Specifically, this work explores users'

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experiences in relation to the socio-technical and spatial factors shaping telehealth use, and it identifies the strengths and challenges for utilizing telehealth, and the importance of community involvement with place-based considerations in telehealth implementation and decision making. Drawing on Science and Technology Studies (STS) theory, this work uncovers how technologies and users mutually shape telehealthcare practice – practices are entangled within complex webs of interactions (Mackay et al. 2000) which are locally and geographically situated.

This article begins by first framing the challenges of accessing care and telehealth as a technological solution, pointing to current knowledge gaps. Next, a brief overview of the methodology and community-based approach is provided, highlighting the importance of community collaborations in the research design. This is followed by a discussion of the findings and analysis of the core themes, sharing community insights into the Northern Saskatchewan telehealth context. Finally, this article concludes by offering some key observations and recommendations.

## **Literature Review**

### ***Background: Challenges to Accessing Care in Remote Communities***

There are multiple and complex challenges to accessing and delivering proper health services for Indigenous peoples living in northern and remote communities in Canada (Mikkonen and Raphael 2010; Health Canada 2014; Adelson 2005; Bosco and Oandasan 2016). A number of factors have been identified which include the clustering of services, resources and facilities in urban centres (Laurent 2002; Brassolotto et al. 2019); the remote and vast geography with a dispersed population across the Canadian North preventing the timely delivery of services (Health Canada 2008; Romanow 2002; Sevean et al. 2008); and an ongoing shortage of physicians and healthcare providers located in rural and remote communities that in turn has resulted in under-staffing and limited availability of services (Canadian Institute for Health Information 2014; Bosco and Oandasan 2016). To receive care, patients often travel long distances and deal with harsh climates and limited transportation options. This is associated with higher costs in terms of time as well as financial and emotional burdens while away from family and cultural/language supports (MacLeod, Browne, and Leipert 1998; Nagarajan 2004; Romanow 2002). Northern and remote regions face unique challenges that present barriers for accessing healthcare services and in turn, create health disparities for these communities that is contrast to urban and southern populations. Rural realities and the unique conditions for accessing care and other services are also well-documented within the Canadian geography literature (Brassolotto et al. 2019).

### ***Telehealth as a Technological Solution***

Remote healthcare technologies such as telehealth have been identified as valuable solutions for overcoming access barriers that could have the potential to improve health service delivery in northern and remote regions. Telehealth can create the capacity for patients in remote communities to connect with providers at distant sites in real-time and enable individuals to stay within their home communities with family and support networks, often not available when patients leave their community to access specialized services (Heaton 2006). Telehealth encompasses a broad range of digital technologies that mediate access to healthcare including videoconferencing and remote presence robotics. Rapidly expanding in scope, telehealth mediates distance in healthcare delivery by linking two or more end users for the exchange of information and for the delivery of services outside of traditional health facilities (World Health Organization 2019; Mitton et al. 2011; Schwamm 2014).

Information and Communications Technologies (ICTs) with audio-video capabilities can facilitate the provision of care with the use of peripheral devices for diagnostic, monitoring, and therapeutic services. According to Canada's Health Informatics Association (2015), telehealth has grown and expanded across Canada nationally with an increase of 41.5% telehealth endpoints and 45.7% growth in the number of clinical sessions between 2012 and 2014 (11). In Saskatchewan, there was a 49% increase in the number of patients utilizing telehealth between 2016 and 2017 and 132% growth in First Nations communities (eHealth Saskatchewan 2017; Exner-Pirot 2017). Although there has been consistent growth with telehealth utilization, there is still lower uptake in many rural and remote Indigenous communities (Health Canada and the Public Health Agency of Canada 2017).

### *Drivers for Telehealth Adoption and Current Knowledge Gaps*

The overarching discourses surrounding the benefits of telehealth are frequently underscored by improved cost-effectiveness with greater return on investment and increased efficiency for healthcare delivery. Government savings, reduced costs of service delivery for regional health authorities and health organizations, improved work efficiencies for healthcare providers and cost savings for patients in the way of travel and lost wages, are frequently described as drivers for telehealth (American Telemedicine Association 2015; Déry 2019; Health Canada and Public Health Agency of Canada 2017; InTouch Health 2019; Jong, Mendez and Jong 2019). In line with this, a large body of the academic and grey literature has centered on organizational perspectives, reinforcing optimization, and determining the cost-effectiveness and increased efficiency of telehealth as a viable option (Jennett et al. 2003; Jong, Mendez, Jong 2019; de la Torre-Díez 2015). Discourses surrounding cost-effectiveness depict telehealth “as a means to reduce costs by delegating tasks and responsibilities from doctors to less expensive nurses, patients and technical devices” (Oudshoorn 2009, 390–91). Oudshoorn (2009) warns how technologies in healthcare are problematically viewed as “neutral mediators” that simply deliver another form of the same care. According to STS scholars, technologies are not simply neutral or passive objects, but rather play important roles in the making of knowledge and practice (Berg and Mol 1998; Lupton 2014; Oudshoorn 2009; Winner 1980; Miller 2021; Verbeek 2015). Specifically, the move from face-to-face to remote consults fundamentally changes the nature of healthcare practice and the roles of various actors involved.

While organizational perspectives importantly operationalize telehealth in healthcare settings, the role that users play in integrating telehealth into service delivery and how telehealth shapes healthcare practices are often limited in scope that do not fully take into consideration the full range of technical and human or user-related factors. More work can be done to reveal how healthcare practices adapt with the introduction of telehealth—i.e., how healthcare providers integrate telehealth into their everyday work routines, new modes of patient involvement, and technological and spatial considerations. The viability for telehealth, including understanding issues such as slow uptake and low utilization, requires examination of how well the technologies are working from the perspectives of users. User-centered research approaches in the fields of Human-Computer-Interaction (HCI), STS and user experience design have paved the way in this particular area of research inquiry.

In the field of HCI and user experience design, studies have drawn attention to how technologies shape users' actions and perceptions. For instance, Rae, Takayama, and Mutlu (2013) examined interactions between local and remote users in telepresence sessions. They found that manipulating the height of telepresence robots changed users' perceptions of authority and comfort in consults; in the case of shorter robotics the authority of the users was maintained while the taller robotics diminished users' sense of authority shaping their experience. In an HCI study of a custom video chat application it was found that including video feedback (a preview of the users' own video stream) helped to increase self-awareness

that directed attention towards themselves and concern for how they were perceived by others (Miller, Mandryk, and Birk, et al. 2017). Examining cultural factors shaping experience and user-centered approaches are also prominent in HCI and user experience design research. Reinecke and Bernstein (2011) evaluated a culturally adaptive system where they found significant increases in users' experiences in terms of ease of use and satisfaction with interface designs that were adaptive to cultural preferences with personalized options. In other contexts, user experience design researchers conducted a digital mapping project in a city where they found that the capacity to visualize data in a meaningful and accessible way for users was initially limited by the technologies and systems in place (Deveau and Goodrum 2015). Their study points to the complex nature of cultural mapping with respect to standardized data across specific areas and challenges of categorization that they argue better emerges naturally from communities and driven by users. In their study of telerehabilitation systems examining movement data, Akinsiku et al. (2021) found that experiential information of the lived experience of stroke survivors was essential for specialists to interpret movement data accessed through the telehealth system and to adequately develop a rehabilitation plan. These studies not only highlight the complex qualities embedded within technological designs that play a role in shaping users' experiences and perceptions but also the need for user- and patient-centered approaches to care delivery.

Bhat, Jain, and Kumar (2021) examined how the COVID-19 pandemic facilitated the adoption and integration of telehealth into doctor-patient care in urban India through patient and provider experiences. They found that there was not only a shift in how technologies were adapted to respond to the pandemic, but also identified a shift in expectations around patient-doctor exchanges and the dynamics of caregiving. The authors point out that future work is needed to examine resource-poor contexts to fully explore contexts outside of urban India. Orlando, Beard, and Kumar (2019) conducted a systematic review to examine patient and caregiver satisfaction with telehealth for those living in rural and remote areas (specifically videoconferencing). They found that telehealth satisfaction among patients and caregivers was overall positive on each factor examined (system experience, information sharing, consumer focus, and overall satisfaction) and determined that telehealth offers an "alternative mode of service delivery that when integrated into an established service could form part of patient choice when clinically safe and appropriate" (15). Most of the studies selected were in high-income countries (Canada included) and further research in other regions was identified to assess telehealth satisfaction. Not all regions in Canada, particularly in the north, have the same level of access to high-speed bandwidth or the technical infrastructure and expertise readily available in comparison to other regions in the country. The reality that telehealth is not yet fully integrated into mainstream healthcare services in Canada may also challenge meaningful patient engagement to the extent this study suggests, however, recent calls for a virtual first model of care amidst the COVID-19 pandemic point to the reconsideration of a more integrated approach (Deloitte 2020; Khalid 2020; Canadian Medical Association 2019).

Studies focused on understanding of the strengths and challenges of telehealth with the consideration of users' experiences are emerging more generally, however, there continues to be limited studies specifically focused on users' experiences of telehealth in Northern and remote Indigenous community contexts. Community-based collaborative studies and user experience from HCI research have started conversations on community acceptance and cultural appropriateness of telehealth applications which are transforming the field. For instance, an emerging body of research from community-based participatory design, HCI and user experience is focused on the topics of community and cultural acceptance in Indigenous contexts (Mah 2011; Caffery et al. 2018; Caffery et al. 2017; Davies et al. 2015; Halseth 2018; Hensel et al. 2019; Holt et al. 2018; Jones, Jacklin, and O'Connell 2017; Wickramasinghe et al. 2016; O'Donnell et al. 2016) and have identified that meaningful user involvement is critical for telehealth adoption (Wherton et al. 2015) along with understanding the socio-cultural contexts

remote rural settings (Chandwani and Kumar 2018). End-user adoption of technology requires exploring users' needs, particularly for Indigenous populations where needs may differ from other cultural contexts (Davies et al. 2015; Mah 2011; O'Donnell et al. 2013) and collaboration with Indigenous end-users is critical for developing culturally safe and relevant technologies that enhance utilization and stability (Maar, Seymour, and Sanderson 2010). Ensuring users are included in decisions surrounding how technologies will be used and meaningfully designed for their care will be instrumental to the design and implementation of new technologies aimed at serving Indigenous communities.

## **Methodology**

### ***Examining Telehealth Using a Collaborative Community-Based Approach***

The findings presented in this article draw on qualitative and exploratory fieldwork from a community-based research project in partnership with four Northern Saskatchewan communities including Île-à-la-Crosse, Pinehouse Lake, Hatchet Lake Denesuline First Nation, and La Ronge. Following Community-Based Participatory Research (CBPR) approaches founded on building respectful relationships in co-partnership with communities, this project responded to community-identified concerns around access to healthcare services which were raised by members in all four communities. This research represents a snapshot of community perspectives from the four Northern Saskatchewan communities which involved a series of 24 semi-structured interviews and small focus groups with key knowledge users and stakeholders capturing a variety of perspectives: patients and family supports (including Elders and community leaders), local and remote healthcare providers and staff (from Registered Nurses, community resource staff, to mental health workers and a family physician), Telehealth Coordinators (on-site and regional), IT staff and eHealth Advisors. In addition to obtaining ethics approval by the University Research Ethics Board, research approval was also granted by the Saskatchewan Population Health Unit to conduct research with healthcare employees and community support for the project was provided by community leaders in the form of signed letters of support and research agreements.

Recruitment was community-led, where participants were invited by key informants within each of the communities drawing on their specialized, local knowledge of the main telehealth users. Discussions with community members comprised of sharing personal experiences of using telehealth and perspectives on what telehealth means for their community and northern and remote Indigenous communities more broadly. Telehealth users were asked to describe their experiences with telehealth and their understanding of how telehealth may facilitate or impede in building capacity for delivering care. The specific telehealth technologies utilized in the participating communities included remote presence robotics (RP7i), the "doc-in-the-box", a colloquial term for a hand-held remote presence technology (RP Express), and traditional videoconferencing units.

Thematic analysis of the interview and focus group data was conducted using NVivo 12 qualitative software to organize the data using constructivist grounded theory principles for coding. This involved an iterative process of data collection and analysis starting with open, axial, and focused coding to refine the coded data and generate themes. During the open coding phase, data was coded into multiple topics, based on multiple and holistic readings of interview and focus group data ensuring all details were captured in the coding structure. This approach served as a method of telling the story through the coded data by using higher level (top/parent) nodes and sub-nodes in a logical but sequential way that captured the essence of the conversations. Using a storytelling approach in the coding structure was instrumental for thematic analysis – during the (re)coding phases (axial and focused) it was easy to group nodes into broader categories in meaningful ways. A thematic map was created to visualize the themes

derived from the analysis and to further explore interconnections between the themes, actors, and technologies (i.e., socio-technical mapping).

## Findings: Community Perspectives on Telehealth

Community members shared their experiences pointing to the strengths and challenges in their everyday use of telehealth. It became immediately evident that telehealth involves complex considerations around where the technologies are located and integrated within their communities. Conversations highlight how using telehealth is multifaceted with multiple interconnected socio-technical and spatial factors that shape its implementation and use. While telehealth offers great potential, several implementation and utilization barriers prevent the full realization of these benefits, and in turn, transforms how we think about accessing care and the unique realities of technologically mediated care. The analysis reveals that various users and technologies mutually shape telehealthcare practices and experiences which are presented in four central themes as depicted in Figure 1, including: 1) Collaborative and Shifting Roles; 2) Co-Configuring Users and Technologies; 3) Place and Space Matters; and 4) Socio-Structural Challenges for Telehealth Implementation and Utilization.

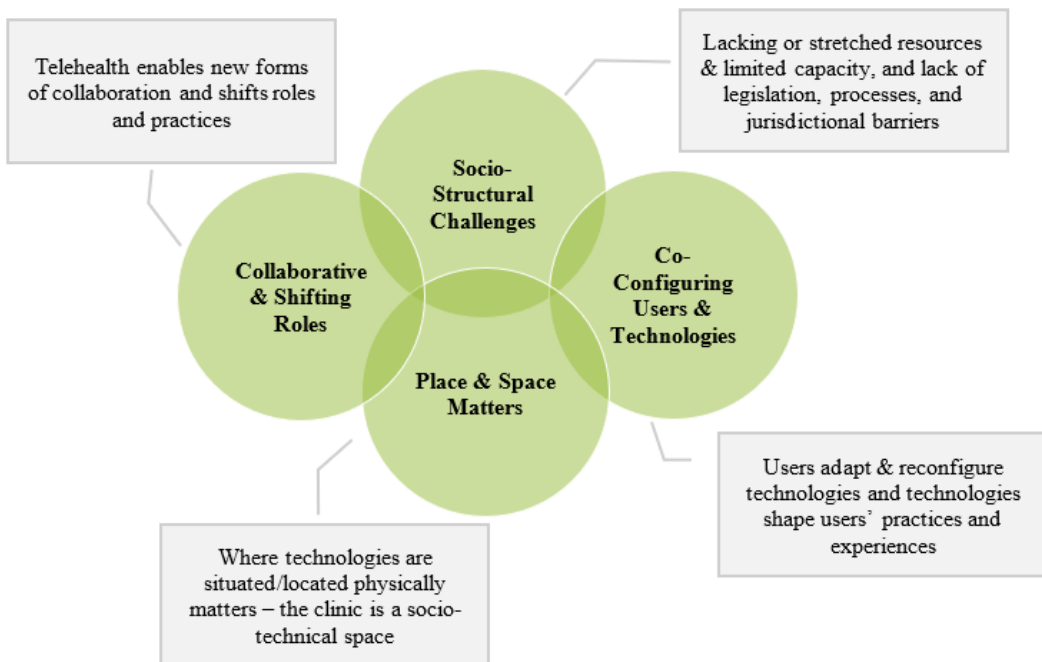


Figure 1: Main Conceptual Themes  
Source: Leader 2020

### *Collaborative and Shifting Roles*

With the introduction of telehealth into the space of the clinic and work practice, the roles of healthcare staff, physicians, and patients and their supports are shifting in new ways promoting collaboration by human (users) and non-human (technologies) actors. This shifting work practice was clearly demonstrated where constant interaction and communication between local

nurses and remotely connected physicians is necessary to facilitate care over telehealth. As one healthcare provider described:

We use Telehealth if for any reason – if the weather’s bad, if we’re not getting a physician. We’ll often use telehealth where the nurse will do the physical assessment, the nurse will be the eyes and hands of the physician, who then will do the rest of the assessment and make decisions based on what we find together.

The nurse’s presence during consultations, while remotely connected with a physician, was viewed as critical. Local nurses serve as the eyes and hands (and legs in the case of using the doc-in-the-box) of the physician by conducting the exams and working with the doctor and patient collaboratively. Here, a nurse on the local side actively provides the hands-on, physical assessment that would previously been the role of the physician in a typical clinical setting. At the same time, the physician observes the patient and works closely with the nurse to make an assessment and they make a care plan together. Using telehealth not only resulted in a role reversal for the nurse and physician, but it also meant that the nurse (acting with and through the technology) was an extension of the “eyes and hands of the doctor”. That is, local nurses act as the physical embodiment of care during telehealth sessions. There were comparable descriptions of the embodied nature of healthcare practice made by both physician and nurse participants.

Patients described how they also play an active role in their own care experiences by positioning their bodies in different ways while using the cameras to locate physical symptoms causing concerns and being more involved in care plans. They also shared how the doctor uses the technology to zoom in the camera to take a closer look. With the audio-visual capability of standard telehealth machines, the screens and cameras play a critical role in presenting images and information as well as the body language and facial expressions of the connected users. Technologies are engaged in the collaborative relationship, not just simply standing in for the individuals presented on the screens, but as a form of digital embodiment. Telehealth technologies are not operating neutrally or separately from their human or social contexts, they are rather actors in the assemblage of various social, cultural, and technical components that adds complexity to the telecare experience. For instance, the audio and video features of the telehealth machines provide visual cues that are viewed as important for promoting effective and clear communication, and relationship building between remotely connected doctors, nurses, or patients. Commenting on the strengths of telehealth, a healthcare staff member described the benefits as follows:

...when we’re coming from such different places, different backgrounds, and cultures even and sometimes over the phone – or especially over an email or over a text – there can be that break in communication. Whereas when you can see someone on the screen, you can kind of see the way their eyebrows move, or you can see how comfortable they’re feeling [...] It gives you those cues that you need. Like, you know I don’t think they’re understanding this, or they seem uncomfortable with this, and it prompts you to try harder, reach deeper and find a solution.

The above comment highlights how the camera is a crucial actor within this space, specifically through its ability to capture facial expressions, gestures, and body language. Compared to non-visual remote care (e.g., audio only), the visual component enables more accurate assessments and improved understanding of patients’ conditions. As described by participants, the ability for physicians to *see* and *hear* patients clearly during consultations was necessary given that much of their work has shifted from hands-on to observing through cameras and screens remotely. Importantly, participants shared how cameras allowed for interactions that created a sense of

familiarity and trust which was culturally necessary and crucial for facilitating healthcare in the context of their Indigenous communities.

The descriptions above demonstrate the important roles that both human and non-human actors play in co-constituting the space of the clinic, and in turn, how telehealthcare practices and experiences are *mutually shaped* by both users and the telehealth technologies. Community insights support the notion that the boundaries between humans and non-humans are shifting and malleable (Latour 1992; Mort et al. 2005; Haraway 2000). As Mort et al. (2005) observes, these boundaries are “temporary, situated, not inevitable or pre-existing” (2036). This idea was reflected by participants who described the shifting roles and collaborative relationships between telehealth users such as the local healthcare staff, patients, families and remote providers, as well as the various technologies including cameras, screens, microphones, and peripherals as taking on more active roles depending on the functionality of the telehealth system. Local and remote providers, technologies, and patients formed a *socio-technical assemblage* that was being (re)constituted within the space of the clinic (Suchman 2007, 2012). This finding supports claims regarding the important role of non-human actors (Latour 1992; Suchman 2007; Barad 2003; Mort et al. 2005) and the relational and performative nature of agency through which embodied interactions reinforce the inseparability of bodies and objects (Dourish 2001; Mol 2002; Lupton 2015).

The theme of *collaborative and shifting roles* goes against the theory that people and technologies are inscribed into a stable series of dualities or scripts (Akrich 1994) that are ultimately unchanging. Because participants understood various the roles to be shifting and contingent depending on how well the technologies were working or the continual communication between local and remote providers, the scripts were never stable. Nurses would take over for the doctor by providing physical touch while the doctor observed and coached them through the technology in a collaborative way. The shifting roles from doctors to nurses and the interaction of the audio-video components of the telehealth system showcase how actors are interconnected as well as continually changing within this space, conceptualized variously as “cyborgs”, “sociomaterial assemblages” or networks of human and non-human “actants” (Suchman 2007; Haraway 2000; Latour 1987, 1991, 1992).

User-technology relations are, therefore, a hybrid of physical and digital embodiment that enables new forms of collaboration and shifts roles and practices through their interactivity or intra-action (Barad 2003). Following Barad’s (2003) concept of *intra-action*, participants’ descriptions of the collaborative and shifting work can be explained as the co-production of work practices that are both relational and performative—that is, action is performed together as an inseparable practice. As described, nurses become the eyes and hands of the physician – representing a shift in roles but also the physical embodiment of the physician that is in collaboration with remotely connected providers and the various technologies-in-use that make up the telehealth system. The relational view of agency is such that it considers how actions are performed together.

### ***Co-Configuration of Users and Technologies***

During interview discussions it was described how telehealth is a collaborative effort between a local on-site facilitator (frequently a nurse) who is involved in setting up and troubleshooting the technologies, remotely connected physician or specialist who typically initiates the sessions by connecting into the telehealth unit, and the telehealth system that connects the dispersed parties through ICTs. Specifically, the telehealth machines’ audio-video components are crucial actors within this space that actively shape users’ experiences and perceived use in enabling (ability to have seamless, real-time discussions) and constraining (technical glitches/delays that interrupt interactions, potential privacy concerns) ways. The importance of visually seeing and hearing during virtual visits was emphasized by patients and healthcare providers for promoting



better communication, building relationships, a sense of familiarity and accuracy in assessments. For instance, a physician described how having access to an advanced dermatoscope device allowed him to look at the skin closer with the peripheral than in person, providing a clearer image for diagnosis: “I had a dermatoscope and I can look at the skin closer, even better than I can in my own clinic because I don’t usually have dermatoscopes, so I’d actually have a better visual.” Enhanced visuality through the dermatoscope configured his use of the system by enabling greater accuracy in his assessments.

At the same time, audio and video communication features must work seamlessly for telehealth to benefit users. When the technologies were not functioning optimally (e.g., delays or glitches that make it difficult to relay information) it was found to disrupt and constrain users’ ability to communicate and use the system. Frequent comments were made regarding low bandwidth speed and power outages (especially in the far north), where limited or lost internet connections impacted video quality or interrupted services entirely. Some participants shared how when they encountered audio and/or video lag in sessions, it was frustrating. However, when the technology worked seamlessly (uninterrupted) it was near equivalent to being there in person. A telehealth coordinator shared:

It has to be seamless basically in order for it to be beneficial, I think. Because if you’re talking to somebody and you get stuck and you’re trying to explain something to your client, then the audio cuts out, and then you know, it’s not good. It has to be seamless.

He continued: “If it’s seamless and they can just communicate with the other person on the other side, they love it.” These comments importantly illustrate how, in order to support telehealth and fill healthcare delivery gaps, reliable digital infrastructure and high-speed connectivity are needed.

The automation of the machines is another aspect that presents both enabling and constraining factors in using telehealth. When sessions automatically start and stop as expected, it increases the smooth functioning of the system. Alternatively, when the sessions did not operate as expected or were interrupted, it was found to pose constraints. More specifically, scheduled sessions that were automated, typically the case for educational sessions across multiple community sites, were viewed as restrictive because sessions were potentially cut off prematurely. These types of sessions are programmed to turn on and off at a pre-set time, which often meant the system would work on its own without human intervention. However, this was seen as limiting the flexibility and use of the system—i.e., organic conversations may be cut short as participants were aware of the scheduled time and would see visible countdown timers on their screens.

In response to a variety of challenges, users tinker with and adapt telehealth technologies, including the related systems and environments they encompass, to work better for their local needs and situated contexts to better improve the ease of use. In some cases, this called for new approaches and modifications, both formally through working with system providers and informally in local spaces. For example, a telehealth coordinator shared that she worked with eHealth Saskatchewan, the main governing body that coordinates electronic health information systems for public health care organizations in the province, to create a modification for their lactation consultant to allow spontaneous consults via telehealth using video software on a laptop:

This was a way to enhance the programming for what she’s doing. Because access to Telehealth is specific [...] she has to check with the site to see if they’re available, it has to be scheduled. It can’t really be spontaneous. So, she needed something that

was...to help with a spontaneous consult with the communities because she's working with all of them. So, this was a solution for that.

She explained that the new software allowed the lactation nurse to easily connect to their telehealth service at any time and place which meant she could avoid scheduling constraints with busy boardrooms (where telehealth suites were typically located) and was able to expand the services provided to communities. This option was created in response to a distinct user need that was not being met which required more flexibility and mobility than what the videoconferencing units were able to provide.

Users also creatively repurposed telehealth spaces and created makeshift solutions to mitigate issues they encountered. For example, a telehealth coordinator explained that the removal of carpet in their telehealth room to meet Occupational Health and Safety (OH&S) requirements resulted in limited soundproofing, and in turn, created explicit privacy concerns:

The whole thing was carpeted and due to OH&S cleaning issues they got rid of the carpet, but never thought 'how are we going to fix this potential noise problem in the doors?' That was my solution. My thought was, can we get these little ... normally [they are] supposed to be like weather stripping where they kind of block drafts and things, and it seems to help a bit.

He described how using unconventional materials, such as weather stripping, helped to reduce sound carrying into the hallways which temporarily created better soundproofing and privacy for clients. Additionally, healthcare providers described instances where they needed to rearrange or move telehealth units to be closer to clinical equipment and computers because they are often located elsewhere, usually in a multi-purpose room not equipped for health consultations. Adjusting the location made it possible to utilize telehealth for consults more easily and efficiently.

Discussions with telehealth users demonstrate that both users and technologies play important roles. Telehealth machines play active roles in configuring users' experiences and use of the system that was meaningfully interpreted by participants as both strengths and barriers. In response to barriers, users actively re-configured technologies, their use of the system and the environment in which they are located, to better support telehealth for their use and situated clinical contexts such as moving telehealth units to another location or coming up with new methods or creative solutions. This is conceptualized as co-configuration or a two-way process of configuring (Mackay et al. 2000; Oudshoorn and Pinch 2005). Co-configuration adapts the STS concept of "configuration", defined by Woolgar (1990) as designers' attempts to "define, enable and constrain" the user or simply put, the process of defining users' identities and actions during the design of technologies. More specifically, telehealthcare practice, and the associated experiences, is a two-way process that is co-produced and co-configured by both users and technologies. As evidenced by this study, users tell their story through adapting and (re)configuring technologies in ways that fit with their community needs; they are not simply passive actors following inscribed protocols and encoded as (non)relevant users in the design of technologies.

In addition, when technologies do not work as intended or users encounter challenges with operating the system that does not meet their needs, they find ways to adapt their use of the system. This creative reconfiguring has been described in the STS literature as tinkering often associated with the invisible work done after technologies are in the hands of the users (Knorr Cetina 1979; 1981; Nutch 1996; Leader 2012; Auld, Snyder, and Henderson 2012; Mol, Moser, and Pols 2010a; Winance 2010). Similarly, Cartwright (2000) points the invisible work that is often done by nurses and healthcare teams who perform tasks in the absence of physicians during telehealth sessions and often become the expert users of the technologies. Building on

this, Star (1999) also examined how infrastructure “becomes visible upon breakdown” pointing to the invisible tasks that would otherwise not be seen. Just as infrastructure becomes visible, when information systems such as telehealth break down, the otherwise invisible tasks and relationships between users and technologies can be seen.

### *Place & Space Matters*

As discussed in the previous sections, where technologies are located and situated physically matters. A critical finding arising from discussions about participants’ experiences was the range of space-related issues from scheduling challenges with multi-purpose rooms, poorly located telehealth units away from clinical equipment, and difficulties in relocating technology due to limited mobility, to privacy concerns with telehealth spaces that are centrally located and lack soundproofing. Without a dedicated space, there are difficulties in accessing telehealth when the rooms are occupied for other purposes. Healthcare providers discussed the physical challenges with moving larger telehealth units to different rooms or floors to be closer to clinical equipment, signaling a distinct oversight in the planning and implementation process with respect to adequately understanding existing space, infrastructure, technical requirements, and community needs for telehealth use. Having more mobile units would increase the ease of use, especially when moving machines where they need to go, and provide more flexibility particularly in emergencies. Increased mobility, as it was the case for the “doc-in-the-box” hand-held remote presence device, means bringing the technology to the patient rather than the patient to the technology.

The notion of *place and space*, matters—for patients using telehealth, being within their community to receive care and having family and language translation supports was important and necessary. Patients commented that telehealth means that they can receive care locally and access services without leaving their community which has several benefits including not having to take time off work or arranging daycare or eldercare. They are in a familiar place with people they know, reduced travel costs and time away from family, connection to the land and place, and availability of cultural and language supports. In many cases, leaving communities for clinical visits was described as stressful and time-consuming, which resulted in patients missing or not taking appointments. For instance, one healthcare provider shared that telehealth removes the stress of leaving the community to access care:

This place is familiar to them. [...] Some people in this community, especially the older population, it's a bit scary for them but when they're with telehealth it's not, because you're still in the same community, you're still in your hometown. [...] It just feels safer for them.

A level of safety was connected to staying within communities for health visits. Moreover, participants described how one of the main benefits of telehealth is the readily available access to language translation, family, and cultural supports.

The *technogeography of care* is a concept within the STS literature that points to the importance of place in connection to technology use – technologies define and are defined by place (Oudshoorn 2012). Nelly Oudshoorn (2011, 2012) describes how place within telecare practice and experience matters such that the locally grounded and situated care acts, in both private and public spaces of care, are important for shaping the implementation and use of telecare technologies as well as how technologies shape those spaces. This concept conceptually links technologies and spatial dimensions to telehealth users’ experiences. Where technologies are located requires careful considerations about users and their interactions in those environments. This work points to how designing culturally safe spaces within telehealth systems are critical and involves in-person and cultural supports that take into consideration

local and situated spaces. Place is an integral part of the telehealth experience. There is also clear evidence that the involvement of communities, patients, and local healthcare providers in decision-making around implementing telehealth is needed given the challenges and unintended consequences related to where telehealth is located.

### ***Socio-Structural Challenges for Telehealth Implementation and Utilization***

Telehealth adoption and utilization in Northern Saskatchewan was slowed down due to lacking resources and personnel to operate these systems during the initial implementation including critical roles such as telehealth coordinators, on-site facilitators, and IT positions. These positions were either under supported and lacking, or not funded, which in turn, created massive gaps in supporting the optimal utilization of these systems. An eHealth advisor described how, if they continue to stretch current resources, “we could be heading for failure” pointing out how northern communities never had the people, processes or supports in place from the start for telehealth to succeed. This undoubtedly challenged implementation from the beginning:

It's been an incremental development over the years. You know, we never had, right at the beginning, everything we needed. This was always piecemeal. [...] eHealth has never been properly funded and resourced [in Saskatchewan] like the other provinces or even the private sector. We're always working on a shoestring.

He shared how the lack of human resources and funding to support critical positions such as telehealth coordinators and IT has been a real challenge for many communities.

Lacking or over-stretched human resources continues to be a chronic issue that results in nurses and healthcare staff wearing multiple hats to ensure telehealth is operating by serving as technical supports. The reliance on healthcare staff stretches available resources and capacity that may not be easily sustained over the long term. As one healthcare manager commented, wearing multiple hats is just part of everyday life in the north:

We are on a remote, northern community, so each staff has multiple roles. Myself and another staff were in charge of getting the Telehealth ready if it's going to be utilized by the nurses, by the patients. [...] you basically have to play different roles to make sure that things are running efficiently.

Without staff taking on multiple roles, it would not have been possible to operate the telehealth system. It was described how, in some cases, taking on multiple roles was necessary when there was a gap in services and a lack of qualified people to fill those roles.

Another healthcare provider shared how she had to serve as an IT technician by troubleshooting the system when the phone lines and internet went down due to limited flights in and out of the community to get a technician on site. She shared how there was a lack of human resources and trained IT personnel in communities to maintain the systems:

So [those are] the kind of technical things that happen in these northern communities that really, really have such a lot of impact on what we do. Not having those trained professionals and trained people. And community members that have the ability and the potential. We could engage our community members to be those people. You know, have SaskTel engage some of our community members to be on-site SaskTel people or IT people. So important.

In this example, she identified that an on-site facilitator is critical for the smooth functioning of telehealth in her community. Importantly, she points out that there are community members that have the ability and potential to be trained to fill those roles for on-site IT support. This

demonstrates that having the proper resources and opportunities for training local people is important for the sustainability of telehealth and community development. Moreover, having on-site support was also viewed as building the capacity to increase telehealth utilization which could go beyond consults for community-driven initiatives – i.e., the creation of support networks for mental health and wellbeing.

Despite these challenges, one of the main factors enabling telehealth in the north has overwhelmingly been the willingness of people and communities to work together. Alongside this, informal cross-community partnerships have helped to foster access and build education/training opportunities and networks of support for the purpose of troubleshooting technical issues. It was found that healthcare teams across communities frequently work together to support one another in response to limited resources and to address technical issues and recurrent problems. Although collaboration has been central to mitigating barriers and to ensure telehealth operation and use, ongoing barriers and structural constraints exist that remain problematic for sustaining telehealth over the long-term. Challenges related to resourcing, policy, and technology design and integration must be addressed for telehealth to succeed. More critical is the need for community involvement in decision-making and ensuring that technologies and resources match communities' needs for driving long-term success.

## Discussion

This article examined telehealth experiences from the perspective of Northern Saskatchewan community members, demonstrating that users and technologies mutually shape telehealthcare practices and care experiences in new ways through embodied interactions. Analysis revealed the complex coordination and co-configuration of users and technologies that make up the *socio-technical assemblage*—technologies shape patients' and local/remote providers' use of the telehealth system in enabling and constraining ways and users (re)configure technologies. Specifically, users *tinker* with technologies to address issues and create solutions that work better for their needs and local contexts. Further, where technologies are situated and located physically matters within the context of telehealthcare forming new socio-technical spaces of care that could be conceptualized as *technogeographies of care*. Socio-structural challenges shine a light on the broader issues that shape the implementation and utilization of telehealth, the technologies, and spaces in which they are located, along with human and financial resources that impact its long-term ability to support telehealthcare.

STS theoretical concepts offer new ways to better understand how telehealth users experience technical systems and draw attention to the importance of place and space and the role of both users and technologies in shaping telehealthcare practice. Specifically, concepts such as “sociotechnical assemblages” (Suchman 2007), “intra-action” (Barad 2003), “co-configuration” (Oudshoorn and Pinch 2005), “tinkering” (Knorr Cetina 1979, 1981; Mol, Moser, and Pols 2010b; Winance 2010), “embodied interaction” (Dourish 2001) and the “technogeography of care” (Oudshoorn 2012), are identified as promising conceptual tools for examining telehealth use in Indigenous communities. Such concepts move beyond Westernized views of technology highlighting the fluid, relational, and interconnectedness between humans and non-humans. Further, the four conceptual themes of *Collaborative and Shifting Roles, Co-Configuring Users and Technologies, Place and Space Matters, and Socio-Structural Challenges for Telehealth Implementation and Utilization* provide valuable insights into telehealth use in Northern Saskatchewan and creates space for multiple ways of knowing from the perspectives of Indigenous communities.

A mutual shaping lens provides a depth of insight into the relational and performative nature of socio-technical agency by showing how people, places, and technologies contribute to and mutually shape the socio-technical space of the clinic. This work points to the social and human factors that are shaping technology use including how they are designed, implemented,

(re)configured during use in their community contexts, and conversely, how technological and spatial factors are also shaping healthcare practices and the meanings associated with these socio-technical spaces. Exploring these factors enables us to reconsider the notion that telehealth is simply a tool to augment and enhance healthcare services in communities, but rather, it is part of a larger socio-technical assemblage enacted by multiple actors and is context specific. It is argued here, and elsewhere (Leader 2020) that examining the specific context in which telehealth technologies are situated and experienced will be increasingly necessary, and in some cases, critical to ensuring success as these systems play greater roles in our healthcare system and the delivery of care. Successful implementation of telehealth programs in northern and remote settings is contingent upon understanding cultural and community contexts as well as multiple factors including technical, social, and organizational considerations at the individual, community, and system levels.

### ***Limitations & Future Work***

While this research contributes to the telehealth and STS literature in locally specific ways with insights into the context of telehealth use in Northern Saskatchewan, future studies could expand the scope to a national study examining communities across northern Canada more broadly rather than being limited provincially. One hurdle for a larger study would be dealing with the large amount of data produced from this type of in-depth qualitative study. Future research would benefit from examining telehealth use over a longer time frame and with focused observational studies to assess long-term use, disruptions, and shifts in telehealthcare practice. Given that this study was pre-pandemic, much has changed since the original data collection, pointing to the ever-changing nature of telehealth and the need for future work in understanding pandemic shifts.

## **Conclusion**

### ***Implications & Recommendations***

Overall, the empirical results presented in this article contribute to a better understanding of user-technology relations in the context of Northern and remote Saskatchewan communities. Specifically, this work extends prior work on telehealth by drawing attention to the user-technology interface against the backdrop of the rural-urban (and north-south) divide. By focusing on the context of community telehealth use, the goal of this research was to magnify and uncover the intersections between users' experiences and technical artifacts in their everyday use. This work highlights the need to closely examine users' perspectives and experiences of technologies within the context they are used and experienced.

Community insights provide several recommendations for improved telehealth implementation and utilization including the need for long-term funding for critical staff such as telehealth coordinators, on-site facilitators, and IT staff who implement and maintain telehealth, and access to reliable and robust digital infrastructure for connectivity needed to support telehealth. Implications of this work include the ongoing need for assessing community capacity, infrastructure, and resources as telehealth evolves as well as in the context of other healthcare information technologies. For instance, recent shifts towards home-based virtual care models that have emerged during the COVID-19 pandemic could mean the eventual phasing out of traditional telehealth models. Given the importance of access for remote health, one key issue associated with this shift would be potential gaps in access for homes that either do not have internet connectivity, poor or unreliable broadband infrastructure, or high-quality hardware to ensure quality care can be accessed. Further, this study identified the critical role of local providers (nurses and clinic staff) and telehealth coordinators in creating culturally safe spaces,

providing language supports and improved familiarity with the systems and processes. If a home-based virtual care models is adopted, there could be additional issues with navigating this new mode of delivery with fewer resources and supports. Care in understanding the community context will be necessary for future remote care models. Of critical importance is the need to involve communities in the decision-making process to drive the design and implementation of telehealth, along with matching technologies to community needs with considerations for space, privacy, and mobility. A key recommendation is the development of a long-term telehealth strategy that is driven by communities and knowledge users (eHealth Advisors and Telehealth Coordinators) who are working directly with communities to ensure Indigenous interests and priorities are at the forefront. Involving communities early on in the development and planning process will be critical to the success of telehealth and future iterations of healthcare technologies.

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