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REGULAR PAPER

Anticipating Technology-Enabled Care at home

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Abstract

The spread and growth of ubiquitous smart technology to deliver public health outcomes, particularly within/at home, urgently requires greater scholarly attention. This paper uses data from interviews with professionals in Scotland who are designing and implementing Technology-Enabled Care (TEC) for current and future homes. Theoretically informed by both critical geographies of home and futures scholarship, this paper presents a three-part framework – "homes-that-are," "homes-that-ought," and "homes-to-be" – to explore the techno-solutionist accounts of home, bringing to bear the messiness and complexity of home, both its conceptualisation and experience. It highlights prediction as an emerging form of anticipatory practice, generating new questions and conceptualisations about the openness of futures. Moreover, it demonstrates the importance of understanding the underlying assumptions of those who make decisions when planning for future TEC and housing; about who they imagine they are planning for, and how diverse these futures are.

KEYWORDS

futures, healthcare, home, Scotland, technology

1 | INTRODUCTION

> If we could get to the stage where the house could say Betsy's taking an hour to get dressed in the morning, this is far too long, she needs somebody to go and help her, without her having to go and make a fuss about it, that's where I would want to be. (Housing Professional 1)

Home is a well-established area of geographical scholarship (Blunt & Dowling, 2006; Brickell, 2012; Ellsworth-Krebs et al., 2015; Gibas, 2019; Reid et al., 2010), a theoretical concept and an experience, loaded with desirable, problematic, complex, and multiple dimensions. Home is central to our quotidian experiences, imagined and real, is simultaneously where we spend vast amounts of time, and where we think about spending time in the future, our "home-to-be" (Gibas, 2019). Home is thus "an irreplaceable centre of significance" (Relph, 1976, p. 39), but of course not always in a positive way. Critical geographies of home scholarship is rich with insight, but has yet to substantively engage with smart technologies, particularly new, digital, forms of Technology-Enabled Care (TEC), and how such future homes are imagined. For example, this morning when you were in front of the bathroom mirror brushing your teeth, you could have been measuring your cardiovascular health using an optical sensor embedded in the mirror (monitoring your skin colour and blood flow). In January 2018, Google submitted a patent to develop such technology. With

new "smart" technology, homes are increasingly being viewed and used as sites of healthcare, or mini-hospitals. But what does this mean for our homes, how we live in them, and how this may change in the future? Specifically, how are these futures anticipated, and by whom? The importance of considering the normative and political assumptions around TEC for homes, to understand how they are designed and made, implemented, experienced, adapted, and/or rejected, is therefore an urgent task given unprecedented global efforts to enable phenomena such as aging-in-place and technology-enabled self-care (Petrakaki et al., 2018).

There is a trend towards TEC across the world, accelerated by COVID-19 (Bendahan et al., 2020). From home monitoring of cardiac devices in the USA (Miller et al., 2021), care of cancer patients in Israel (Kaye et al., 2020), management of Parkinson's disease in Spain (Luis-Martinez et al., 2020), to development of social robots (Pendersen et al., 2018), these trends present important consequences for how we might conceive of and experience home now, and in the future. These global trends suggest movement in the imaginaries of home and care (Pasveer et al., 2020), and how ideas of home may co-evolve with understandings of the future. By exploring the experience of healthcare and housing professionals in Scotland, this paper aims to provide a theoretically informed account of the complexity and contingency of anticipatory practices which make the future present in homes.

TEC is defined as "where outcomes for individuals in home or community settings are improved through the application of technology as an integral part of quality, cost effective care and support" (TEC Scotland, 2020, n.p.), and includes, for example, telehealth, telecare, and telemedicine, much of which takes place at home. In this paper, TEC at home is explored via a three-part conceptual framework – "homes-that-are," "homes-to-be," and "homes-that-ought," to understand the configurations of home meanings and their relationality with notions of (in)/(inter)dependence over time. In the latter, I introduce prediction, a novel way to develop Anderson's (2010) triumvirate of precaution, pre-emption, and preparedness. A focus on prediction enables recognition of what digitalisation and machine learning makes possible in the context of TEC, generating new questions and conceptualisations about the openness of futures, and therefore of home.

The findings have relevance beyond health and social care, by exploring notions of home, how these are co-constructed with ideas of the future, specifically ideals around prediction, and what this means for how homes of the future are made real. Moreover, the paper underlines the importance of understanding who makes decisions when planning for future TEC and housing, their underlying assumptions about who they imagine they are planning for, and how diverse these futures are – debates of global relevance given our ageing population and pressure on healthcare systems.

2 | HOME-ING IN ON THE FUTURE: THE ANTICIPATED ROLE OF TEC

2.1 | Home-ing in on TEC

The desire for efficient solutions that encourage greater patient independence and cost-savings for public health, largely driven by the neoliberal agenda (Kong & Woods, 2018), has materialised in several generations of healthcare technology developed for use in the home. Geographers have examined how neoliberalism, individualism, and commodification (Hall, 2011) have been "shifting landscapes of care provision" (Power & Hall, 2018, p. 308) and the role of technologies in institutionalising homes has been highlighted (Dyck et al., 2005). What is becoming increasingly clear is that the design and implementation of smart technologies for healthcare are imbued with particular expectations:

> Smart technologies have been embraced as a means of enabling eldercare [and other forms of care, e.g., for people with chronic conditions or disabilities] in most cost-effective, and less resource-intensive ways, yet they have primarily been understood from the functionalist perspectives of engineers and information scientists. (Kong & Woods, 2018, p. 1)

For instance, the Internet of Things (IoT) and rise in automation promises the revolution of domestic life, whether that is via smart fridges that can monitor and manage their contents, vacuum cleaners that can be operated remotely, or mirrors that can monitor and report cardiovascular health, saving trips to the doctor.

Such technological solutionism is closely related to reductionist approaches "underpinned by an understanding of human action where people act in rational ways and technologies determine particular courses of action" (Strengers, 2013, p. 61). Likewise, this ontology is visible in discussions on digital data that concentrate on personal rather than interpersonal data (Goulden et al., 2018), presuming that we are atomised agents. As Kong and Woods (2018) highlight, the principle of homogenisation infiltrates many assumptions around smart technologies: "that the problems and processes that they help to resolve can be resolved in the same way, every (and any) time, every (and any) where" (Kong & Woods, 2018, p. 2). The way people

"appropriate" technologies for alternative purposes than intended by designers (Hand & Shove, 2004) helps to emphasise the importance of understanding what objects, technologies, infrastructures, and data make possible, rather than what they are. Work on energy smart homes, in particular, demonstrates how an understanding of everyday life, and of the home, can be employed to bring richer and more sophisticated understandings of how and why households desire and live with particular types of technologies (Hargreaves et al., 2018; Shove, 2010; Strengers, 2016). Moreover, emerging evidence during COVID-19 (Reid, 2021) suggests that consumer devices such as voice assistants (Alexa, Echo, Siri) and other devices (Hive) are being re-appropriated to enable care from afar, reducing or replacing in-person home visits.

While TEC relates to an array of technologies, predominantly telecare (personal alarms, bed mats, fall detectors), telehealth (devices to monitor vital signs at home), and telemedicine (video conferencing a consultant) that are not necessarily digital or "smart," these technologies are increasingly so. For instance, in Scotland, the analogue telecare system is currently being switched over to digital as British Telecom shift to digital services by 2025, and discussions are ongoing about how to develop national digital infrastructure to better deliver health services more broadly (e.g., patient records, video consulting). This phenomenon has dramatically accelerated in pace following COVID-19, with reports by organisations such as the Nuffield Trust (2020) and British Medical Association (2020) providing some sense of this urgent uptake. Even prior to COVID-19, the transition to increasingly digitised environments had led to lively critical debates examining the role of digital data in everyday lives and social institutions (Kitchin, 2014; Ruppert et al., 2017), leading to discussions around the ethics of data gathering and use (Lupton, 2018), specifically, the increase of "dataveillance" (Maalsen & Sadowski, 2019). Such literatures have highlighted that "how people live with their data – is often ignored" (Lupton, 2018, p. 3). For instance, interesting debates around the "quantified self," about self-tracking using devices such as smart watches, and how this relates to the discipline of the self (e.g., being active, fit etc.) have also arisen (Lupton, 2018; Petrakaki et al., 2018) and are applicable in domestic spaces as they take place at home. With COVID-19 and the necessity to "shelter-in-place" (Reid, 2021), the domestic TEC agenda, what it means for lived experience, and for ideas of home, is even more urgent to understand.

Neglect of the lived experience of TEC interventions for the individual householder and their sharer/carer has been a particular oversight (Goulden et al., 2018; Hine, 2019; Marikyan et al., 2019), and how these interventions are designed, made, and implemented by different professionals is also not well understood. A dominant focus within research around TEC has been the potential benefits of continued home-living for older people, such as maintaining social relations, independence, and autonomy (Gitlin et al., 2006; Hillcoat-Nalletamby & Ogg, 2014). Indeed, ageing, or progressive impairment/cognitive decline, has been central to the narrative of TEC at home, often to the detriment of other intersectionalities, which has obvious cultural and societal implications for inequality. Moreover, such work has been limited in investigations of how networks of/for care are affected. This is particularly pertinent given COVID-19 and risks of visiting in-person at home. Indeed, new digital TEC practices may expose people and their caring networks in ways that are beyond their control (Ball, 2009), causing them to reconfigure their relationships with each other and with the home (cf. Ball et al., 2016; Di Domenico & Ball, 2011). These gaps in knowledge are critical to address when attempting to intervene in homes with the development and use of new smart healthcare technologies, and how they are informed by ideas of future healthcare and homes-to-be.

2.2 | Back to the future: anticipation

The future has been recognised as an often "taken-for-granted category" (Anderson, 2010, p. 778), one deserving of interrogation given that "the experience of the presence of certain futures is used to demand, justify and legitimate certain forms of action to secure life (including inaction)" (Anderson, 2010, p. 787). There has been widespread recognition that different representations, practices, and logics of the future are performative, that they contribute to the production and reproduction of social reality (Konrad et al., 2017), or they serve to define and maintain normativities. There has been a proliferation in conceptualisations of anticipation as part of futuring scholarship, but common to each is some assessment of likelihood of (in)action, the affects and effects of (in)action, the types of actors/action involved, and the relationality of past, present, and future phenomena.

Work in geography has explored the differing logics of anticipation, using precaution, pre-emption, and preparedness as concepts to understand a variety of futures (Anderson, 2010). This has been complemented by Science and Technology Studies (STS), which has dominated in studies of the future across social sciences more broadly and developed ways of thinking about the future via the anticipatory concepts of expectations, visions, and imaginaries (Konrad et al., 2017). While it is important to recognise that all these anticipatory concepts are themselves dynamic and not without challenge, these constructions have been central in discussions of the future, and of how the relationship between the past, present, and future are conceptualised. Critically, they differ in what type of phenomenon the anticipatory concept co-evolves with. For instance, consideration of anticipatory practices has been dominated by high-profile (often events with catastrophic consequences), systemic threats such as

climate change, terrorism, bio-politics, and epidemics to deal with fundamental questions such as "what life is to be protected or saved, by whom, and with what effects. And, conversely, what life has been abandoned or destroyed, by whom, and with what effects" (Anderson, 2010, p. 788).

More recently, and perhaps in reaction to a focus on global and/or national matters of significance, attention has moved to explore the idea of "lived" futures, and the opening-up of intersectionality. For instance, Groves has highlighted the necessity of exploring the "multiplicity of lived experiences of place and community, interpreting potential futures through histories told at various levels" (2017, p. 35). Likewise, Kinsley (2012) distinguishes between anticipatory knowledges which happen *to* us, or *for* us, creating discussions about for whom anticipatory knowledges are important. Such contributions helpfully recognise the fluid and dynamic nature of anticipation and that "the diagram of lived futures is spiral and fractal, rather than linear" (Groves, 2017, p. 35). Relatedly, scholarship on social practices (Shove, 2010) and new materialities (Puig de la Bellacasa, 2011) have demonstrated the importance of repeated mundane everyday activities and how those combine to have significant effect. Indeed, Nettleton et al. (2018a, p. 1157) suggest that futures scholarship has overlooked the mundane and consequently a focus on domestic routines and homes as they are now and are perceived to be in the future will add new perspectives to futures scholarship.

Together, the geographical and STS scholarship emphasise the importance of anticipatory practices. Anticipatory practices are fundamental in the way that TEC is designed and installed, based on an understanding of future homes, home lives, and domestic and caring practices. Broadly, futures scholarship encourages us to investigate how current (home-making) practices co-evolve with ideals of the future, and the material impact of these understandings. This makes ideas of prediction – prevalent as a theme within TEC and aspirations for healthcare technologies – an interesting logic of anticipation to explore further, not least because of the potential reliance of TEC systems and devices on machine learning algorithms, which are poised to replace human intervention. Attention to prediction in this paper is a key contribution I hope to make to both futures and critical geographies of home scholarship.

3 | EXPLORING FUTURE TECHNOLOGY-ENABLED CARE HOMES IN SCOTLAND

Launched in late 2014, the TEC Programme is a Scotland-wide initiative overseen by the Scottish Government, "designed to significantly increase citizen choice and control in health, well-being and care services" with the ambition "to place Scotland at the forefront of innovative approaches to technology enabled care." It coincided with the Public Bodies (Joint Working) (Scotland) Act 2014, which required local authorities and health boards to jointly prepare an integration scheme. There are currently 31 health and social care partnerships across Scotland, managing £9 million of health and social care budgets. These developments were a response to recognition that people are living longer, healthier lives but that a growing number have complex care requirements. The TEC programme in Scotland reflects that expectations around services are changing. One of the challenges of delivering TEC surrounds general health inequalities and health inequalities are a concern in Scotland (Craig & Robinson, 2019); those who experience health inequalities are more likely to be digitally excluded, potentially increasing inequality. The availability of a workforce to drive a programme of work and the often remote and rural geographies of Scotland create additional challenges for service delivery compared with the rest of the UK. To give some sense of track record in this area, it is worth noting, however, that Scotland received the award of "4-star Reference Site" status by the European Commission's Innovation Partnership for Active & Healthy Ageing in December 2016. This is the highest standard under the system, awarded to only 8 of 74 sites reviewed by the scheme (Scottish Government, 2018).

Participants in this study represented institutions that govern, design, implement, and evaluate healthcare technologies for homes. They came from an array of professions, for instance, clinicians, policy makers (national and local levels), employees of non-departmental public bodies,[1] local authority care managers, allied health professionals, occupational therapists, carers, housing association officers, care charities or charities that promote in-home healthcare technologies, software developers, and analysts. Participants had differing levels of seniority, from directors with responsibilities for delivering national policies and those with responsibilities for the management and direction of their own institutions (e.g., NHS innovation, housing association boards, charities), to those managing and delivering care every day, allied health professionals, and carers.

Interviews were the dominant method of enquiry (26 were conducted), with one additional focus group (five participants) when it was more expedient for the participants (i.e., it coincided with a team meeting). This paper draws on material from the interviews and the focus group. Themes for the interviews and focus groups included: the multiple visions and versions of "health smart homes;" the diversity of technological devices and preferences towards these; and the extent to which professionals consider the impact of these technologies on attachment to and meanings of home.

The data were explored using thematic analysis to identify participants' ideas of home (current and future) and the role that TEC may play in homes of the future. The analysis investigated both individual narratives and shared perspectives between and across the whole sample (e.g., according to TEC device and their professional background). Indeed, and as will be reflected in the following discussion, that the participants were drawn from different sectors mattered little to their ideas of home (e.g., there was no clear difference in enthusiasm according to sector). Some participants had multiple professional identities, for instance original training as an allied health professional but had moved into policymaking with experience in different services (e.g., care and housing). In reporting data in this paper, the participant's current role is used as an identifier. Ethical approval was awarded by the University.

The remainder of the paper explores how these participants conceived of home. Section 3.1 explores homes-that-are, commenting on the stability and persistence of ontological security, the tensions around this, and the paradoxical ways in which participants felt this may change in the future. Moving on in section 3.2, I adopt Gibas' (2019) term of homes-to-be to reveal how participants imagined future homes in light of TEC, specifically the types of people, "the being," and nature of social relations expected. Finally, in section 3.3, homes-that-ought, I explore what types of homes or practices of everyday life are valued and the constitutive role that prediction may play.

3.1 | Homes that are: the stability of ontological security

As highlighted in section 2, academic scholarship has attended to the plurality of meanings around home: fluid, performed, embodied – emerging from practices rather than an object, attempting to move beyond phenomenological accounts of home (Gibas, 2019), and interrogating their socio-material relations (Lupton, 2018). Such scholarship has challenged the supremacy of ontological security (one's ability to have autonomy and control in order to maintain continuity in their lives) in questioning notions of stability and fixity, just as can be seen in work on futures. In this section, I explore notions of ontological security, particularly the contingencies and paradoxes therein, and how they were anticipated to change in the future. In doing so, ideals related to ontological security, specifically independence and empowerment, are reflected on.

Participants' conceptualisation of what home means to them were reliant on dominant personal norms of home as a place of safety, stability, and retreat, reiterating core concerns of debates in ontological security; "I'm going to give you a personal answer, I think it's a haven, for me a home is a haven, it's somewhere you feel secure and safe and happy and it's somewhere that is personal to you" (Allied Health Professional 1). Such comments were expressed by nearly all of the participants: "I feel safe and secure in my home and when I shut the front door, I know it's just me and I can bounce around in my pyjamas or whatever I want to do" (Housing Professional 2). Such expressions were irrespective of their organisation, level of job responsibility, and background, and based on very personal reflections as the quotes demonstrate. Notions of safety, and the desire to encourage independence and empowerment, were key outcomes highlighted and repeatedly expressed by all participants throughout the data collection. These outcomes are also valorised in policy documents around TEC; "these services use technology to support people to live safely and independently in their own homes" (NHS Inform, 2020). For instance, participants talked about devices as delivering independence:

> I think when you come from an OT background it doesn't matter to me whether it's an Alexa or whether it's a stair lift, it's about, what does that give, in an activity of daily living, what independence does that give an individual to be able to fulfil that themselves, so it's them doing for themselves rather than others doing it to them and I think that does stand you in good stead. (Occupational Therapist)

Other participants highlighted the role of policy in creating the outcome of independence:

> In Scotland we've got a National Digital Health & Care Strategy which is quite clear about providing more choice and empowerment to citizens to manage their own health and well-being and support them in their own homes and communities. (Policy maker 2)

Independence and empowerment were remarked on by all participants as being among the most important outcomes in the context of home. The desire for independence at home is not a new political project and the focus on individualisation and individual responsibility for self-care (Lupton, 2018) has been recognised as a product of neoliberal choice-based notions of governance (Power & Hall, 2018). While none of the participants problematised notions of independence, the paradox that TEC may create new

dependencies was reflected on. To demonstrate this, many participants used a well-known phenomenon of householders frequently pressing a call alarm because they are lonely and want someone to talk to, rather than because there is an emergency:

> The telecare service in Edinburgh is an emergency service that has nearly 10,000 clients that use the service in the city. Last year it took half a million calls, but we've seen a significant increase in telecare services around people who just want to talk, they want to have contact with a human being. It's not necessarily an emergency but they're lonely. (Policy maker 1)

While almost all discussions of this nature surrounded telecare alarms, there was recognition that a similar phenomenon could apply to other types of alarms and devices, generating new, or different dependencies. Not just dependencies for the individual, but the wider social care system:

> If a telecare service in Scotland has a particular manufacturer's alarm receiving centre, that's the platform that takes the calls, we can only then purchase peripheral equipment from that single manufacturer. So, systems are kind of locked down. (Policy maker 1)

The fragility or precarity of dependencies was often reflected on, particularly in relation to the digital switchover of telecare and the efforts to build a national infrastructure for better connectivity. Recognition of the internet as "the fourth utility" (Policy maker 2) was common to all interviews. The centrality and importance of a good connection was a basic need in Maslow's hierarchy:

> So that's the bottom of the pyramid now, so this whole building on that. And that is true to a certain extent, because if you're not digitally connected you can't connect to your home in different ways, you can't connect to the heating in your home, you can't connect to paying your bills, to benefits, to welfare support. (Researcher 1)

Participants identified a range of different types of dependence, perceived to threaten or undermine ideals around independence and empowerment, revealing that decision-making related to TEC in Scotland continues to be explicitly driven by the desire to enable independence and empowerment. Thus, if we accept that discussions of the future are driven by an aim or ambition "to support tasks in the world as we understand it now, rather than imagine anything radically different" (Kinsley, 2012, p. 156), then independence and empowerment will remain key outcomes considered when planning for technology-enabled homes.

Yet, just as discussions of independence bring to the fore discussions of dependence, they also relate to notions of interdependence, which was not raised by participants. In studies of home, particularly smart homes literature, ideas of the home as a place that is shared, where data are co-created between carers and those who share the home, has been an important one (cf. Goulden et al., 2018; Hine, 2019):

> As humans, we are not so much independent or interdependent. All of us depend on others, and on various support systems, including increasingly technological systems, for our lives. This is immediately applicable as a corrective to the recurrent strain in work on robotics, intelligent systems, and other technology that puts a strong emphasis on and often valorizes autonomy. (Goggin, 2019, p. 2764)

The goal of achieving independence for householders is only possible because of interdependencies with other people, norms, meanings, devices, infrastructure, and other materialities. Yet the notion of interdependence was not explicitly raised by participants; independence was key, and any sense of dependence or interdependence was not desirable. Attention to interdependence reflects work within geography and STS on material culture and the burgeoning scholarship on new materialities (Benett, 2010; Lupton, 2018; Smith & Reid, 2018), which has revealed the meaning-making processes of socio-material relations and their affects.

One of the ways in which interdependence was implicitly acknowledged was when participant accounts related to the creation of homes that could be flexible and adaptable, allowing them to change over time in accordance with the householder's needs. However, this interdependence was desirable only when it created conditions for independence:

> We think about houses or our physical environments as a fixed asset or a fixed thing that never changes over time, I mean we change wallpaper when it goes out of fashion, we change carpets whey they become worn. I don't see why a house shouldn't be flexible in the same way [to suit our changing healthcare needs]. (Data professional)

Likewise:

> I was doing a ward round yesterday and we're waiting for patients' homes to be fitted out … the accommodation is not suitable, so in the future I'd like the design aspect and the commissioning aspect to think about this from the very start, that it's almost normal business. (Consultant Clinician)

Material flexibility in the building design or fabric was key for how participants felt independence may be achieved in the future, but implicitly signalled the importance of *inter*dependence. Moreover, participants highlighted interactivity, or the ability to link up different devices (off-the-shelf consumer kit as well as commissioned devices) in a "smart" home, as desirable:

> What's really interesting is how stuff that is commercially available to everybody is and can be adapted to help people supporting independence, and I think that's where the Smart house shows really well, Alexa, mobile phone technology which is so powerful; we have to get better at embracing what's already out there and adapting to what we need rather than just saying here's the bog standard kit that we all buy and you know within a year it's obsolete. (Allied Healthcare Professional 2)

Relatedly, participants stressed that any of these interventions ought to be unobtrusive, "When I need these devices, I think probably one of the most important things is they need to be relatively unobtrusive, also you'd have to decide whether you wanted to opt in to being continuously monitored or not" (Clinician GP). This was important to avoid being stigmatising:

> We tried to make it just look like a normal house but it has all of these things embedded within it and I suppose the overarching message with all of that was that this move towards housing for an aging population isn't about you know housing for the over 65s which is advertised around the place, it is just good homes, just good design. (Housing Professional 3)

Despite independence being explicitly lauded as the key outcome for TEC at home, participants' accounts revealed the importance of interdependence of devices, data, meanings, practices, skills, and their interactions over time, giving rise to dynamic, flexible, appropriate, and adaptable homes. Discussions of interdependence should therefore be given more consideration in planning for TEC at home.

In this section I have sought to reveal how homes are differently anticipated through time, with homes of the present tied to dominant norms of ontological security as places of safety, security, and control, and these ideas becoming more fluid as temporal horizons extend into the future. Underpinning both current and future homes were dominant ideas of independence and empowerment, anticipated to be operationalised differently through time. I also identified the importance of interdependence, which was not expressed as an explicit goal for participants, and the need to investigate this to challenge notions of ontological security. Together these discussions bring into question the issue of temporality in homes and futures scholarship, encouraging us to consider how notions of stability may change. Although others, such as Gibas (2019), have sought to explore the contradictions between home as place to be rooted and ontological security enacted, while simultaneously being temporary and translatable, scholarship on home more generally has yet to engage with futures scholarship and specific logics of anticipation. Indeed, whose anticipation is an important aspect to consider, and in the next section I move on to explore questions of social distribution and inequalities of technologies by discussing the "being" at the centre of TEC homes.

3.2 | Homes-to-be: the "being" of socio-material environments

Critical geographies of home literature has highlighted the importance of understanding the multiplicity of lived experiences (Blunt & Dowling, 2006; Brickell, 2012; Gibas, 2019; Hine, 2019; Reid et al., 2010) and of everyday, domestic routines and practices (Shove, 2010; Strengers, 2013). So too has futures scholarship, with Groves (2017) emphasising the importance of lived futures to encourage consideration of the way in which futures can be implicit and the meaning of such experiences understood. Groves encourages us think about the material and more-than-humanness of experience to help explain what types of futures are conceivable, something that could be more clearly articulated in critical geographies of home scholarship. In this section I therefore explore what type of "being" in TEC homes was imagined by participants, why, and how that may change over time as part of how the nature of homes and care in the future is anticipated.

Scholarship on smart homes has highlighted how "ideal" expectations of future energy users and the attributes of future energy systems are "literally and materially scripted into" these energy systems (Delina & Janetos, 2018, p. 2, quoting Borup et al., 2006, pp. 287–8), suggesting that how we anticipate the future is in part related to who we anticipate being in the future. Ageing, and notions of progressive impairment (whether cognitive or physical), is central to narratives around TEC, and how older people are imagined. Certainly, older people were key anticipated beneficiaries of TEC at home:

> They want to do it to stop all the old dears going into hospital and getting hospital-acquired infections and such like when frankly they could stay at home and have diagnostics at home. For example, by sticking your finger into a blood pressure thing it could measure all sorts of other things at the same time and that data can be gathered, fired back to the hospital, reviewed by a clinician who can then go, "No we're not bringing 98-year-old Mrs What's-her-name in for a urine test, you can do it at home and you can treat her at home." (NHS manager)

The emphasis on ageing is also reflected in academic literature on TEC more generally (Kong & Woods, 2018) and not unique to TEC in Scotland. However, one participant questioned dominant ideas of who or what constitutes an older person:

> Our image of care is our image of our grandparents and I continually have to remind people that the average age of a person in a care home today is somebody who probably went on civil rights marches in the 1960s and early 1970s, it's not somebody who's listening to Vera Lynn, it's somebody who grew up with the Beatles and the Rolling Stones and people like that. (Charity professional)

Contradictions in the participants' accounts, for example, in the proceeding quote about "old dears," or via use of "vintage" names to describe those individuals they refer to, such as "Betsy" in the opening of the paper, reveal a persistence in the imagining of TEC for older people.

Despite this, participants reflected that while early iterations of policy or housing interventions around TEC had been focused on older people and ageing, this was evolving:

> A lot of our focus was on older people and adults in their 50/60s with long-term conditions. So we're doing some work with people aged between 13 and 25 on their views around how they would want their health and care to be delivered. (Policy maker 2)

As were ideas about who may want to live in TEC homes:

> We thought initially, they [the homes] were designed for older people and that's what we anticipated when we set up the evaluation; it was going to be a homogenous group of older people. That wasn't who applied to live in the homes, so we ended up with a very mixed group. A lot of younger people ended up in those homes. (Researcher 2)

These quotes reflect changing conceptualisations of who is imagined in TEC homes; previously TEC was envisaged for older people, although more diverse (e.g., younger) people were being imagined. Who TEC homes were being imagined for was also discussed in other ways. For instance, one participant in particular was critical when considering who was being imagined in the roll-out of TEC across homes in Scotland, reflecting that many of the early pilot schemes for "smart" housing:

> Tend to self-select a nice little group of patients to work with so you know, they are not working with somebody living in a council flat with no carpet, no furniture, no cooker or you know somebody living in a squalid bedsit when they don't have their wheelchair because it broke six months ago and nobody has replaced it for them yet. (Policy maker 3)

Similar biases have been discussed in critical disabilities studies, finding that a lack of diversity in the people shaping the political and policy agendas helps to deliver interventions that implicitly target specific groups in society (Ellis et al., 2019; Goggin, 2019; Goodley, 2013). Throughout the interview, Policy maker 3 struggled to reconcile the promise of a magical device or "technical" intervention in the face of poverty and inequality, as did a GP, who remarked that

> The people that need it [the TEC] the most are probably dead by the time they're 75 because they're in very deprived communities, so average life expectancy across the road is 12 years less than it is two miles down the road in the country, so the average life expectancy is about 70 in our more deprived schemes, so they wouldn't even get to the

> technology bit. So I suppose what, we set an age banding at the moment but that might not be the best thing looking at, I think you'd have to adjust that for deprivation and also for overall accumulative disease burden, so if somebody's in their forties they've got diabetes, they've had a stroke and they're developing arthritis, biologically they're aged 60 or 70 but they're 40 years old, and are they able to use technology, are they able to use technology as well or not. (Clinician GP)

While these two quotes are profound, only one participant, Policy maker 3, was consistently vocal on the aspect of inequality and the potential for it perpetuating existing conditions, with almost all the other participants viewing TEC at home as a "technology-for-good," if carefully managed to address potential limitations around access, consent, and abuse. Moving beyond understandings of the home as apolitical, critical geographies of home scholarship have shown how types of social relations, living arrangements, and homes are differently configured through time and space. That particular people are envisioned for TEC homes should therefore not be a surprise, but why this is the case, and the implications of it, requires investigation.

The conceptualisation of who TEC at home may be used by, and why, was detectable from some interviews where participants were imagining their future selves:

> So I'm designing this in the mind that I'm going to use it, you're going to use it and I find this quite easy because you go 'well would I like that?' 'well no I wouldn't' so that's not happening and it's very much like that if you sit on an ethical basis. (Housing Professional 1)

or what they imagine for other close, familial relations:

> I think it goes back to what would I look for my grandparents, they've passed, or my mum and dad when they get to that stage, what is it I would want services to be looking like for them, what would I want services to look like if I needed to start engaging with services. (Occupational Therapist)

Futures scholarship tells us that

> Futures are also apparently made present through practices that stage the possible through some form of acting, gaming or pretending. Here the potential future of technology use is made present and rendered actionable "as if" an as-yet unmade technology is, instead, a finished product. (Kinsley, 2012, p. 1559)

For my participants, who were professionals working in this area, their "as if" was employed in the context of "as if it was me/my home/my care." There is therefore a danger that homes of the future, and TEC, are unwittingly envisioned for particular groups of people and it raises questions about the extent to which futures are participatory. As Groves has argued, the "socio-material organisation of anticipation is not a neutral process: it distributes unevenly and unequally the capabilities required by actors in order to influence the present and the future" (2017, p. 30). Building on Groves (2017) and Puig de la Bellacasa (2011), I suggest that how participants anticipated TEC homes of the future, who they imagined them for, and the types of lifestyle they afforded were largely an imagination of their future self or people like them. These anticipatory practices are entwined with personal notions of proximity and distance to types of ageing or lifestyle, informing visions of homes-to-be.

The socio-material configuration of TEC homes (and evolution of this over time) was observable in participant accounts and traceable to the participant's positionality; how accounts of "being" are understood, and the prioritisation of human experience above that of other "beings." As Anderson suggests, we need "to understand how the experience of the future relates to the materiality of the medium through which it is made present" (2010, p. 793). While participants located the "being" in TEC homes as almost entirely the human being, the contingency of that experience with material/immaterial, animate/inanimate relations was obvious, as the quotes throughout this paper demonstrate. A practice of "caring through things" (Puig de la Bellacasa, 2011), with "homes-to-be," TEC, devices, data, infrastructure, services was omnipresent and we should therefore be aware of different ways of relating to the future and what they reveal (cf. Anderson, 2010). As Nettleton has observed, "our lives and our bodies invariably change and bring a degree of provisionality to the places we call home" (2018, p. 55).

Who we imagine in the context of TEC homes creates something of a self-fulfilling prophecy, delivering homes and environments with those people in mind, potentially to the exclusion of others. Why particular types of people are imagined is important to understand for it reveals the social, material, and cultural making of TEC and of homes. It expands futures scholarship by raising the importance of the diversity of futures, who anticipates them, for whom. It also reveals a humanistic perspective where the focus is, and anticipates being, on the inhabitant of TEC homes and constructs of independence and

empowerment. Building on these insights around homes-that-are and homes-to-be, the next section will move further to explore prediction as a specific logic of anticipation, and how that reveals ideals around homes-that-ought.

3.3 | Homes-that-ought: prediction as anticipatory practice

Sophie Haines explores ways of recognising that the future "lies between 'is' and 'ought'; a condition of striving to know what to do under pressures of time" (2019, p. 112). She highlights the necessity of questioning how "futures that ought" come into being while recognising these co-evolve with technical, relational, political, and affective challenges. The word "ought" is important here, denoting an informal rule, a measure of advisability or desirability – that a particular type of future should be realised. In the paragraphs that follow, by building on understandings about homes-that-are and homes-to-be, I aim to explore the ways in which my participants accounts revealed "homes-that-ought." This is important because, as Mahony (2019) suggested, all forms of thinking about and planning for the future are culturally situated, shaping, for instance, ideas of pre-action and predictive capacity. This means "homes-that-ought" are being desired, planned, and built in accordance with the cultural and political contexts in which they are produced. The idea of prediction is poised to play a pivotal role in TEC homes but is as yet underexplored as an anticipatory logic or practice.

As the quote opening this paper demonstrates, there was a desire to harness the potential of AI and machine learning to create homes that can predict ill health or the deterioration of an individual in a home environment, to facilitate intervention. This is a common aspiration in policy; for example, Scotland's Digital Health & Care Strategy commits to:

> Provide dynamic data capability, with machine learning where appropriate, that enables a forward looking predictive view that supports modelling and continuous improvement of future health and care services. (2018, p. 16)

In my interviews, participants' discussions of prediction revealed the dominance of techno-utopian thinking, and the variety of ways in which prediction can affect. Most talked about prediction in relation to events such as a fall, or change in a pattern of behaviour, and the possibility of prediction reducing the likelihood, severity, or consequences of that event:

> So, we said to the NHS what is your biggest cost and they said "falls," so we looked at predicting who was likely to fall before they had a fall. It wasn't about predicting an event, it was about predicting the likelihood of an event. (Housing Professional 1)

This is not unlike Anderson's pre-emption and precaution, in that there is a desire to stop a future event happening. The use of prediction was also imagined as giving authorisation for intervention to take place:

> It's preventative in the sense that it can allow a conversation around "you've not had much to eat today, do we need to do something around that?" and it lets people intervene in a much more controlled and planned way … so that can then start to deliver more in terms of the preventative work and avoiding the need for services (Policy maker 2)

Shifting the responsibility about intervening from carers and home sharers to algorithms and devices. Further, prediction was anticipated as being "useful" beyond the reason it was originally installed for, creating behavioural nudges or advice to improve general health:

> We've started with technology and using data science to try and predict an event. And then, drilling down a bit further you can look to see specific problems, so new respiratory illness, respiratory rate, physiology is the logical measuring in the home. Getting that high-level data to healthcare providers from monitoring. So, let's say epilepsy or diabetes or other chronic ill healths, how could we use technology to keep a person safe, but also to nudge them into better health behaviours potentially? I think technology has a role there. (Consultant Clinician)

This quote illustrates the role that prediction could have in delivery of longer term interventions. Indeed, discussions revealed the temporality of prediction, for example, increases in frequency, duration, and number of devices involved in prediction:

> How can we use appropriate technology particularly on the prevention and early prevention? I think too often we're dealing with issues once a problem has emerged; how do you do that more predictive and preventative type of approach

> where you're beginning to anticipate, be able to put in appropriate supports if people's health or safety is being compromised in any way? (Policy maker 1)

Implicit in these accounts are the multiple ways in which aspirations or expectations of "homes-that-ought" are being co-constructed with ideas of surveillance and control (who should be monitoring, how, and to what end). This is of concern in contemporary debates on dataveillance and governing through data (Lupton, 2018; Maalsen & Sadowski, 2019), which has been demonstrating how machine learning algorithms, that allow for different types of prediction, need to be more fully investigated (Amoore, 2019), particularly the paternalistic use of predictive methods to nudge behaviours (Reid & Ellsworth-Krebs, 2019).

Prediction is possible because of the socio-material context where data, devices, practices, and routines co-evolve:

> Data and information which would come through the caring activity or through apps or monitors or other smart devices and map the needs, map the dependency, changes in behaviour, be an early warning for risk and coordinate the application of the resource from the care provider so that if Jean, evidenced this week, she needed a little bit more care or support because she didn't have a good week, then that resource could be increased for her. (Charity professional)

The opportunities that digital data afford to automate risk detection and responses to create efficiencies for the public sector and improve experience were commonly reflected on: "so, the public sector should be embracing it actually because not only is it better for the human beings, it's financially sensible as well" (Policy maker 2). However, and as Kinsley (2012) has noted, there is a real possibility that automation may act to propagate contemporary geographies of inequality. As one of my participants remarked, there is a danger that:

> We are absolutely repeating a pattern of getting excited and interested in a shiny thing, because it distracts us from how miserable the picture over there is when we look at it. So, if somebody comes to me and says look, we've got this digital health pilot and it's running with people living in squalid council houses, I'll be very interested in that but most of them aren't. (Policy maker 3)

Interrogation of prediction is therefore important for it brings into focus a specific form of anticipatory practice, and one that is arguably different from the existing logics explored in futures scholarship. While others have attempted to add to Anderson's three styles of anticipatory logics, few have identified prediction as being of importance. In applications of smart homes, prediction is reliant on algorithms and machine learning, for example, to open a door using face imaging in order that a carer may enter, to predict sunrise and sunset to open window blinds in a home inhabited by someone using a wheelchair, or heating systems that adapt to the routines of inhabitants. The implications of these computational techniques within domestic contexts are only now fully being examined and challenged (Maalsen & Sadowski, 2019). But these concerns span the range of social life, with Martin Mahony stating that:

> Although predictions might refer to systems assumed to be independent or external to the sociotechnical systems that are the subject of hopeful imaginings and expectations, the practices and politics of prediction, I suggest, are profoundly shaped by the imaginative and expectant contexts within which they are produced and put to work. (2019, p. 1282)

Prediction in relation to smart devices and thereby TEC homes is made possible because of machine learning, where devices and data come together (e.g., a network of sensors detecting gait, daily activities, including hygiene and sleeping patterns, leg and arm movements, combined with pressure/temperature sensors such as those on doors, baths, floors, and beds), developing a framework that purportedly mimics human thought processes, which can learn and update itself. This means that computational systems detect reasons to intervene without being programmed to do so, that the system "thinks for itself." Importantly, such systems will have learning algorithms representing a range of different assumptions, primarily contingent on past patterns (e.g., change in frequency of night-time activity patterns to predict likelihood of a fall), reducing future events to previous phenomena.

Prediction is in this sense different from other anticipatory practices in futures scholarship where human decision-making is central and critical throughout generative processes. With the advent of machine learning, the algorithm underlying the prediction acts in ways that cannot always be anticipated. But more importantly, and unlike most conceptualisations that paint the future as open and multiple (cf. Anderson, 2010), prediction, facilitated by machine learning is not because "the machine learning algorithm must reduce the vast multiplicity of possible pathways to a single output" (Amoore, 2019, p. 151). Normative

assumptions about domestic routines, what types of homes, organisation of carers, and role of those who share the home are therefore embedded in the algorithm, however the machine learning decision-making and intervention process evolves.

While TEC homes may be an example of pre-emption (pre-empting an older, frailer population with a higher rate of chronic ill health), the potential capacities of the home and devices are not just pre-emptive. With machine learning algorithms these systems can and will evolve as time goes on, which could make them increasingly predictive. As Kinsley noted, "the anticipated 'futures' of all subsequent renditions of ubiquitous computing remain anticipatory because they invoke that knowledge and are emergent from practices that take place in the present" (2012, p. 1564). A reliance on prediction and a ratcheting of provision to enable more people to "age-in-place" or access healthcare at home will have consequences for how we view home as well as how we view the future. Greater society-wide discussions about the persistence and circulation of cultural norms, the participatory nature of planning and implementation, and of how these combine to impact on what is predictable within TEC homes, are therefore required.

4 | CONCLUSIONS

In this paper, and taking seriously the notion that the future is contingent on the present, understanding how TEC homes are currently envisioned by those responsible for their design, implementation, and roll-out is an urgent task. To this end, a triumvirate framework was developed to explore the variety of ways of thinking about TEC homes in Scotland. Although this framework has been deployed for the empirical case of TEC homes, there is potential value in its application beyond this by exploring the categories of "homes-that-are," "homes-to-be," and "homes-that-ought" in critical geographies of home more broadly, as I will suggest throughout this conclusion.

Homes-that-are encapsulated the "here and now" of current homes and showcased the dominance of ontological security, made real by personal history and experience. This discussion also revealed the persistence of notions of independence and empowerment in the TEC homes arena, but a flexibility in how they may be achieved in the future, reflecting a move from functionality to relationality. Despite some participants querying the inequality of TEC homes, most remained hopeful of the transformative possibilities TEC promises. Indeed, examination of homes-that-are demonstrated fluidity and permutation over time, suggesting there was something fundamentally different about the future and what homes may be like compared with current understandings. It encourages those interested in the critical geographies of home to examine imagined and future homes as well as current ones, problematising the complexity and contradictions of ontological security therein.

All participants assumed that homes of the future will necessarily involve some form of smart, digital infrastructure, system, or devices. Although independence was the outcome they were seeking to deliver, the interdependence of material/immaterial and human/non-human relations was clear. The "being" of home, now and in the future, although determinedly human, was only possible because of these socio-material relations. Moreover, it revealed a need to extend and expand who is shaping the TEC home agenda, why, and for whom. It is necessary, therefore, to better understand how the "capacities and capabilities through which lived futures are expressed are often already unequally distributed" (Groves, 2017, p. 36). In examining homes-to-be, the "being" is of central importance; the contingency of home with socio-material relations and the experience of that as related to other intersubjectivities. Much work is therefore required to examine the nature of "being" at home to question the situated and emergent phenomena at play. This may be possible through expansion of our non-essentialist, non-reifying ontologies combined with a more participatory approach when undertaking critical geographies of home scholarship.

Part of the power of future anticipation is in the (re)making of spaces, in this case, homes. Futures scholarship suggests that how future homes are imagined in the present is likely to be closely linked to what they will be. Future TEC homes are thus inherently related to current normative ideas of "homes-that-are," "homes-to-be," and, critically, "homes-that ought." For instance, a co-constructive relation exists between prediction and homes-that-ought: what prediction makes possible is reflected in the normative expectations of homes, at the same time as such expectations create a role for prediction. Homes-that-ought therefore awards attention to which futures are important, and why. Throughout the paper it has become clear that neither TEC, home, nor futures are neutral; all contain a normative sense of what is possible and what homes "ought-to-be." Problematising the "ought" of homes-that-ought, and in particular whose "ought" is preferable, is an approach that will be useful beyond this empirical case in the study of home and future home-making. Ultimately, the openness of futures may be foreclosed due to their predictive, machine learning capabilities.

The increasing role of ubiquitous smart technology to deliver public health outcomes within/at home urgently requires greater scholarly attention. With this paper I attempt to engender debate and dispel the myths prevalent in techno-solutionist thinking, bringing to bear the messiness and complexity of home – both its conceptualisation and experience. By examining how participants conceived of home and future homes, it revealed concerns over representation, particularly the diversity and

participation in futures. It also highlighted the contingencies of meanings related to ontological security, expectations and their origin in personal experience, and the persistence of human centric focus at a time when we are increasingly reliant on our interaction with non-human devices, data, and systems. Finally, I hope to begin a conversation among futures scholars around prediction as a new type of anticipatory logic, encouraging them to consider the extent to which machine learning algorithms, proliferating throughout our social lives, are closing the openness of the future.

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Author elects to not share data.

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ENDNOTE

[1] The UK government's definition in 1997 of a non-departmental public body was: "A body which has a role in the processes of national government, but is not a government department or part of one, and which accordingly operates to a greater or lesser extent at arm's length from Ministers" (HM Government, 2006).

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