International Journal of Drug Policy 126 (2024) 104359

Contents lists available at ScienceDirect

International Journal of Drug Policy

journal homepage: www.elsevier.com/locate/drugpo

Research Paper

Tinkering with care: Implementing extended-release buprenorphine depot treatment for opioid dependence

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ARTICLE INFO

Key words:
Extended-release buprenorphine depot
Opioid pharmacotherapy
Implementation practices
Tinkering
Care
Innovation

ABSTRACT

We examine how extended-release buprenorphine depot (BUP-XR) is put to use and made to work in implementation practices, attending to how care practices are challenged and adapted as a long-acting technology is introduced into service in opioid agonist treatment (OAT) in Australia. Our approach is informed by ideas in science and technology studies (STS) emphasising the irreducible entanglement of care practices and technology, and in particular the concept of 'tinkering' as a practice of adaptation. To make our analysis, we draw on qualitative interview accounts ($n = 19$) of service providers involved in BUP-XR implementation across five sites. Our analysis considers the disruptive novelty of BUP-XR. Tinkering to make a novel technology work in practice slows down the expectation of implementation in relation to transformative innovation, despite the promise of dramatic or rapid change. Tinkering allowed for more open relations, for new care practices that departed from the routine and familiar, opening potential for how BUP-XR could be put to use and made to work in its new situation, and as its situation evolved along-with its implementation. Flexibility and openness of altering relations was, however, at times, held in tension with inflexibility and closure. This analysis identifies a concern for what is made present and what is made absent in the altered care network affected by BUP-XR, with the multiple effects of supervised daily dosing practices thrown into relief as they become absented. Tinkering to implement BUP-XR locally connects with a broader assemblage of trial and movement in the constitution of treatment. The introduction of long-acting technologies prompts new questions about embedded implementation practices, including supervised dosing, urinalysis, the time and place of psychosocial support, and how other social aspects of care might be recalibrated in drug treatment.

> *… the task is that of attuning everything to everything else, one way or another. What to fiddle with and what to keep fixed, is rarely obvious. What you try to do, may not work out. Try something else. Keep on tinkering. Doctoring. Caring. It would be great if things were so simple that a wise choice made at a single, crucial moment were all that was needed to control a body suffering from a disease. It would be great if the world fitted into little vignettes. But as it happens, there are always contingencies and surprises.*
>
> – Annemarie Mol, *The Lancet* (2009, p.1757).

Introduction

Extended-release buprenorphine depot (BUP-XR) is a potentially disruptive technology, described as 'game-changing' (Lagios, 2021) and a 'watershed event' (Ling et al., 2019) in the treatment of opioid dependence. Administered subcutaneously by a healthcare provider either weekly or monthly, BUP-XR provides sustained release of buprenorphine over the dosing interval, thus mitigating the costly requirements of daily dosing and the inconvenience of frequent service attendance (Haight et al., 2019; Larance et al., 2020; Lintzeris et al.,

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https://doi.org/10.1016/j.drugpo.2024.104359

Available online 20 February 2024

2021; Nosyk et al., 2023; Sigmon & Bigelow, 2017). Emerging clinical literature indicates that BUP-XR is associated with high retention in opioid agonist treatment (OAT) and may have additional benefits compared to sublingual buprenorphine (Dunlop et al., 2022; Farrell et al., 2022; Frost et al., 2019; Haight et al., 2019; Ling et al., 2010; Lintzeris et al., 2021; Lofwall et al., 2018; Martin et al., 2022; Rosenthal et al., 2016). Given the emphasis on supervised dosing frameworks in some countries, including Australia, Canada, and the United Kingdom, where daily supervised dosing of methadone and sublingual buprenorphine is required in a clinic or pharmacy especially in the first months of treatment (Kleinman et al., 2022), it is hoped that the implementation of a long-acting technology might provide additional choice and help reshape how OAT can be delivered, in effect, relocating when and how care in drug treatment is done. The different temporal and social relations produced by the innovation of long-acting technologies are arguably altering the OAT landscape, opening up new possibilities for trial and movement in the constitution of treatment. BUP-XR is in the process of becoming-with social and clinical worlds, with the localised work of implementation an element of these more global shifts.

BUP-XR undoubtedly has implications for the future of OAT, its configuration and delivery, but precisely how BUP-XR might come to be integrated into services is still "yet to be known" (Ling et al., 2019, p.76). Attending to how 'real world' implementation practices can shape uptake, discontinuation, retention, and other treatment outcomes beyond that demonstrated in controlled clinical trials is essential (Iacono et al., 2024; Morgan & Assoumou, 2023; Morgan et al., 2021). Studies examining clients' experiences of BUP-XR offer some indications of how new formulations can work to alter relations of OAT service delivery, for example by generating a sense of freedom from restrictive and costly treatment regimens (Barnett et al., 2021; Matheson et al., 2022; Neale et al., 2023), reconfiguring clients' relationship with treatment by offering release from short-term cycles of living (Lancaster et al., 2023), and altering stigmatising relations (Treloar et al., 2022). These studies also gesture towards the complex adaptations required to implement an OAT medication that acts as a bridge to care without necessarily being the focal point, given the potential to disrupt other aspects of treatment delivery sometimes relied on for daily contact and social support (Barnett et al., 2021; Johnson et al., 2022; Lancaster et al., 2023; Matheson et al., 2022). It has been observed that the "relative absence of medication in daily routines makes present other vital aspects of treatment", relocating how treatment is made to work "not only in the routines and felt effects of medication" (Lancaster et al., 2023, p.10).

Closely attending to how implementation practices are adapted as BUP-XR is rolled-out is important but remains underexplored. In medical research there is increasing attention to practices of implementation, with quality improvement methods such as "plan–do–study–act" cycles proposed to help support iterative development (Reed & Card, 2016; Taylor et al., 2014), as well as other approaches within implementation science orienting towards treating intervention implementations as effects of social practices in complex systems (Byrne, 2013; Callaghan, 2008, 2013; May et al., 2016). These practice-oriented approaches emphasise that intervention implementation is not a simple one-off thing, but rather made up of many adaptive parts. Although these approaches seek to understand the messy, less predictable, outcomes of implementation by recognising intervention implementations as complex and adaptive, they nonetheless "fall short of appreciating the role that material practices play in constituting evidence and intervention as emergent fluid objects" (Rhodes & Lancaster, 2019, p.2). Shifting attention towards intervention implementation as a matter of relational materiality allows for seeing in new ways how interventions are on-the-move, with implementation networks and events becoming sites of investigation to attend to how interventions are transformed and made *in practices* (Rhodes & Lancaster, 2019). The complexities and contingencies of implementation practices and the material configurations of services can profoundly affect how care is constituted in drug treatment and an intervention's recovery potential (Fraser, 2006; Fraser & valentine, 2008; Gomart, 2002; Rhodes, 2018; Theodoropoulou, 2023).

Technologies like BUP-XR do not work alone, nor are their potentials 'given'; the effects that interventions make are shaped by how they are *put to use* and *made to work* in situated practices (Rhodes & Lancaster, 2019). Here, we emphasise an approach that expands notions of agency beyond those of human actors to also include nonhuman actors, thus opening out the category of the actor to include, for example, "tools, plans, logics and processes" (Andrews & Duff, 2019, p.129). Implicated in the introduction of long-acting formulations are a range of material practices and arrangements, for example: matters of storage and logistics; space to accommodate new models of care; staff allocation and clinic structure; how these new treatments might be provided alongside the continued provision of other oral and sublingual OAT in the one service (and across different practice settings); appointment booking and management for initial and subsequent visits; technical and practice-based considerations surrounding injections and who can prescribe and administer the dose; managing clients' information needs as well as changing goals and preferences; the changing role of supervision in light of new dosing regimens; and how clients, clinicians, and others in decision-making positions about treatment imagine who may benefit from this particular formulation (Chappuy et al., 2020; Farrell et al., 2022; Lancaster et al., 2023; Larance et al., 2020; Neale et al., 2023, 2019; Vorspan et al., 2019). Although new long-acting formulations seem "poised" to provide OAT in new ways, hopefully increasing convenience and ameliorating burdens for both clients and providers alike, the clinical literature speculates as to what role practices such as additional psychosocial services, urinalysis, and medical monitoring might continue to play, reflecting enduring concerns about diversion, safety and adherence in OAT delivery (Sigmon & Bigelow, 2017, p.386). Here we can begin to see how the introduction of new technologies bring about relational effects in a network of care, throwing into relief (and bringing into question) how other elements in the network are affected and might be re-assembled. Altering practices in an evolving situation, in light of new technologies, has rippling flow-on effects, creating differences that need to be navigated, including in the face of tensions and uncertainties that emerge. Thus, as practices of OAT delivery are adapted in light of the introduction of new long-acting formulations, a key question is "what to fiddle with and what to keep fixed" (Mol, 2009, p.1757) in order to maximise benefit.

In this article we examine how BUP-XR is put to use and made to work in everyday implementation practices, specifically attending to how care practices are challenged and adapted in relation to the introduction of a new long-acting treatment technology in OAT services in Australia. We draw on ideas in science and technology studies (STS) which emphasise the irreducible entanglement of care practices and technology, and in particular the concept of 'tinkering' as a practice of adaptation (Mol, 2009; Mol et al., 2010). Tinkering centres the relation between care and materiality, with care understood here as material practice, interwoven into the everyday (Lindén & Lydahl, 2021). As Mol, Moser and Pols argue, technologies "do not work or fail in and of themselves. Rather, they depend on care work. On people willing to adapt their tools to a specific situation while adapting the situation to the tools, on and on, *endlessly tinkering*" (2010, pp.14–15, emphasis added). These are not reasoned choices of decision-making as such, but adaptations that are worked out in practices, responsively working out the changing character of technologies according to their situation, along with other elements of daily care practices (Mol, 2009). Care, understood in this way, thus involves "not simply particular kinds of subjectivities, but also instruments, and technologies together with other material elements, texts and inscriptions" (Law, 2010, pp.66–67). Through this lens, we seek to attend to how BUP-XR is adapted in everyday practices, responsive to an evolving situation, noticing its continual re-negotiation.

In examining the implementation of a new long-acting treatment technology in this way, our approach also emphasises innovation as one

part of a wider set of social and material relations. This approach questions the presumption of "a one-way flow of innovation from source to consumer (or user)" and instead accentuates a "continuous process of transformation, re-use and re-configuration" (Irwin, 2023, p.45). This approach directs attention not only to the 'thing-in-itself' (here, a novel medication formulation) but also to the practices and relations within which it is given shape and meaning (including "expressions of creativity, care, concern, hope and resourcefulness": Irwin, 2023, pp.45,51). Innovation is a distributed effect, and depends on a variety of actors (Sørensen, 2007; Webster & Wyatt, 2020). Thus, not only do technologies like BUP-XR not work alone, we might also posit that the particular innovation of BUP-XR can only be made sense of in context, including in relation to "healthcare systems, patterns of inequality and trust, global relations and industry-government entanglements" (Irwin, 2023, p.47), as well as its localised situations of use and the continuous adaptations and interventions that characterise the field of drug treatment.

We take care and technology together, thus complicating the promissory discourse within the field of drug treatment which has, at times, positioned the potential of new long-acting technologies at a distance from the specificities, ambivalences, complexities, and contingencies of how care is done in specific (and often resource-constrained and highly stigmatised) sites of practice. Through this analysis, we seek to notice and learn from practices that emerge along with opportunities, challenges, and constraints as BUP-XR is introduced into service in an effort to help "tinker towards good care" (Mol, 2010, p.230). In doing so, we aim to cast both innovation and 'good care' as situated concerns for drug treatment; practices of "persistent tinkering in a world full of complex ambivalence and shifting tensions" (Mol et al., 2010, p.14).

Method

The Community Long-Acting Buprenorphine (CoLAB) study was a 12-month prospective single-arm, multicentre, open-label trial of monthly BUP-XR. The parent study evaluated clinical outcomes among people with opioid dependence receiving BUP-XR and implementation practices across a range of healthcare settings in Australia. This trial used a subcutaneously injected, extended-release monthly buprenorphine formulation (Sublocade®). The dosing schedule involved two doses of 300 mg BUP-XR at baseline and month 1. Thereafter doses were flexible with 100 mg or 300 mg every 28 days (−2/+14 days) (see Larance et al., 2020). Sublocade requires suitable secure storage, either under refrigerated conditions (where at the time of the study it was expected to be stable for 24 months when stored at 2–8 °C) or at room temperature (where at the time of the study it was considered stable for a maximum of seven days at 15–30 °C; it has subsequently been shown to be stable at these conditions for 28 days). None of the sites had experience of the use of Sublocade prior to trial commencement and for some sites this was the first experience of delivering any long-acting buprenorphine formulation. The study received ethical approval from St Vincent's Hospital Sydney Human Research Ethics Committee (HREC/18/SVH/221) and was registered with ClinicalTrials.gov (NCT03809143) (see Farrell et al., 2022; Shahbazi et al., 2023).

Here, we draw on qualitative data generated alongside the parent study to explore practices involved in the implementation and delivery of BUP-XR for the treatment of opioid dependence in community-based general practice and specialist treatment settings. This qualitative study focused on how BUP-XR was put to use and made to work (Rhodes & Lancaster, 2019) in different sites and situations; how the introduction of long-acting treatment formulations reshaped treatment and service provision; and the possibilities of, and challenges posed by, BUP-XR. In-depth interviews with service providers involved in BUP-XR implementation practices were undertaken by SG between April 2020 and March 2021, facilitated by a topic guide. Most interviews were conducted by phone, due to Covid-19 restrictions, with a minority in-person during site visits. Overall, nineteen service providers and clinicians involved in the CoLAB study were interviewed, across five sites in Australia (three sites in New South Wales and two in Victoria; one private general practice, one community clinic, and three specialist drug treatment clinics, and in regional and metropolitan settings). The characteristics of the five sites are described in Table 1. At four sites (regional NSW, remote NSW, metropolitan Sydney NSW, metropolitan Melbourne Victoria), BUP-XR was predominantly administered by a nurse or nurse practitioner, and at one site (outer suburbs Melbourne Victoria) a combination of nursing and medical staff administered the treatment depending on staff availability and rostering. All participants interviewed were closely involved in one or more aspects of implementation, prescription and review, administration, management (ordering and storage) of BUP-XR, or aspects of the trial, at one or more of the sites. Participants represented a range of professional backgrounds and roles: seven addiction medicine specialists and researchers (including trial investigators, OAT prescribers, psychiatrists, and general practitioners); nine nursing staff; two pharmacists; one receptionist with a client-facing role. Most participants had long-standing experience of OAT delivery, research, or administration. Three respondents had fewer than two years of experience in OAT service delivery or research. To protect as far as possible against deductive disclosure, the CoLAB study sites and the roles and demographics of participants interviewed have been deidentified, with pseudonyms used, and specific references to names, locations, or local services removed.

All interviews were audio recorded with consent, transcribed verbatim, deidentified, and organised for analysis with NVivo12. The corpus of participants' accounts was mapped following a process of initial and focused coding (Charmaz, 2006). A reflexive and interpretative approach to coding and analysis was used, developing, reviewing, and refining thematic categories identified in the interview data. In keeping with our conceptual framework and informed by emerging literature on BUP-XR promise and implementation practices, analysis focused on tinkering as a practice of adaptation in service models, systems, procedures, and care work that occurred along with the introduction of a new technology. Following STS scholar John Law's (2010) contribution to Mol, Moser and Pols' volume, in which he extends the concept of 'tinkering' to examine the multiplicity of care in practice as what he calls a 'choreography of care', we asked three questions to guide our analysis of BUP-XR's implementation: "How does it work? How is it managed? And when and how does it break down?" Underpinned by a relational ontology, these questions attuned attention to the manner in which things transform, evolve and open up in the process of assemblage, not conceiving of BUP-XR or its implementation contexts as fixed in shape, but constituted in part as they entangle together (Law, 2004). Centring our attention on the relation between care and materiality, we focused on BUP-XR's implementation within 'the clinic' ('the clinic' also here conceived as in-the-making; a process of assembling in which its constituent elements come together). Through our analysis, we attended to the temporal and spatial arrangements of treatment service delivery, and the coming together of actors and events, examining how the introduction of long-acting formulations altered and transformed relations and routines of the clinic. Our analysis sought to notice adaptations in implementation practices as matters of ontological movement (Dennis et al., 2020), that is, as shaping what it is that treatment can do and become in its situation (Fomiatti et al., 2017; Fraser & valentine, 2008; Gomart, 2002; Rhodes, 2018; Rhodes et al., 2019, 2023; Savic et al., 2018). We present our analysis in three sections. First, we consider the disruptive novelty of BUP-XR, before then looking at how BUP-XR was tinkered with in relation to time and space. Third, we examine how the flexibility and openness of altering relations was, at times, held in tension with inflexibility and closure.

Table 1
Characteristics of qualitative study sites.

Location	No. prescribers	No. nurse practitioner prescribers	No. doctor prescribers	Pharmacist in service	No. social workers	No. psychologists	No. other staff	Other services available	Operating hours
Regional NSW	6	1 session/week 1 transitional 1 session/week	6	1	0	0	10 FTE 7PT	Counselling, needle exchange, take home naloxone, MERIT program	8:00–16:00 Mon-Fri 8:00–12:00 Sat-Sun
Remote NSW	2 (staff specialist and MO)	1 transitional NP	2 (telehealth)	0	1	1	1 NUM, 5 RN, 1 D&A counsellor	Counselling, needle exchange, take home naloxone, MERIT program	7:30–16:00 Mon-Fri 8:15–10:45 Sat-Sun, public hols
Sydney (Metropolitan) NSW	4	1	3	1	0	1	10	Case management, Hepatitis C including fibroscan, ECG, pathology, research	8:00–17:00 Mon-Fri 9:00–12:00 Sat-Sun (dosing only) A private OAT clinic 6 days per week
Melbourne (Metropolitan) Victoria	8	2	6	0	2 (+2 completing studies)	1	25	Community clinic; Psychiatry, care & recovery co-ordination, AOD counselling, non-residential withdrawal, hospital consultation liaison, ED Clinical nurse consultant	9:00–17:00 Mon-Fri
Melbourne (outer suburbs) Victoria	4	0	2	1	0	0	1 FTE practice manager 2 Nurses/ receptionists 4 reception 4 GP	Primary care; Onsite pathology, diabetes educator, physiotherapy	8:00–17:00 Mon-Fri 9:00–15:00 Sat 9:00–12:00 Sun

Analysis

Tinkering with novelty

Participants reflected on the introduction of BUP-XR as "a total game changer" (Robert) and an "amazing big leap" (Catherine). In contrast with other areas of medicine, where new pharmaceutical treatments were perceived to more frequently become available, the novelty of BUP-XR was sensed as a significant disruption to the OAT landscape in which "there is not much medications development" (Thomas). BUP-XR was spoken about as something different for OAT service delivery, which required new learning and altered ways of working in the everyday:

> We have not had any new treatments for opioid use disorder for many years and so we have got very comfortable using methadone and sublingual buprenorphine and so suddenly… […] The injecting mechanism was different, and the storage is a bit different, and there are a whole lot of things that are different. It was a whole lot of learning. How do we order them, how do we store them, how do we count them, how do we actually educate our patients? (Robert)

Robert, a senior clinician with decades of OAT service delivery and management experience, reflected on the novelty of BUP-XR and the alterations in practice needed to make it work, comparing this with his earlier experiences of first implementing sublingual buprenorphine after methadone. It was important not to assume that existing systems and practices would simply translate and fit with a new technology; things needed to be done differently:

> I remember when [sublingual] buprenorphine came in and a lot of our systems on how to do a buprenorphine treatment was based on methadone, and it took about 5 to 10 years to realise they were quite different, and things needed to be done differently. I see a parallel with the introduction of the buprenorphine long-acting products, that we almost assumed it just going to be like buprenorphine, same drug, but actually, you know, there [are] so many other differences. (Robert)

Tinkering to make a novel technology work in practice slows down the expectation of implementation in relation to transformative innovation, despite the promise of dramatic or rapid change. Attending to the assemblage of the clinic through participants' accounts, we saw how networks of care needed to be afforded time, space, and flexibility, to adapt. There was a sense that the introduction of BUP-XR into services required refitting, rearranging, and reshaping routine practices, in small and big ways, which initially produced some hesitation and anxiety. There was concern about "extra duties, extra jobs with the new product coming onto the market" (Catherine) and "significant workflow changes" for some OAT service staff, depending on how their usual role was situated within the evolving system: "it was a change process and there was a fair bit of anxiety about it […] internally around workflow and safety" (Oscar).

The change surrounding BUP-XR's introduction was not experienced as a one-off moment in services, but as an unfolding and iterative process. Collectively adapting practices in response to novelty was not necessarily easy, despite the technology's reported promise and potential:

> Anything new is challenging, changing something is challenging, learning something new is challenging at a service level to get multiple people to accept change and do something differently. Clinicians probably get too stuck in their ways, not want to do anything new, they learnt what they learnt 20 years ago, whatever they learnt, they don't want to change, they don't want to do anything different, that's the barrier. (Thomas)

Within the clinic assemblage it took time to become familiar with the new relations BUP-XR produced. This novel technology required 'working out', experimenting to make care work. Administering injections is one element of implementation through which practices of tinkering can be traced. Injections were something that "needed a bit of time to sort through" (Catherine); "normalising it and sort of working a way around how it will be delivered" (Kelly). Administering depot injections was a new skill for some clinicians, especially psychiatrists who did not usually perform these procedures. Participants spoke of how they practiced these skills and, through time, learned to understand how different bodies responded to the depot injections (for example, understanding that clients with less body fat sometimes experienced more pain in injection sites):

> We practiced a few times. So, we [became] familiar with the injection and how to do it and about the angle and knowing to rotate around the sites, so that was helpful, and I guess, we knew to do it very slowly as well. (Susan)

The work of tinkering is a practice of adaptation, done in incremental, and sometimes small and mundane ways, in the everyday. By tinkering in the situation, new practice-based knowledge emerged. For example, different sites experimented with the use of ice packs to numb skin on the abdomen for 5–10 min, and others provided clients with lollypops to help pass time in the extended appointment and manage pain and discomfort sometimes associated with depot injections. Embedded in these small, practical experiments was a desire to make the relations of care work in the moment of administration: "whatever works […] even just the conversation about the lollypop, is a distraction in itself, you are not talking about the injection" (Saanvi). Making the injection events acceptable for clients, and especially managing localised pain, was initially a key concern to help retain clients' engagement with this novel treatment. When trying out new approaches, participants tinkered towards practices that would be manageable, balancing time with complexity, which was a situated concern. In this account, we were told why the use of ice packs was preferred in one service:

> Once you start looking at local anaesthetic or topical anaesthetics and things like that, it just becomes too complex. I think cooling the skin works well, so it just requires a little bit of time that's all, so you know 10 min or so, 5 to 10 min of having something cool on the skin. (Catherine)

In another community-based service, anaesthetic was used to save time:

> So now we are using local anaesthetic whereas before we just have to spend a lot of time injecting it really slowly, which you know in a busy clinic is you know it's a waste of time really and even then it doesn't completely stop or doesn't mitigate against the pain terribly well. The other alternative we were using was ice packs and that would be time consuming for the patient, for our staff, and for the doctor having your patient sit there with an ice pack on their stomach. (Peter)

As changes in practice evolved, participants spoke of how they would "work together" (Robert), sharing new information between service providers through discussion groups and chats, as well as internal meetings, recognising that knowledge was constantly changing. There was an effort to remain responsive, to continually come to know how to work with a novel technology as it came together with clients' bodies in evolving practices in different clinic situations, including by listening to feedback from clients themselves. This was especially evident in how participants spoke about how knowledge was reciprocally exchanged between staff and clients as they learned together what to expect from the event of injection administration, and as those expectations shifted through experience:

> It's often because they are not sure what to expect you know, we were honest and said, 'look, we have had feedback that this can sting a lot' […] Some of them would say, 'look, I hate the injection, it's

> painful but just that whole month of not having to come is worth it.' So, certainly there was some negative feedback initially about how painful the injection was, but again I think it got better once the patients were used to it. We probably got better at giving them. (Susan)

Tinkering with practices in time and space

BUP-XR required adapting how time and space was allocated and worked-with in services. For some services, finding the space required for secure storage and refrigeration (as was required at the time of the study) was "the absolute number one obstacle" (Susan). The challenges associated with ordering, dispensing, refrigeration and storage were "time consuming" (Quang). Ease of access to appropriate refrigeration varied according to the facilities at each site and was more difficult to manage in services that were not connected to large clinic or hospital infrastructures. This meant that for some services, the spatial arrangements of how BUP-XR was stored and where a fridge was located constrained how, where, and when care practices could happen:

> The restrictions[1] about what you can have mean that you have to have a fridge inside a safe, rather than a securely lockable fridge. Actually, the space that would take is so big, that we haven't done it, because it would take away… the room where it could go, where we have our other safe is relatively small, and the nurses sometimes give injections in that room. So, we haven't got a fridge at the moment to store our available Sublocade without having to order individually just because of the space logistics. […] We're still ordering for individual clients, and we have to plan, have to know who's coming, and let pharmacy know who's coming this week for an injection, and do a script for them individually. So, we still have that process for Sublocade and the logistics of that, we're maintaining like that, because we don't have easy space to put a large fridge. (Oscar)

These challenges initially related to not only the storage of BUP-XR itself, but also to the storage of ice packs used when administering the injection:

> The other barrier we have too at the moment also is we are in the process of trying to get a freezer so we can keep ice packs for the patients for the administration. (Catherine)

Spatial and material constraints worked to delimit adaptations to practice.

Comparisons with the different spatial and temporal arrangements of supervised daily dosing of methadone and sublingual buprenorphine were frequently invoked when participants gave accounts of how they worked with BUP-XR:

> You've got to have the physical space to do it. It's not like having a dosing area like in the methadone or buprenorphine clinic. You've got to have a room where we can take somebody. Ideally they can lie down, so you can give an injection, you've got to have the room for a little while, so people can wait afterwards and get prepared for it, and you can ask other questions, and that's a different sort of encounter to a dosing encounter, which is normally at a window, sort of semi-public […] and that's a different interaction to having two people in a room with the patient and the nature of the interaction is different, and a bit longer, and probably a little bit less formal, more interactive. (Thomas)

This was not simply the substitution of one medication for another but a process of tinkering and working out, to attune the patterns and routines of treatment delivery and care to the new technology.

Spatial and temporal arrangements were reconfigured so that BUP-XR injections could take place in a separate, clinical room. Clinicians folded their routine practices into the time and space the injection event created, for example beginning the assessment while the client was holding an ice pack to their skin, to prepare for the injection. The different time and space required to administer BUP-XR injections worked to slow down treatment interactions, and brought staff and clients into closer physical proximity, in turn reconfiguring practices to do with care:

> they are sitting there holding ice onto the injection site, [and we'd say] 'So while we are waiting for the ice to do its thing, let's keep chatting' and it just became a bit more flexible and it's just adapting to you know the different types of interactions. It's not like with methadone, you know you would have your assessment and then go to the window, get your dose and leave. You don't want to keep the assessment going while they are taking their methadone, because it's going to hold up the queue. [With BUP-XR] you've got 10 min to set them up and give them the injection and then chat to them afterwards. And I noticed the nurses were often interacting a lot more and continuing their clinical assessment during the actual injection and it might be, 'Hey how's it going? What have you been doing? How are your kids?' But, you know, that sort of stuff you could do while you are chatting, and in some ways, it relaxes them, so they are not so focused on getting the injection (Robert).

Slowing down practices like assessment, due to the time and privacy created by injection as the mode of delivery, and the place it occurred, also had other contingent effects. These spatial and material adaptations to how and where clinical encounters took place were felt to reconfigure relations of trust within the clinic, with some participants speculating about how this might alter stigma and engagement with clients. BUP-XR was perceived to break down barriers characteristic of OAT service delivery (no longer "shouting through bullet-proof glass": Crawford, 2013), by moving the practices of dosing, and therefore care work, into a different material space:

> With methadone and suboxone […] we have got a locked door. […] A button's got to be pressed, and so you enter, then you are given your dose, and there is a glass screen, a perspex screen or glass, between the client and the clinicians. With the depot, it's none of that at all. […] There's actually more trust I think with the depot, because it's just not that perspex door or glass […] and obviously that's going to improve the engagement and rapport with the client. (Breigh)

Participants reflected on the relative comfort and stability experienced by many BUP-XR clients, and the implications of this for care practices and especially scheduling of appointments over time:

> We have found that they have been very difficult to get, to attend scheduled appointments, and my view on that is because they feel very well and they certainly don't feel like they are in any opiate withdrawal, they don't necessarily prioritise their schedule and appointments that have been booked. So, if something else comes up for them on a particular day, then they, you know, may not come. (Catherine)

This comfort forced a slowing down of care in other ways, disrupting procedures and the patterning of how and when clients would ordinarily connect with the clinic space, requiring practical adjustment to keep pace with the new temporal arrangements produced by the long-acting formulation in contrast to daily dosing:

[1] For information regarding the specific requirements in New South Wales and Victoria, see the following guidelines: https://www.health.vic.gov.au/publications/refrigerated-storage-for-schedule-8-medicines-in-victoria ; https://www.health.nsw.gov.au/pharmaceutical/Pages/refrigeration-s8s.aspx#:~:text=a%20medication%20room.-,The%20refrigerator%20must%20be%20securely%20attached%20to%20the%20premises%20and,with%20food%20or%20other%20goods .

> People do not necessarily turn up on time, because it's lasting them for so long. So I guess, if I was saying to a colleague who was starting, I would say, 'You need to be a bit more flexible about it and certainly don't expect them to come on time or you know come on a set date' […] That I guess changes our approach to expecting that people will come at a set time and get a dose of medication, because we are thinking that we might need to be a little bit more flexible with some people who are stretching it out for much longer. (Susan)

The potential for these new temporal arrangements to cause disconnection from the service as a material site of care was a key concern. The lack of regular, in person, on-site contact with clients made possible by long-acting formulations made visible other essential aspects of treatment and care being absented. Tinkering thus oriented towards caring for the care made absent in the altered treatment situation. Noticing the disentangling of psychosocial support from medication provision, one participant reflected on the future of OAT as something to be cared for, adapting practices in ways that maintain good care, not only through medication provision but also in relation to "the other stuff we do":

> [BUP-XR clients] only come in once a week or once a month, whereas the other people are coming in every day for methadone or buprenorphine, or [even if] they're only coming in a couple of times a week, they are still getting a lot more interaction than the people that are getting the long-acting product. […] What we offer on OTP [OAT], it's not just about the medication, but it's about the other stuff that we do, the other psychosocial stuff, and I think we just have to be careful in the future that we don't lose sight of that. (Robert).

Even as the long-acting formulation seemingly absented the need for regular contact, participants spoke of how they tinkered with routine practices, in consultation with clients, to maintain connection and care beyond the clinic. Participants reflected on how other practices could be folded in alongside BUP-XR, to enact care beyond the provision of medication itself, contemplating how and where practices such as follow-up could be integrated into the system and procedures at various points, for instance through case work and at prescriber reviews. Activities beyond those usually regarded as clinical care in 'treatment' were also posited, as a way of keeping clients connected to community and social support:

> we were talking about trying to help people who had not much in their life, either by having groups or things – because of course the whole plan is for them not to have to come in – but we were looking at try to encourage them to have some other activity […] not just groups in here but trying to think for our clients of alternate activities or hobbies they could get involved with. (Susan)

There were, however, other aspects of routine OAT practice absented, no longer seen to be as significant in the new, more diffuse, spatial and temporal relations afforded by the longer-acting formulation. For some clinicians, urinalysis was no longer felt to be an essential element of supervision or monitoring practices, given the way the treatment was made to work through time:

> There is much less focus on that [urinalysis] now […] I guess we feel, I am not going to say, less concerned, that's not right, but it's knowing that the depot is on board, I think the urine samples, you know, the purpose of obtaining the urine sample isn't as important. (Breigh)

At times, the extension in time and space created by the four or more weeks between injections became a concern to be managed. For example, one prescriber described with concern the case of one long-term methadone client who had commenced BUP-XR. They spoke of the isolation this shift had precipitated, as well as the individualised care arrangements they agreed to put into place to protect against the absence of connection made through the extension in time the long-acting formulation had made:

> I was a little bit concerned that he, you know, not having the regular contact and it could be 4 weeks. We made arrangements […] We had a plan in place that 'If I don't hear from you, I will contact your brother and make sure you are okay'. So it was all like an individual plan around that. 'If I can't find you then, do we need to do a police welfare check for you?' (Kelly)

Some participants recognised that what was lost in the shift to long-acting formulations was not the benefit of a daily dose per se, but the sense of routine connection to the clinic space and contact made in that alternate set of relations:

> Daily dosing can actually be helpful for some patients, even though the majority of people do want to have the freedom not to come in. I think a lot of people who are quite lonely, or they don't have a lot in their life, it's actually very meaningful for them to go to a pharmacy or to go to a clinic everyday […] it becomes a sad thing for them that they are not having that contact. […] There is a minority of people who don't like that loss of contact with the staff. (Susan)

The extended time between dosing was not only discussed as a challenge for clients, but as a challenge for clinicians, for how they understood their role in making care work. Relinquishing surveillance as a mode of care was felt as an adjustment, resetting years of routine practice:

> Having worked in the field for a long time, over two decades, I'm very conditioned to having very close monitoring of my patient group in the initiation phase of treatment and with this medication, it prevents you from monitoring because the patient doesn't have to come every day […] As a clinician that you've administered something and then the patient leaves and they may have other health issues, other substance use issues going on and so on, but I think that's conditioned from a long time of working in the field and how our treatment has typically been delivered. (Catherine)

Tinkering with (in)flexibility

The 'game-changing' promise of BUP-XR was troubled at times when it was felt that new practices and relations could not easily co-exist with the business-as-usual routines of OAT delivery. The altered relations, made possible by the added choice of a new technology, did not replace, but augmented the everyday care work required in services:

> There's this expectation that we are going to have a lot more spare time, 'what are the nurses going to do?' […] There is not a lot more time available because we are actually still running the usual service, plus having the nurses to do the injections, so it's actually more work at the moment. It's not a bad thing because it's good for the patients, but it's certainly not freeing up any time for us. (Susan)

To handle these emergent tensions, initially some services attempted to "quarantine" (Robert) BUP-XR care practices from the rest of the clinic, for example by scheduling appointments only one morning in the week, or administering doses in an entirely different space: "we split off into a separate depot opiate treatment team and we moved to a different site" (Catherine). This practical ordering worked to separate out BUP-XR care from other OAT care practices, containing new relations, and providing cohesion for staff working together with the new formulations. In some services, this 'quarantining' productively altered relations of care with clients, who felt their care was being set apart as something exceptional:

> They said, 'We really like being somewhere else, we don't like being in the old junkie [sic] clinic with all of the people who aren't going so well and now you know feel like sort of life is different and we are going somewhere else and we are doing something else, we are

> moving on in life and not stuck with that other crew who aren't doing so well'. […] Patients felt like they were being treated differently too, better, because of that change. (Thomas)

The openness of some relations was, however, held in tension with inflexibility and closure in others. In contrast to the routines and ready availability of other OAT medications, managing the ordering, storage and dispensing of BUP-XR meant that for most services appointments generally needed to be booked in advance: "we have to plan, have to know who's coming and let pharmacy know who's coming this week for an injection and do a script for them individually" (Oscar). The refrigeration and shelf life of Sublocade, as well as guidelines specifying the dosing window,[2] had implications for how clinics and workflow were structured, and how appointments were scheduled. Missed appointments had a cascade effect, which required additional work, following-up with clients throughout the week, so as not to miss the dosing window or waste medicine:

> We had a particular day […] they were a priority. We chose Monday, so that if anything happened and the patient missed or forgot to turn up, we still had plenty of days in the week for them to come back in, ideally Tuesday again which is a fairly well-staffed day and then you know the rest of the week to try and catch them before the Sublocade was out of the fridge and couldn't be used […] We knew we had some time still to catch them. (Susan)

The flexibility of a long-acting technology which absented the need for regular contact, was troubled as it entangled with the inflexibility of appointment systems, staff capacity, and clinic opening hours, as well as the material constraints of clients' lives. Changing phone numbers or lost phones sometimes rendered some clients uncontactable for weeks at a time, which created tensions with scheduling and difficulties for continuity of care in the absence of regular clinic visits:

> I guess it's just for us to kind of accept that and to try to just do the best we can […] We were telling them we need to have up-to-date phone and you please need to answer it but it's an ongoing problem. (Susan)

To mitigate against this loss of contact, and ensure continuity of care, one service implemented a new phone system, contacting clients more regularly via text messages:

> We now have a work dedicated mobile phone where we can send messages to patients so they know who we are and we are asking patients to contact the clinic and that's made a difference and people are contacting us to let us know that they are okay. (Catherine)

To harness what BUP-XR could do, in terms of the flexibility it afforded in clients' lives, there was a sense that services needed to adapt to become more flexible to make care practices work:

> If you want to have a service that's flexible and trying to meet people's needs […] you just need to have enough staff that you can be flexible about when you give it, so, I think it's far more suitable to clinics that are open most days of the week and have staff who are there most days of the week who can give it. (Susan)

Over time, services found that much more fluidity in practice was not only possible but desirable, once the new technology had become more familiar:

> What we realised is that [limiting BUP-XR clinic days] was very rigid and the patients didn't really like that, because if you were on long-acting, it doesn't matter if you come a few days later […] The one good thing that came about with those medications is that maybe we need to be a bit more flexible. […] We've just learnt to relax a bit more, be a bit more flexible now that we are a bit more confident. (Robert)

Through experiences gleaned through the early implementation phase, one service evolved its staffing arrangements, moving to a nurse-led model of care, recruiting a nurse whose role would be dedicated to delivering BUP-XR. This role was imagined to connect-up care, through the stretching of time that long-acting formulation creates, producing a thread of continuity for clients between the various practices that constitute 'treatment' in this arrangement:

> There's a next step in the evolution happening now […] We're going to employ a nurse to our clinic […] a nurse available to manage the medication, manage the injections but also there with the client questions and appointment changes and confusion […] So, having some case management support and then medication management injection support. (Oscar)

Tinkering allowed for more open relations, for new care practices that departed from the routine and familiar, opening up the potential for how BUP-XR could be put to use and made to work in its new situation, as its situation evolved along-with its implementation.

Conclusions

Implementing a new technology is not so simple, and "there are always contingencies and surprises" (Mol, 2009, p.1757). It is widely recognised that intervention requires complex adaptation. But despite acknowledgement of complexity, there is little emphasis on how contingencies and complexities are managed and worked-with in the practices of implementation (Byrne, 2013; Callaghan, 2008; Mowles, 2014; Rhodes & Lancaster, 2019). In this analysis, we have attended to BUP-XR's implementation as a practice-based matter of concern, shifting attention to the "messy, material […] or tedious activities that tend to be difficult to do" (Mol, 2009). The concept of tinkering helps make visible material care practices, which are often small and mundane, and thus sometimes disappear from view. Our analysis draws attention to how alterations in the time-space of intervention has effects for how care is done, and for alterations within networks of care. Tinkering slows down the expectation of rapid and dramatic change; the practices on which this technology depends demand invention and adaptation (Mol, 2009). These alterations work across different scales, with the localised work of implementation an element of more global shifts, with the absenting of particular aspects of care prompting reflection on the future of OAT as something to be cared for. By consequence, the introduction of novel long-acting formulations opens up both potentials and challenges for OAT delivery. Tinkering that is done to implement BUP-XR locally connects with a broader assemblage of trial and movement in the constitution of treatment.

Our analysis draws specific attention to tinkering as a practice of adaptation which comes together in an assemblage of evolving spatial and temporal relations to make BUP-XR work (Mol et al., 2010; Rhodes & Lancaster, 2019). Borrowing from Cussins' (1998) concept of choreography, Law (2010) emphasises the coming together of technologies with other material elements to make up care, thus drawing attention to the intricate ordering and effort that goes into such organisation. Law notes that "what may sometimes appear to be simple from the outside never is in practice". We have seen in our analysis how care is choreographed through space and time, including in the coming together of staffing rosters, room allocations, appointment booking systems, fridges, ice packs, phones, and even lollypops. Our analysis also shows how OAT care is made multiple (Law, 2010), and how practices to do with care are not always compatible and do not always cohere. The introduction of BUP-XR shows how different care practices in OAT can be in tension – BUP-XR care depends on spatial-temporal arrangements that separate it

[2] The dosing window for the monthly injections is from two days prior to the due date, and up to 14 days after the date the monthly injection is due, though state guidelines currently enable administration for up to 8 weeks from the last monthly injection without reinduction.

from the routine everyday practices of supervised daily dosing of methadone for example. However, this attempt to separate (spatially, temporally) nonetheless entangles and makes effects, altering the clinic assemblage and what treatment can do. Moreover, the very flexibility afforded by long-acting formulations was sometimes held in tension with the inflexibility of the time and space required for the administration of injections. Following Law (2010), we observe that "care depends not so much on a formula as a repertoire that allows situated action".

This analysis identified a concern for what is made present and what is made absent in the altered care network affected by BUP-XR. The multiple effects of supervised daily dosing practices are thrown into relief as they become absented. The disentangling of medication provision from practices of psychosocial support is one example, which raises not only the question of how to protect such care as it becomes absent, but also whether the clinic or the dosing event are the only (or best) temporal and spatial sites for delivering such care. We suggest this practice-based learning has relevance not only for BUP-XR, but also for the more restrictive practices of sublingual buprenorphine provision in some countries (see Kleinman et al., 2022). In this analysis, we have seen new practices emerge to handle the tensions between different objects and technologies of care, including an orientation to flexibility, as far as arrangements can stretch within material constraints. What we see here is a set of practices for "holding together that which does not necessarily hold together" (Law, 2010) – tinkering and experimenting, holding together, and apart, different enactments of care in OAT. We find, then, that tinkering is a practice which manages difference and tension, ruptures and break down, but more than this, also works to enhance good care as potentials are opened up. We argue that the disruptive potential of long-acting formulations must be understood within these wider relations. We also emphasise that there is a need for approaches which better attune to noticing how this 'good care' is done.

Reflecting on the potential for BUP-XR in OAT, it has been noted in the clinical literature that "without real system change, it may be that the impact of these medications will be missed in the future" (Ling et al., 2019, p.76). Indeed, in some settings, including North America where concern about opioid overdose is particularly urgent, scholars have emphasised the need to look beyond clinical trial outcomes and better understand 'real world' implementation practices to help mitigate against discontinuation of treatment (Iacono et al., 2024; Morgan & Assoumou, 2023; Morgan et al., 2021). Innovative technologies such as BUP-XR bring with them new and different effects, and both the technology and the settings and practices in which it is used change in unpredictable ways, requiring modes of evaluation that orient to the study of emergence and evolving experimentation (Pols & Willems, 2011). In many ways the discourse of biomedical promise of long-acting formulations has located what needs to be fixed in drug treatment – the deficit – inside the 'thing-in-itself', in a technological effort to overcome the problem of retention in treatment. However, understanding innovation not as a 'thing' but rather as a continuous process of transformation opens up consideration of how innovation might itself be harnessed as a technology of improvement in drug treatment wherein deficit can be explored in the practices of implementation. As Pols and Willems argue, "rather than promises that technologies will, by their sheer installation, 'fix' something, there is a need for more modest accounts of technologies in practices, details about ways in which technologies are working, who is using them and what goals are brought into being" (p.496).

By attending to tinkering as a continual practice of adaptation, our aim is to contribute to the generation of 'modest' accounts, so as to "strengthen care practices" (Mol et al., 2010, p.11) and illuminate the material conditions and relations which help shape change. This is a practical challenge, and by no means limited to BUP-XR. As Rhodes and colleagues (2023, p.16) note, "noticing the tinkering that is done to navigate constraining relations also guides the potential for social and structural change". We have shown, through this analysis, that change is possible. The introduction of long-acting formulations has potential to re-open questions about embedded practices and arrangements in drug treatment services, including supervised dosing, bullet-proof glass, urinalysis, and the time and place of psychosocial support, as well as consider how other social aspects of care might be recalibrated. Adaptations in the clinic assemblage can also open up new possibilities for the undoing and remaking of dynamic relations which afford the category dependency its stigmatising capacity (Treloar et al., 2022). Our analysis illuminates the potential of small and incremental movement, that creates practical difference, and is thus a form of care. Although the work of care in the context of drug treatment (or health services, more generally) may seem self-evident, directing attention to variations in practice through a socio-material approach helps to consider time, space, relational arrangements, and what is being *practically done*. Indeed, this approach might help to unpack and reconsider "what is actually done under the name of 'care' […] and what forms of care are prioritised at the expense of others" (Puig de la Bellacasa, 2015, p.707) in drug treatment. It is also a reminder that although new medicines might be hailed as 'disruptive technologies' with potential to change treatment, drug treatment is not static but always constituted by trial and movement and characterised by continuous adaptations. Changes to appointment systems, rostering, and scheduling, for example, are all small innovations done in practice, which work to tinker towards good care. Small changes – tinkering as care – can make a profound difference to the relations of care. The difference made by tinkering towards good care can help reshape what it is that treatment is and can do.

CRediT authorship contribution statement

K. Lancaster: Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **S. Gendera:** Writing – review & editing, Project administration, Formal analysis, Data curation. **C. Treloar:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Formal analysis. **T. Rhodes:** Writing – review & editing. **J. Shahbazi:** Writing – review & editing, Project administration, Investigation. **M. Byrne:** Writing – review & editing, Project administration, Investigation. **S. Nielsen:** Writing – review & editing, Investigation, Funding acquisition. **L. Degenhardt:** Writing – review & editing, Investigation, Funding acquisition, Conceptualization. **M. Farrell:** Writing – review & editing, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests

This study was supported by an Externally Sponsored Collaborative Research grant from Indivior PLC. Indivior contributed to the study design and analysis plan of the clinical parent study (Farrell et al., 2022) but not this qualitative study; Indivior had no role in collection, analysis and interpretation of data, in the writing of the manuscript, or in the decision to submit the manuscript for publication. LD and MF disclose untied educational grants from Seqirus and Indivior for the study of opioid medications.

Acknowledgements

This study was supported by an Externally Sponsored Collaborative Research grant from Indivior PLC. Indivior contributed to the study design and analysis plan of the clinical parent study (Farrell et al., 2022) but not this qualitative study; Indivior had no role in collection, analysis and interpretation of data, in the writing of the manuscript, or in the decision to submit the manuscript for publication.

The Centre for Social Research in Health at the University of New South Wales (UNSW) is supported by a grant from the Australian Government Department of Health. The National Drug and Alcohol Research Centre (NDARC) is funded by the Australian Government Department of

Health and Ageing. The views expressed in this publication do not necessarily represent the position of the Australian Government. KL is supported by the UNSW Scientia scheme, and an Australian Research Council DECRA fellowship (DE230100642). TR is supported by the UNSW SHARP scheme. LD is supported by an NHMRC Senior Principal Research Fellowship (1135991) and a US National Institute of Health (NIH) National Institute on Drug Abuse (NIDA) grant (R01DA1104470).

The authors thank the study participants for their contribution to research, as well as current and past researchers and staff, and the CoLAB Study Team. We acknowledge the following people: Jude Byrne (Australian Injecting & Illicit Drug Users League, Canberra, Australia), Mahshid Tamaddoni (Data manager, Kirby Institute, UNSW Sydney, Australia); Madeline News, Zoe Griffin, Zein Ali (research assistants, NDARC, UNSW Sydney, Australia); Jason Gascoigne (study coordinator, DASSA, South Australia, Australia), Mariana Nasr, Adelaine Nyau, Rebecca Lewis, Linda Broadbent, Xiu Qin Lim, Raphela Van Der Laan, Natasha Kuller, Jessica Leonard, Tammy Dix, James Buchanan, Duncan Tyson (Clinic staff, DASSA, Adelaide, Australia); Teodora Zanesheva-Karamanlieva (study coordinator, St Vincent's Hospital, Sydney, Australia), Tom Kural, Linda Hotong (Clinic Staff, St Vincent's Hospital, Sydney, Australia); Bonny Puszka (study coordinator, Royal North Shore Hospital, Sydney, Australia), Alison Blazey, Esther Han, Helena Cheung, Bernard Chiuarah, Jenny Trinh Lee, Ariana McCauley, Leanne Walsh, Jan Armstrong, Nouvelle Thwaites, Ivy Kwon (clinic staff, Royal North Shore Hospital, Sydney, Australia); Rachael Skews (study coordinator, Frankston Healthcare, Melbourne, Australia), Lionel Kok, Belinda Smith, Naren Morris (clinic staff, Frankston Healthcare, Melbourne, Australia); Danielle Cassar, Teresa Fitzmaurice (study coordinator, Western Health hospital, Melbourne, Australia), Anthony Hew, Shani Pavia, Dimce Kotevski, Fiona Goodwin, Marcus Forsythe, David Silkoff, Tracy Wrigley (Clinic staff, Western Health hospital, Melbourne, Australia); Susan Hazelwood, Louise Go (study coordinator, Newcastle Pharmacotherapy Service, Newcastle, Australia), Michelle Hall, Callen Farmer, Cathy Cochrane, Anthony Winmill, Sally McKenna, Stacey Weedon, Tarun Yadav (Newcastle Pharmacotherapy Service, Newcastle, Australia). We also acknowledge and thank our colleagues on the CoLAB Protocol Steering Committee: Briony Larance, Suzanne Nielsen, Gregory Dore, Jason Grebely, Adrian Dunlop, Nicholas Lintzeris, Robert Ali, Marian Shanahan, Mike McDonough, Mark Montebello, Craig Rodgers, Sione Crawford.

Ethics approval

The authors declare that they have obtained ethics approval from an appropriately constituted ethics committee/institutional review board where the research entailed animal or human participation.

The study received ethical approval from St Vincent's Hospital Sydney Human Research Ethics Committee (HREC/18/SVH/221) and was registered with ClinicalTrials.gov (NCT03809143).

Funding sources

This research received funding from the following sources

This study was supported by an Externally Sponsored Collaborative Research grant from Indivior PLC. Indivior contributed to the study design and analysis plan of the clinical parent study (Farrell et al., 2022) but not this qualitative study; Indivior had no role in collection, analysis and interpretation of data, in the writing of the manuscript, or in the decision to submit the manuscript for publication. The Centre for Social Research in Health at the University of New South Wales (UNSW) is supported by a grant from the Australian Government Department of Health. The National Drug and Alcohol Research Centre (NDARC) is funded by the Australian Government Department of Health and Ageing. The views expressed in this publication do not necessarily represent the position of the Australian Government. KL is supported by the UNSW Scientia scheme, and an Australian Research Council DECRA fellowship (DE230100642). TR is supported by the UNSW SHARP scheme. LD is supported by an NHMRC Senior Principal Research Fellowship (1135991) and a US National Institute of Health (NIH) National Institute on Drug Abuse (NIDA) grant (R01DA1104470).

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