



Research Paper

Systems mapping to understand complexity in the association between image and performance enhancing drugs (IPEDs) and harm



Geoff Bates^{a,*}, Rob Ralphs^b, Vincent Walker Bond^b, Ian Boardley^c, Viv Hope^d, Marie-Claire Van Hout^d, Jim McVeigh^b

^a Institute for Policy Research, University of Bath, 10 West, Claverton Down, Bath, BA2 7AY, UK

^b Department of Sociology, Manchester Metropolitan University, Geoffrey Manton Building, 4 Rosamond Street West, Manchester, M15 6LL, UK

^c School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

^d Public Health Institute, Liverpool John Moores University, 3rd Floor Exchange Stations, Tithebarn Street, Liverpool, L2 2QP, UK

ARTICLE INFO

Keywords:

Anabolic steroids
Image and performance enhancing drugs
Complex systems
Systems mapping
Harm reduction

ABSTRACT

Background: Effective harm reduction work is needed to prevent and respond to the harms associated with image and performance enhancing drug (IPED) use and the diverse needs of IPED communities. Methods based around understanding and mapping complex systems have previously been applied to advance thinking on a range of complex health issues. We applied a systems perspective to explore factors that contribute to IPED-related harms in the UK and to identify harm reduction priorities.

Methods: An illustrative systems map was developed based on methods for mapping complex systems with expert stakeholders. Participants in two online workshops debated the important factors contributing to harm amongst people who use IPEDs and helped to refine and clarify the map. Discussions using the map reflected on where in the system intervention is needed and the policy implications.

Results: Stakeholders (n=18) identified 51 distinct factors as being important determinants of IPEDs-related harms, and the connections between them. These were grouped under nine domains that formed this system: identity, cognitive processes, beliefs about risk and harm, health and wellbeing, social environment, beliefs about healthcare, healthcare providers, interventions, and IPED markets. Four harm reduction priorities identified through reflexive discussion included providing a wider range of interventions, improving engagement between the IPED communities and healthcare professionals, new approaches to disseminating information in the community, and early intervention.

Conclusion: Systems mapping methods are a useful approach to engage stakeholders to discuss drug use issues. A comprehensive policy response is required to this complex issue that recognises diversity in IPEDs communities, their decision-making, and their intervention and service needs, as current approaches are failing to adequately address important areas of harm. Engaging with a wide range of stakeholders is critical to generate new insights that can help respond effectively to reduce the risk of health harms.

Introduction

Image and performance enhancing drugs (IPEDs) are a group of substances that are used to alter physical appearance and/or performance. The most prominent are used to support the development of lean muscle mass (anabolic androgenic steroids, human growth hormone), but this diverse group also includes weight loss drugs (e.g., dinitrophenol) and skin tanning agents (e.g., melanotan II). Use of IPEDs, and particularly anabolic androgenic steroids, has become established as a public

health concern over the past 30 years (McVeigh & Begley, 2017) with evidence highlighting widespread use amongst members of the gym-using community (ACMD, 2010; Christiansen, 2020; Salinas et al., 2019). A substantial evidence base establishes a wide range of physical and psychological associated health harms (Pope et al., 2014). For example, long-term IPED use at high dosages is associated with risk for cardiovascular poor health (Baggish et al., 2017), hypogonadism (Kanayama et al., 2018; Vilar Neto et al., 2021), and structural changes to the brain (Bjørnebekk et al., 2019; Hauger et al., 2019).

* Corresponding author.

E-mail address: gb818@bath.ac.uk (G. Bates).

<https://doi.org/10.1016/j.drugpo.2022.103801>

The policy approach to IPEDs in the UK is unique internationally, as supply, manufacture, and distribution is legislated against under the Misuse of Drugs Act (1971), but personal use is not criminalised. Perhaps consequently, in the UK there has been little policy focus on preventative interventions outside of drug testing and education for elite athletes. Interventions in the UK have been largely limited to attempts to engage people who use IPEDs in the comprehensive national network of needle and syringe programmes (NSPs) to prevent transmission of bloodborne viruses (BBVs) and reduce injection-related infection and injury. Additionally, a limited number of NSPs provide interventions specifically targeting people who use IPEDs, most commonly the provision of specialist information or staff with specialist IPED knowledge (McVeigh et al., 2021). While long championed (Morrison, 1994), specialist IPED services remain rare and scarcely evaluated.

A complex issue

Recently, researchers have called for a broader range of IPED harm reduction interventions and to increase efforts to engage IPED communities with services and healthcare (Bates et al., 2021; Harvey et al., 2020; Hope et al., 2020; Jacka et al., 2020). This will require new policy frameworks and priorities, however preventing and reducing the harms associated with IPED use is not straightforward. Firstly, there is very little existing evidence on effective responses to guide the implementation of interventions, policies and services, including provision of harm reduction services or approaches to manage cessation (Bates et al., 2019). This is the case even for well-established approaches such as the provision of injecting equipment in NSPs.

Secondly, IPED use is a complex behaviour. IPED communities are diverse and include great variation in characteristics, motivations, patterns of use, and associated health risks (Begley et al., 2017; Christiansen, 2020; Christiansen et al., 2016; Murray et al., 2016; Zahnow et al., 2018). The nature of IPED use is multifaceted with a range of influences across socioecological levels combining to influence decision-making (Bates et al., 2018). It seems unlikely therefore that any single approach will be able to engage or adequately respond to the diverse needs of IPED communities. We need to consider this variation in individuals and the complex and multiple pathways through which their IPED use develops if we are to successfully design, implement, and evaluate effective and appropriate interventions and policy frameworks to reduce harm.

Applying systems perspectives to respond to complex problems

To explore changes in practice and policy we can therefore look to methods that help us to understand complexity. A development in public health research is the application of systems thinking and the conceptualisation of interventions as 'events' within complex systems (Hawe et al., 2009; Moore et al., 2019; Peters, 2014). A system represents a group of interrelating and interacting components that directly or indirectly influence each other, with the combined influence of multiple components different from that of any individual component in isolation (Luke & Stamatakis, 2012). Applying systems perspectives to public health problems can help us to understand variations in outcomes and behaviours and to account for this complexity in efforts to tackle these problems.

Complexity in drug-related harms can relate to the multiple determinants across the system that may vary across populations and settings at different times, and the interactive and cumulative effects of the system itself. This has implications for the design, implementation, and evaluation of interventions and policies that seek to bring change in a system. Where we do not understand the system we are seeking to influence, this may lead to the adoption of interventions that may seem logical or appropriate but are ultimately ineffective or counterproductive (Atkinson et al., 2015; Sterman, 2006). A systems perspective

supports researchers and those developing policy and practice to overcome this and to identify and understand complex problems; including the components in the system, the role of diverse actors, and, importantly, the relationships and interactions between them (Carey et al., 2015).

Adopting a systems-based approach to IPED use will help us to understand harms experienced by people who use IPEDs, and how to better deliver interventions to reduce risk of harm (Bates & Vinther, 2021). It will help us understand, not only the determinants of harmful outcomes and behaviours that increase the risks of harm and what interventions should target, but where in this system we might intervene and have the greatest impact and importantly, avoid causing unintended harm.

Systems mapping

A useful starting point in developing a systems perspective is to co-produce with stakeholders illustrations of the important factors in a system and how they relate to and interact with one another. These images of the causal relationships in a system is one approach to mapping complex systems based on representations of how we think the system is behaving (Hovmand, 2014). Such maps of systems dynamics have been applied to aid understanding and new insights on a range of complex issues such as physical activity (Guariguata et al., 2021; Rutter et al., 2019), obesity (Allender et al., 2015), childhood health inequalities (Jessiman et al., 2021), and mental health (Stansfield et al., 2021). Systems mapping can support understanding of the factors that contribute to problems across different sectors and settings and opportunities for intervention (Augustsson et al., 2019; Egan et al., 2019; Rutter et al., 2019). They can support stakeholders to understand their roles and place in the system, and monitoring and evaluation efforts (Rutter et al., 2019).

Developing systems maps can help build consensus amongst groups of stakeholders with different perspectives, who work together to develop visual conceptualisations of systems (Cavill et al., 2020). This collaborative activity with researchers and stakeholders gives communities, such as people who use drugs, a voice in research and provides an opportunity to reflect together on their experiences and perspectives, and to debate tensions and diverse priorities relating to harms, risks, and intervention needs. Ultimately this will help to inform the development of interventions and services. Research teams have recently emphasised the importance of co-production to improve the implementation and effectiveness of IPED interventions (Atkinson et al., 2021; Bates & Vinther, 2021; Gilmore et al., 2020; van de Ven et al., 2020) and it is critical that stakeholders are actively engaged in research as equal partners to academics.

Aims and scope

The current study adopted a systems perspective to explore IPED use and harm amongst people who use IPEDs in the UK. The aim of the study was to co-create with stakeholders an illustrative causal systems map of IPED-related harms that can be used to identify the potential mechanisms to reduce harmful outcomes and improve health and wellbeing amongst diverse IPED communities.

A mapping team, based upon the 'core modelling team' proposed by Allender and colleagues (Allender et al., 2015) for systems mapping, led the production of the map and facilitation of workshops. The team consisted of academics experienced in running participatory workshops and with expertise in IPED use. Development of study aims and scope were supported by the wider research team of investigators on the project that this study was part of (NIHR132730, McVeigh et al., 2021) and its Public Expert Advisory Board. The mapping team proposed criteria to guide the development of the map (Table 1). While broad in nature, the criteria were intended to establish initial boundaries to the system and, therefore, the scope of the problem of 'harmful IPED use'.

Table 1
Scope of the study.

Criteria	Scope
Image and performance enhancing drug (IPED) use Harmful IPED use	Use of anabolic steroids or ancillary substances that promote muscular enhancement, used for physical appearance or performance purposes. Factors that influence the extent that IPED use is associated with harmful outcomes to the individual or to others. The emphasis was on identifying the most significant factors that increase or reduce the risk of IPED-related harms (rather than simply the likelihood of using IPEDs).
Population	The IPED community including people who currently use or have recently stopped using IPEDs, or those who are preparing to start using IPEDs. People who have never used IPEDs, or are not preparing to start, were outside the scope.
Setting	People in community settings in the United Kingdom.

Method

The overall concept was to bring together stakeholders representing a range of experience and expertise relating to IPED use, and through facilitated discussions to support them to identify and group factors that influence harmful IPED use, and the relationships between them. Our approach was based upon processes used by research teams carrying out studies exploring public health problems with expert stakeholders to produce causal maps of systems (e.g. (Allender et al., 2015; Brownson et al., 2015; Guariguata et al., 2021; Jessiman et al., 2021)). In these examples the specific processes followed vary but involve stakeholders representing different perspectives relating to a challenge area working together to identify factors that they think are important for the outcome of interest. In facilitated workshops they develop models or maps to demonstrate how these factors influence one another. The approach is a form of stakeholder participatory research, with its theoretical basis in system dynamics (Hovmand, 2014) and group model building (Vennix, 1999).

Process for building the map

Stakeholders, contributed to the development of the systems map through two workshops held five weeks apart in Spring 2021. Due to COVID-19 pandemic restrictions both workshops were held online. The online approach necessitated the use of virtual boards to record ideas and build the map, and during our limited time with the stakeholder group, we adopted a process whereby stakeholders identified the content of the map during the first workshop. The mapping team then used the content generated in the first workshop to build a first draft of the map, and stakeholders in the second workshop then refined it and addressed areas of uncertainty. The content of the workshops and mapping process is summarised in Fig. 1 and was based on an iterative four phase process.

Step 1. Preparation

The mapping team partially populated three boards on a shared online whiteboard. The boards represented potential influences on harmful IPED use at the individual, social, and policy levels and were used to stimulate discussion using evidence-based factors likely to be included with the map. The team drew on previous works exploring the determinants of harmful IPED use to identify areas of consensus in the literature (Bates et al., 2018; Begley et al., 2017; Christiansen, 2020; Zahnnow et al., 2018).

Step 2. Identifying system components

Participants received an introduction to systems thinking and held discussions to finalise the scope of the exercise. In facilitated groups, participants proceeded to rotate through the three boards guided by the overarching question “What are the important factors that influence harmful use of IPEDs in the UK?”. They debated the pre-identified

factors, identified new ones, grouped them, and discussed how they increased or reduced risk of harm and related to other components. Facilitators prompted participants to explain their thinking and recorded the discussion on the boards in real time so that participants could reflect on other groups’ ideas.

Step 3. Building the map

- Data recorded on the boards and extensive facilitator notes taken during the workshop were analysed and discussed between the mapping team. The components were tabulated with a summary of their meaning and effect on IPED-related harm, based on stakeholder comments. Overlapping components were combined where appropriate and, building on the grouping that stakeholders initiated during the workshop, components with commonality were grouped into domains. Using Kumu system mapping software (www.kumu.io), the team built the digital map by adding components within each theme and drawing the connections between them. Areas of uncertainty such as where there appeared to be less consensus, ambiguity, or a lack of data on a component or relationship were highlighted.
- The draft digital map was presented at the start of the second workshop. Small, facilitated groups discussed and provided feedback as they worked their way around the map. Groups were asked to highlight gaps and misrepresentations, address areas of uncertainty, and provide feedback on suitability of domains. This was an essential step as several components and connections were added or changed through this process. Facilitators again recorded suggested changes to the map on the virtual whiteboard and took comprehensive notes on discussions.

Phase 4. Refining the map

In a similar process to phase 3, the team reviewed the inputs made during the workshop and used these to refine the digital map. The updated map was shared digitally with all participants who were given the opportunity for further review, resulting in a small number of additional minor adjustments to the map.

Alongside the mapping exercise, the workshops included group discussions on the implications for harm reduction. The questions used to promote discussion are included in Fig. 1. The map was used as a reflexive tool to support these discussions, which were recorded in detail by facilitators on the virtual boards. The mapping team reviewed the notes from these discussions to identify key implications for intervention development, service delivery, and policy. Written summations were presented back to stakeholders to review and comment on alongside the updated map (Phase 4) to ensure that the key harm reduction implications identified were accurately represented workshop discussions.

Stakeholder identification

To ensure that a range of perspectives were represented, the team included participants in each of the following groups: practitioners, academics, policymakers, public health experts, and people with lived experience of IPED use. A shortlist was identified through the study advisory

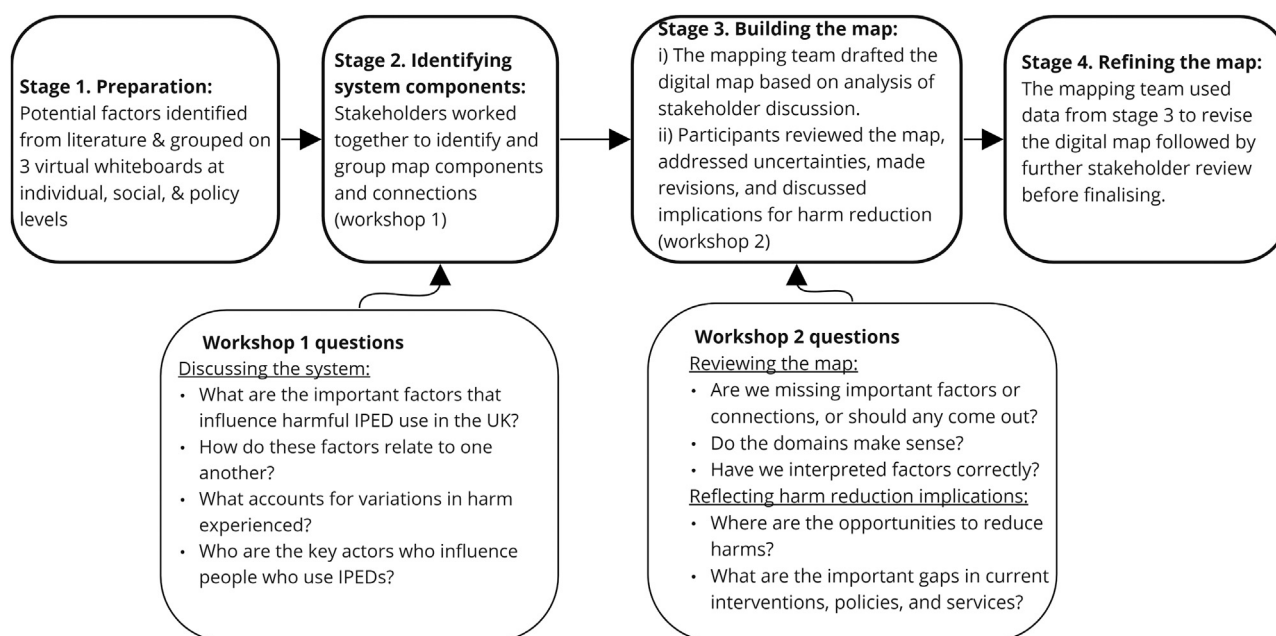


Fig. 1. Process for building the systems map.

group with potential participants shortlisted based on i) their anticipated understanding of the system and ii) their areas of expertise. Of 21 stakeholders invited to participate, 18 accepted and represented a mixture of experience with IPEDs including current or previous personal use, and/ or experience working with people who use IPEDs. Stakeholders were based in different locations in the UK, and 16 took part in both workshops with the remaining two attending either the first or second session only. The study was approved by the ethics committee at University of Bath and informed consent was obtained from all participants.

Results

Through the process described previously, the research team and stakeholders co-produced an illustrative systems map of the influences on harmful IPED use. We provide an overview of the components of the system, present the final map, and discuss the complexity in reducing harms through the key implications that participants identified for practice and policy.

Determinants of harmful IPED use

Through the workshops, 51 factors were identified as important influences on harmful IPED use. These factors are the components within the system that create or reduce the potential for harm, and form the content of the map. A description of each of these components and a summary of its association with IPED-related harm and other system components is provided in the supplementary materials.

The components include a range of individual-level factors relating to how people who use IPEDs process information, think about risk and their health, their self-identity, and their beliefs about healthcare. The map demonstrates how stakeholders discussed these individual-level factors being influenced by factors in social networks and communities. For example, at the social-network level, group norms and advice from peers influences thinking about risk and harms, how information is processed, and feelings about identity. Community-level factors such as prevalence and accessibility of IPEDs in the local area, including access to suppliers, were identified as important influences on norms and pressures relating to IPED use and physical appearance within social networks and wider society. The availability and nature of services and

healthcare in the community were directly linked to the potential for harm through the types of interventions provided and the skills and practices of health professionals, as well as through influencing other factors such as beliefs about risk and harm, and attitudes about engaging with healthcare. The wider policy context at the societal level included perceptions that focus in the UK on preventing BBV virus transmission amongst this population reduces the potential for delivering a wider range of interventions, which was linked to the extent that service engagement is valued. The association between policy and harm was also demonstrated through processes for producing low quality IPEDs linked to current UK legislation relating to importation and distribution of these substances.

To support understanding of the system and how it was arranged in the map, the mapping team grouped components with commonality together into nine domains. The domains were agreed with participants at the second workshop and are defined in Table 2. The domains 'Identity', 'Cognitive processes' and 'Beliefs about risk and harm' appeared highly significant due to the amount of discussion around them and their connections with other themes. Therefore, we presented these centrally on the map and organised the other components based on the relationships between components across themes.

The final map was adapted into an image using mapping software Vensim (www.vensim.com)¹ and is presented in Fig. 2. The map includes the 51 factors presented within the nine domains, with the causal connections represented by the connecting arrows.

Implications for harm reduction

Four key areas to respond to IPED-related harms were identified through the mapping team's review of stakeholder discussions reflecting on the map, based on the extensive note taking during both workshops.

¹ An online interactive version of this map is available at <https://www.anabolicsteroids.org.uk/influences-on-harmful-image-and-performance-enhancing-drug-use/>. The online version has additional functionality using the Kumu software (www.kumu.io). It includes the definitions provided in the supplementary materials built into the components of the map and the ability to isolate and zoom in on different domains and connections.

Table 2

Nine domains in the system.

1. **Identity:** the qualities and values that an individual holds and that are important to them.
2. **Cognitive processes:** the mental processes and biases involved in gaining and understanding information.
3. **Beliefs about risk and harm:** the attitudes that an individual holds towards the possibility of experiencing risks and harms.
4. **Health and wellbeing:** the physical and mental health and wellbeing of an individual.
5. **Social environment:** the social settings and cultures that people who use IPEDs live, work and train in, and where they interact with others and access information.
6. **Beliefs about healthcare:** beliefs about healthcare providers and the medical treatment, formally delivered interventions and services that are available to people who use IPEDs.
7. **Healthcare providers:** the skills, understanding and actions of healthcare providers relating to their engagement with people who use IPEDs.
8. **Interventions:** healthcare interventions that are provided on a formal basis to people who use IPEDs.
9. **The IPEDs market:** the manufacture, distribution and sale of IPEDs.

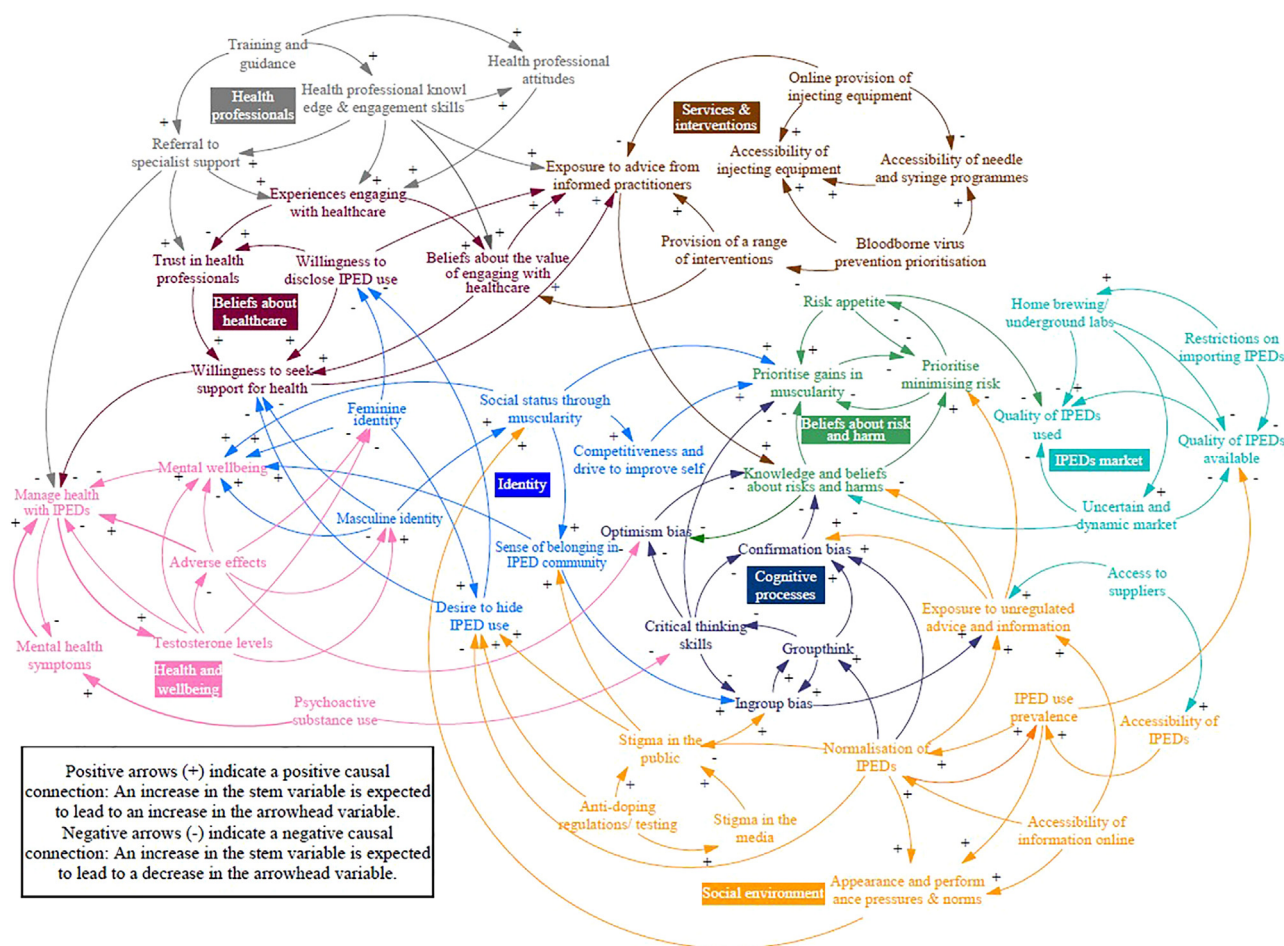


Fig. 2. A systems map of factors influencing IPED related harm in the UK.

Increase access to a wider range of interventions

Participants highlighted that the map emphasised that the widely available harm reduction interventions in the UK delivered through NSPs predominantly only seek to increase access to sterile injecting equipment, and therefore are not addressing the large number of other determinants of harm. Further, the group debated the extent that BBV prevention potentially acted as a limiting factor on engagement with healthcare, and subsequently the provision of advice and care. Specifically, some identified that since sharing of injecting equipment is believed to be uncommon within the IPED communities, this may limit the attractiveness of services based around this form of intervention. The policy focus on BBV prevention over other forms of interventions was also discussed as limiting the types of interventions that services are resourced to provide. As shown in Fig. 3, the prioritisation given to BBV prevention has positive impacts on access to sterile injecting equip-

ment amongst IPED communities but was viewed as likely to reduce the perceived value of attending services. The connections in this excerpt from the map between the factors 'provision of a range of interventions', 'beliefs about the value of engaging with healthcare' and 'exposure to advice from informed practitioners' illustrate stakeholder's belief that offering a wider variety of interventions valued by the IPED communities would potentially contribute to reducing harm through increasing engagement and access to regulated advice.

For example, substance testing services were recommended in recognition of the varying quality of IPEDs, a problem discussed as amplified by 'home brewing' where IPEDs are manufactured in non-pharmaceutical settings (Brennan et al., 2018; Turnock, 2020), as well as a method to engage the IPED communities and support understanding of risk. It was suggested that some members of IPED communities are willing to pay for services such as testing substance quality and metabolic testing to monitor health. Participants also highlighted the need for

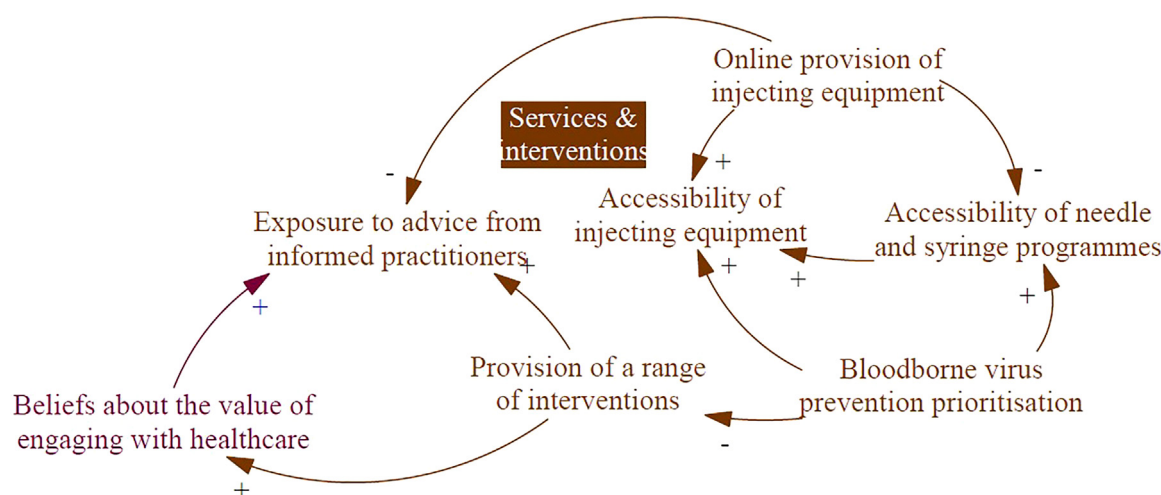


Fig. 3. The impact of a policy focus on BBV prevention.

treatment focused interventions in response to factors contributing to poor health and wellbeing outcomes, including improved referrals in primary healthcare to endocrinologists, access to therapeutic interventions, and approaches to encourage and support IPED cessation.

Interventions to overcome barriers to engagement with health services

Poor understanding about IPED risks and harms and low prioritisation of risk were identified as significant influences on harmful IPED use at the individual level. Many factors were believed to contribute to risk appetite and risk reduction actions including where advice and information were sought. Participants agreed that an imbalance between exposure to information from influential voices in the community ('exposure to unregulated advice & information'), in comparison to that from health professionals ('exposure to advice from informed practitioners'), was a significant concern. As demonstrated through the connections to factors within the domain 'Beliefs about risk and harm', this imbalance was perceived to negatively impact knowledge and risk minimisation behaviours.

Increasing engagement with services was perceived to be a key challenge to overcome, but if successful would help overcome this imbalance through increasing exposure to advice from informed practitioners. This is demonstrated through the excerpt from the map in Fig. 4, which also represents how the factors within the 'health professionals' and 'beliefs about healthcare' domains were recognised as important in improving engagement. They were discussed as offering several avenues that could be addressed to improve IPED communities' experiences, attitudes, and beliefs about engagement with healthcare. In addition to potentially offering a wider range of interventions, improving knowledge and skills amongst health professionals through improved and increased training and guidance was highlighted as a key area to address. However, participants commented that this is a challenging intervention area as there are significant training and knowledge gaps in healthcare providers for whom IPED use is not a core concern or part of their education.

New ways of disseminating relevant information to influence beliefs about risk and harm

In addition to emphasising the need to increase engagement with healthcare professionals, participants highlighted the need for new ways to disseminate advice to the community. Factors within the identity and cognitive processes domains including ingroup bias and the strong sense of belonging to IPED communities help to explain why information from influential voices may be trusted and valued. When discussing ap-

proaches to reduce harm through tackling this issue, participants recognised the influence of the social environment. The role of peers and sociological influences on individual-level factors are demonstrated in Fig. 5 and were suggested to strongly influence beliefs about risk ('Beliefs about risk and harm' domain), provide positive reinforcement for IPED use ('Identity' domain), and influence how information is received and understood ('Cognitive processes' domain).

To bring change in these social environments, participants agreed that assertive outreach approaches are needed to increase high quality information provision and to reach those who were starting or thinking about using IPEDs. The power and influence of online influencers and experienced members of IPED communities whose voices are respected within these communities indicates that they are potentially excellent information providers, if they can be supported to provide reliable, relevant, and relatable information. Identifying and building relationships with key influencers in the community was suggested to not only potentially improve information provision, but also to help address factors elsewhere in the system such as beliefs about the value of engaging with healthcare and trust in health professionals.

Early intervention and prevention targeting the domains: identity, beliefs about risk and harm, and cognitive processes

Participants debated how approaches to build skills and resilience could help to tackle the harmful impacts of the factors in Fig. 5. Discussed in the context of school-based interventions as part of physical or health education curricula, examples included focusing on critical thinking skills, media critique, social media management, and establishing norms and expectations about bodies and physiques. These were identified as being important factors that influenced vulnerability to unreliable and biased information sources, body image, and self-esteem.

We did not set out to discuss prevention of IPED use but participants discussed the early intervention opportunities highlighted above as having potential outcomes as prevention of harm and IPED use itself. Some participants commented on the complex ways that higher prevalence of IPED use in the social environment may contribute towards more harmful use amongst others through changing norms around IPED use and physical appearance. While it was acknowledged therefore that prevention activities might play a part in reducing harms, it was emphasised that further criminalisation of IPED use, as in countries such as the USA and Australia (Collins, 2019; Van de Ven & Zahnow, 2017), would not in their view reduce prevalence. It was anticipated this may have unintended consequences elsewhere in the system such as leading to further uncertainty in the IPEDs market and reduced engagement with healthcare.

Discussion

By conceptualising the multiple factors that contributes to or reduces the risk of harm, and their connections, it is hoped we can encourage new ways of thinking about this challenge. Using a pragmatic process to engage diverse stakeholders, we produced a map that represents stakeholder understanding of the system that determines harmful IPED use in the UK. It is intended as a tool to help communicate the nature and complexity of IPED-related harms and to support stakeholders to think about how to respond to them. While produced in the UK context, many of the components and connections identified will be applicable internationally and the map may be useful to explore variations in different contexts.

Reducing harmful IPED use

The map presented here can help to identify areas for intervention and outcomes that these interventions can seek to change. Recently, several studies have called for changes in how we support good health amongst people who choose to use IPEDs through seeking new ways to engage with IPED communities and additional interventions (Bates et al., 2021; Harvey et al., 2020; Hope et al., 2020; Jacka et al., 2020). The four key areas for harm reduction that our stakeholders identified (access to a wider range of interventions, better engagement between IPED communities and healthcare professionals, new ways of disseminating information, and early intervention to promote later healthy decision-making) all reinforce messages about rethinking harm reduction policies.

Currently, UK IPEDs policy is largely based around reducing supply and preventing injection-related infection and injury through the provision of NSPs, with little attention given to, or funding for, other activities. Stakeholders in our study felt that the focus on preventing sharing of injecting equipment within IPED communities is not only disproportionate to the extent of the problem, but the emphasis on injection behaviours may be a deterrent to service engagement (Underwood, 2019) including the estimated one third of this population that only ever use IPEDs orally (van de Ven et al., 2020). However, there is evidence of HIV and hepatitis B and C infection amongst IPED communities in the UK (Hope et al., 2016; Hope et al., 2013) and while, for some, priorities are likely to be on other health issues, for others there remains a need to reduce the risk of BBV transmission through encouraging safe sexual practices and providing sterile injecting equipment (McVeigh, 2019).

This debate highlights that harm reduction approaches need to be appropriate to those that they are targeting and we must recognise the substantial diversity in IPED communities such as relating to types of IPEDs used (Begley et al., 2017), methods of administration (van de Ven et al., 2020), attitudes towards risk (Christiansen et al., 2016; Zahnow et al., 2018), and motivations for use (Brennan et al., 2016; Greenway & Price, 2018). While studies of IPED use in the UK have commonly focused on young white males, studies highlight IPED use amongst other demographic groups including women (Begley et al., 2017), men who have sex with men (Hibbert et al., 2021), older men (Harvey et al., 2021; Turnock, 2021), and South Asian communities (Van Hout & Kean, 2015), which adds to this diversity. There is therefore great variation in needs and preferences for healthcare, services, and interventions. As our map illustrates, this is a complex behaviour with many determinants at multiple levels in the system and currently interventions are only designed to address a small proportion of these. A policy framework that recognises the need for multiple interventions that seek to address different types of risks and harms amongst different groups is needed. It is increasingly evident that no 'one size fits all' approach to engaging with this population and tackling IPED-related harms is sufficient (McVeigh, 2019).

We echo calls from other research groups to co-produce interventions with stakeholders including members of IPED communities (Atkinson et al., 2021; Harvey et al., 2020; van de Ven et al., 2020)

to help ensure that these complexities are better considered and to enhance the potential for interventions to meet diverse needs. Collaborating with IPED communities and other stakeholders to understand needs and barriers to engaging with healthcare is critical. Our map illustrates the importance of improving trust in, and perceived usefulness of, engaging with health professionals to improve access to healthcare. This is likely to need both interventions that target professionals and that seek to build confidence in health services amongst IPED communities. Developing peer-based interventions to disseminate information and promote service use in the community may help to overcome the barriers to engagement illustrated in the map (Bates et al., 2018; Kimergård & McVeigh, 2014). Additionally, it is possible that engaging in effective co-production will support the identification of new possibilities to enhance the delivery of harm reduction. For example, stakeholders in our study suggested that some members of IPED communities may be willing to pay for some services although it should be noted that other stakeholders have indicated less support for this and raised concerns about equity of access (Hope et al., 2020).

Our study highlights how cognitive processes and aspects of identity contribute to decision-making, and addressing these issues are likely to be beyond harm reduction services in most instances. This was reflected in how our participants discussed the potential for school-based interventions to establish generic critical thinking skills and healthy body ideals that would help support later healthier decision-making and behaviours. Government guidance on school-based health education in England encourages covering media literacy and body image expectations (Department for Education, 2019), and policymakers should seek to enhance uptake in schools of toolkits and modules designed to further address these factors (Mental Health Foundation, 2017). Considering IPED use alongside mental health topics such as eating disorders and body image wellbeing in prevention and education will help in developing relevant materials and messages. Evaluation of the impacts of such approaches on later IPED decision-making will be needed to understand optimal delivery, and importantly the main outcomes should include the experience of harms and of healthy decision-making amongst people who use IPEDs, as well as the impact on IPEDs use.

Limitations and strengths

We acknowledge that there are limitations to the approach and output. We have not attempted to quantify the associations between the different factors included in the map that influence harmful IPED use. For example, approaches such as creating formal causal loop diagrams with balancing and reinforcing loops are sometimes used within systems mapping (Allender et al., 2015). Rigorous modelling approaches, in contrast to the soft systems approach applied here, may be an additional step to demonstrate causality. However, such techniques require extensive evidence to support the production of formal causal maps, and quantifying relationships in a system may be difficult or even impossible to achieve (Rutter et al., 2020). The process was based on common methods to build systems maps with groups of stakeholders, but we acknowledge that an alternative group may have produced a different map. For example, in contrast to factors relating to healthcare provision and how information is received and processed our map may underrepresent societal-level factors such as political and economic influences on harms. However, the components were drawn from a substantial evidence base and the experience and knowledge of a diverse group of stakeholders, including members of IPED communities, and the active engagement with this group was a strength of the study. Applying the map in different settings and with different stakeholders will help to refine and improve it, and a specific investigation of societal-level influences may be required.

We reflect that while the map's content was generated by stakeholders, the online workshop format limited our ability to co-build the map. We considered asking participants to engage in map building but determined that the time needed to provide instructions and support to use

the required software was too great and would have impacted on the quality and quantity of discussions. While the online format likely had some negative impacts, we also believe it had strengths, including supporting easy access for geographically spread stakeholders, and anonymous participation for one stakeholder who discussed their experiences dealing IPEDs and did not wish to be identified.

Conclusion

Systems mapping methods can be a useful approach to engage stakeholders to discuss complex substance use issues and come to shared understandings. The components and connections both within and across nine domains illustrate the complexity of factors influencing harmful IPED use. The factors are spread over multiple levels in the system, which reinforces the need to think about IPED use as a complex issue that requires a comprehensive policy response that recognises the substantial diversity in IPED communities, their decision-making, and their intervention and service needs. Engaging a wide range of stakeholders in policy and intervention development will be critical to understand this complexity and to generate new insights that can help respond effectively to reduce risk of health harms.

Declarations of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Geoff Bates: Conceptualization, Methodology, Investigation, Writing – original draft, Visualization. **Rob Ralphs:** Conceptualization, Methodology, Investigation, Writing – review & editing, Visualization. **Vincent Walker Bond:** Investigation, Writing – review & editing. **Ian Boardley:** Conceptualization, Writing – review & editing. **Viv Hope:** Conceptualization, Writing – review & editing. **Marie-Claire Van Hout:** Conceptualization, Writing – review & editing. **Jim McVeigh:** Conceptualization, Methodology, Investigation, Visualization, Writing – review & editing, Supervision, Funding acquisition.

Acknowledgements

This study was carried out in partial fulfilment of the UK National Institute for Health Research development grant (NIHR 132730), Image and Performance Enhancing Drugs (IPEDs): Assessment of available intelligence and research gaps to inform intervention evaluation

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2022.103801.

References

- ACMD. (2010). *Consideration of the anabolic steroids*. London: The Stationery Office.
- Allender, S., Owen, B., Kuhlberg, J., Lowe, J., Nagorcka-Smith, P., Whelan, J., & Bell, C. (2015). A community based systems diagram of obesity causes. *PLoS One*, 10(7), Article e0129683.
- Atkinson, A. M., van de Ven, K., Cunningham, M., de Zeeuw, T., Hibbert, E., Forlini, C., & Sumnall, H. R. (2021). Performance and image enhancing drug interventions aimed at increasing knowledge among healthcare professionals (HCP): Reflections on the implementation of the Dopinglinkki e-module in Europe and Australia in the HCP workforce. *International Journal of Drug Policy*, 3, Article 103141.
- Atkinson, J. A. M., Wells, R., Page, A., Dominello, A., Haines, M., & Wilson, A. (2015). Applications of system dynamics modelling to support health policy. *Public Health Research & Practice*, 25(3), Article e2531531.
- Augustsson, H., Churrua, K., & Braithwaite, J. (2019). Re-energising the way we manage change in healthcare: The case for soft systems methodology and its application to evidence-based practice. *BMC Health Services Research*, 19(1), 666. 10.1186/s12913-019-4508-0.
- Baggish, A. L., Weiner, R. B., Kanayama, G., Hudson, J. I., Lu, M. T., Hoffmann, U., & Pope, H. G. (2017). Cardiovascular toxicity of illicit anabolic-androgenic steroid use. *Circulation*, 135(21), 1991–2002. 10.1161/circulationaha.116.026945.
- Bates, G., McVeigh, J., & Leavey, C. (2021). Looking beyond the provision of injecting equipment to people who use anabolic androgenic steroids: Harm reduction and behavior change goals for UK policy. *Contemporary Drug Problems*, 48(2), 135–150.
- Bates, G., Tod, D., Leavey, C., & McVeigh, J. (2018). An evidence-based socioecological framework to understand men's use of anabolic androgenic steroids and inform interventions in this area. *Drugs: Education, Prevention and Policy*, 1–9. 10.1080/09687637.2018.1488947.
- Bates, G., Van Hout, M.-C., Teck, J. T. W., & McVeigh, J. (2019). Treatments for people who use anabolic androgenic steroids: A scoping review. *Harm Reduction Journal*, 16(1), 75–75. 10.1186/s12954-019-0343-1.
- Bates, G., & Vinther, A. S. (2021). Applying insights from implementation and intervention science to improve the evidence base on image and performance-enhancing drugs (IPEDs) interventions. *Performance Enhancement & Health*, Article 100193. 10.1016/j.peh.2021.100193.
- Begley, E., McVeigh, J., & Hope, V. D. (2017). Image and performance enhancing drugs. 2016 National Survey Results.
- Bjørnebekk, A., Westlye, L. T., Walhovd, K. B., Jørstad, M. L., Sundseth, Ø., & Fjell, A. M. (2019). Cognitive performance and structural brain correlates in long-term anabolic-androgenic steroid exposed and nonexposed weightlifters. (1931-1559 (Electronic)).
- Brennan, R., Wells, J. S. G., & Van Hout, M. C. (2016). The injecting use of image and performance-enhancing drugs (IPED) in the general population: A systematic review. *Health & Social Care in the Community*. 10.1111/hsc.12326.
- Brennan, R., Wells, J. S. G., & Van Hout, M. C. (2018). "Raw juicing" – An online study of the home manufacture of anabolic androgenic steroids (AAS) for injection in contemporary performance and image enhancement (PIED) culture. *Performance Enhancement & Health*, 6(1), 21–27. 10.1016/j.peh.2017.11.001.
- Brownson, R. C., Kemner, A. L., & Brennan, L. K. (2015). Applying a mixed-methods evaluation to Healthy Kids, Healthy Communities. *Journal of Public Health Management and Practice: JPHMP*, 21(suppl 3), S16.
- Carey, G., Malbon, E., Carey, N., Joyce, A., Crammond, B., & Carey, A. (2015). Systems science and systems thinking for public health: A systematic review of the field. *BMJ Open*, 5(12), Article e009002.
- Cavill, N., Richardson, D., Faghy, M., Bussell, C., & Rutter, H. (2020). Using system mapping to help plan and implement city-wide action to promote physical activity. *Journal of Public Health Research*, 9(3), 278–284.
- Christiansen, A. V. (2020). *Gym culture, identity and performance-enhancing drugs: Tracing a typology of steroid use*. Routledge.
- Christiansen, A. V., Vinther, A. S., & Liakafos, D. (2016). Outline of a typology of men's use of anabolic androgenic steroids in fitness and strength training environments. *Drugs: Education, Prevention and Policy*, 24(3), 295–305.
- Collins, R. (2019). *The war on anabolic steroids: An examination of US legislative and enforcement efforts*. Edited collection on human enhancement drugs (HEDs). UK: Routledge.
- Department for Education. (2019). Relationships education, relationships and sex education (RSE) and health education. Statutory guidance for governing bodies, proprietors, head teachers, principals, senior leadership teams, teachers. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1019542/Relationships_Education_Relationships_and_Sex_Education_RSE_and_Health_Education.pdf
- Egan, M., McGill, E., Penney, T., Anderson de Cuevas, R., Er, V., Orton, L., & Petticrew, M. (2019). *NIHR SPHR Guidance on systems approaches to local public health evaluation. Part 1: Introducing systems thinking*. N. I. f. H. R. S. f. P. H. Research.
- Gilmore, H., Shannon, S., Leavey, G., Dempster, M., Gallagher, S., & Breslin, G. (2020). Help-seeking beliefs among anabolic androgenic steroid users experiencing side effects: An interpretive phenomenological analysis. *Journal of Clinical Sport Psychology*, 14(4), 359–375.
- Greenway, C. W., & Price, C. (2018). A qualitative study of the motivations for anabolic-androgenic steroid use: The role of muscle dysmorphia and self-esteem in long-term users. *Performance Enhancement & Health*, 6(1), 12–20. 10.1016/j.peh.2018.02.002.
- Guariguata, L., Unwin, N., Garcia, L., Woodcock, J., Samuels, T. A., & Guell, C. (2021). Systems science for developing policy to improve physical activity, the Caribbean. *Bulletin of the World Health Organization*, 99(10), 722.
- Harvey, O., Parrish, M., van Teijlingen, E., & Trenoweth, S. (2020). Support for non-prescribed anabolic androgenic steroid users: A qualitative exploration of their needs. *Drugs: Education, Prevention and Policy*, 27(5), 377–386. 10.1080/09687637.2019.1705763.
- Harvey, O., Parrish, M., van Teijlingen, E., & Trenoweth, S. (2021). Libido as a motivator for starting and restarting non-prescribed anabolic androgenic steroid use among men: A mixed-methods study. *Drugs: Education, Prevention and Policy*, 1–13. 10.1080/09687637.2021.1882940.
- Hauger, L. E., Westlye, L. T., Fjell, A. M., Walhovd, K. B., & Bjørnebekk, A. (2019). Structural brain characteristics of anabolic-androgenic steroid dependence in men. *Addiction*, 114(8), 1405–1415.
- Hawe, P., Shiell, A., & Riley, T. (2009). Theorising interventions as events in systems. *American Journal of Community Psychology*, 43(3–4), 267–276. 10.1007/s10464-009-9229-9.
- Hope, V., Leavey, C., Morgan, G., Acreman, D., Turner, D., & Smith, J. (2020). Facilitators and barriers to health care access amongst people using image and performance enhancing drugs in Wales: Findings & Outcomes Report.
- Hibbert, M. P., Brett, C. E., Porcellato, L. A., & Hope, V. D. (2021). Image and performance enhancing drug use among men who have sex with men and women who have sex with women in the UK. *International Journal of Drug Policy*, 95, Article 102933.
- Hope, V. D., Harris, R., McVeigh, J., Cullen, K. J., Smith, J., Parry, J. V., & Ncube, F. (2016). Risk of HIV and hepatitis B and C over time among men who inject image and perfor-

- mance enhancing drugs in England and Wales: Results from cross-sectional prevalence surveys, 1992–2013. *Journal of Acquired Immune Deficiency Syndromes*, 71(3), 331–337. [10.1097/QAI.0000000000000835](https://doi.org/10.1097/QAI.0000000000000835).
- Hope, V. D., McVeigh, J., Marongiu, A., Evans-Brown, M., Smith, J., Kimergard, A., & Ncube, F. (2013). Prevalence of, and risk factors for, HIV, hepatitis B and C infections among men who inject image and performance enhancing drugs: A cross-sectional study. *BMJ Open*, 3(9), Article e003207. [10.1136/bmjopen-2013-003207](https://doi.org/10.1136/bmjopen-2013-003207).
- Hovmand, P. S. (2014). *Introduction to community-based system dynamics*. In: *Community based system dynamics*. New York, NY: Springer. [10.1007/978-1-4614-8763-0_1](https://doi.org/10.1007/978-1-4614-8763-0_1).
- Jacka, B., Laranca, B., Copeland, J., Burns, L., Farrell, M., Jackson, E., & Degenhardt, L. (2020). Health care engagement behaviors of men who use performance- and image-enhancing drugs in Australia. *Substance Abuse*, 41(1), 139–145.
- Jessiman, P. E., Powell, K., Williams, P., Fairbrother, H., Crowder, M., Williams, J. G., & Kipping, R. (2021). A systems map of the determinants of child health inequalities in England at the local level. *PloS One*, 16(2), Article e0245577. [10.1371/journal.pone.0245577](https://doi.org/10.1371/journal.pone.0245577).
- Kanayama, G., Kaufman, M. J., & Pope, H. G., Jr (2018). Public health impact of androgens. *Current Opinion in Endocrinology, Diabetes, and Obesity*, 25(3), 218.
- Kimergård, A., & McVeigh, J. (2014). Variability and dilemmas in harm reduction for anabolic steroid users in the UK: A multi-area interview study [journal article]. *Harm Reduction Journal*, 11(1), 19. [10.1186/1477-7517-11-19](https://doi.org/10.1186/1477-7517-11-19).
- Luke, D. A., & Stamatakis, K. A. (2012). Systems science methods in public health: Dynamics, networks, and agents. *Annual Review of Public Health*, 33, 357–376. [10.1146/annurev-publhealth-031210-101222](https://doi.org/10.1146/annurev-publhealth-031210-101222).
- McVeigh, J. (2019). Engaging with people who use image and performance enhancing drugs: one size does not fit all. *International Journal of Drug Policy*, 71, 1–2.
- McVeigh, J., Bates, G., Boardley, I., Hope, V., Ralphs, R., & Van Hout, M. C. (2021). Image and performance enhancing drugs (IPEDs): Assessment of available intelligence and research gaps to inform intervention evaluation. Retrieved 6th January from <https://njl-admin.nihr.ac.uk/document/download/2037525>
- McVeigh, J., & Begley, E. (2017). Anabolic steroids in the UK: An increasing issue for public health. *Drugs: Education, Prevention and Policy*, 24(3), 278–285. [10.1080/09687637.2016.1245713](https://doi.org/10.1080/09687637.2016.1245713).
- Mental Health Foundation. (2017). Peer education project. Retrieved January 12th from www.mentalhealth.org.uk/projects/peer-education-project-pep
- Moore, G. F., Evans, R. E., Hawkins, J., Littlecott, H., Melendez-Torres, G. J., Bonell, C., & Murphy, S. (2019). From complex social interventions to interventions in complex social systems: Future directions and unresolved questions for intervention development and evaluation. *Evaluation*, 25(1), 23–45.
- Morrison, C. (1994). Harm reduction with AS users: Experiences of running a well user service. *RELAY*, 1(2), 16.
- Murray, S. B., Griffiths, S., Mond, J. M., Kean, J., & Blashill, A. J. (2016). Anabolic steroid use and body image psychopathology in men: Delineating between appearance- versus performance-driven motivations. *Drug and Alcohol Dependence*, 165, 198–202. [10.1016/j.drugalcdep.2016.06.008](https://doi.org/10.1016/j.drugalcdep.2016.06.008).
- Peters, D. H. (2014). The application of systems thinking in health: Why use systems thinking? *Health Research Policy and Systems*, 12(1), 51.
- Pope, H. G., Wood, R. I., Rogol, A., Nyberg, F., Bowers, L., & Bhasin, S. (2014). Adverse health consequences of performance-enhancing drugs: An endocrine society scientific statement. *Endocrine Reviews*, 35(3), 341–375. [10.1210/er.2013-1058](https://doi.org/10.1210/er.2013-1058).
- Rutter, H., Cavill, N., Bauman, A., & Bull, F. (2019). Systems approaches to global and national physical activity plans. *Bulletin of the World Health Organization*, 97(2), 162.
- Rutter, H., Cavill, N., Bauman, A., & Bull, F. (2020). Systems approaches to support action on physical activity. *Bulletin of the World Health Organization*, 98(3), 226–227. [10.2471/BLT.20.250936](https://doi.org/10.2471/BLT.20.250936).
- Salinas, M., Floodgate, W., & Ralphs, R. (2019). Polydrug use and polydrug markets amongst image and performance enhancing drug users: Implications for harm reduction interventions and drug policy. *International Journal of Drug Policy*, 67, 43–51.
- Stansfield, J., Cavill, N., Marshall, L., Robson, C., & Rutter, H. (2021). Using complex systems mapping to build a strategic public health response to mental health in England. *Journal of Public Mental Health*, 20(4), 286–297. [10.1108/JPMH-10-2020-0140](https://doi.org/10.1108/JPMH-10-2020-0140).
- Sterman, J. D. (2006). Learning from evidence in a complex world. *American Journal of Public Health*, 96(3), 505–514. [10.2105/Ajph.2005.066043](https://doi.org/10.2105/Ajph.2005.066043).
- Turnock, L. A. (2020). Inside a steroid 'brewing' and supply operation in South-West England: An 'ethnographic narrative case study'. *Performance Enhancement & Health*, 7(3), Article 100152. [10.1016/j.peh.2019.100152](https://doi.org/10.1016/j.peh.2019.100152).
- Turnock, L. A. (2021). Exploring user narratives of self-medicated black market IPED use for therapeutic & wellbeing purposes. *Performance Enhancement & Health*. [10.1016/j.peh.2021.100207](https://doi.org/10.1016/j.peh.2021.100207).
- Underwood, M. (2019). The unintended consequences of emphasising blood-borne virus in research on, and services for, people who inject image and performance enhancing drugs: A commentary based on enhanced bodybuilder perspectives. *International Journal of Drug Policy*, 67, 19–23. [10.1016/j.drugpo.2018.11.005](https://doi.org/10.1016/j.drugpo.2018.11.005).
- Van de Ven, K., & Zahnow, R. (2017). *Australia should stop beefing up its steroid laws-that won't help users*. *The Conversation*.
- van de Ven, K., Zahnow, R., McVeigh, J., & Winstock, A. (2020). The modes of administration of anabolic-androgenic steroid (AAS) users: Are non-injecting people who use steroids overlooked? *Drugs: Education, Prevention and Policy*, 27(2), 131–135. [10.1080/09687637.2019.1608910](https://doi.org/10.1080/09687637.2019.1608910).
- Van Hout, M. C., & Kean, J. (2015). An exploratory study of image and performance enhancement drug use in a male British South Asian community. *International Journal of Drug Policy*, 26(9), 860–867. [10.1016/j.drugpo.2015.03.002](https://doi.org/10.1016/j.drugpo.2015.03.002).
- Vennix, J. A. M. (1999). Group model-building: Tackling messy problems. *System Dynamics Review*, 15(4), 379–401. [10.1002/\(SICI\)1099-1727\(199924\)15:4%3C379::AID-SDR179%3E3.0.CO;2-E](https://doi.org/10.1002/(SICI)1099-1727(199924)15:4%3C379::AID-SDR179%3E3.0.CO;2-E).
- Vilar Neto, J. d. O., da Silva, C. A., Bruno da Silva, C. A., Pinto, D. V., Caminha, J. d. S. R., de Matos, R. S., & De Francesco Daher, E. (2021). Anabolic androgenic steroid-induced hypogonadism, a reversible condition in male individuals? A systematic review. *Andrologia*, 53(7), e14062. [10.1111/and.14062](https://doi.org/10.1111/and.14062).
- Zahnow, R., McVeigh, J., Bates, G., Hope, V., Kean, J., Campbell, J., & Smith, J. (2018). Identifying a typology of men who use anabolic androgenic steroids (AAS). *International Journal of Drug Policy*, 55, 105–112.