Applying insights from implementation and intervention science to improve the evidence base on image and performance-enhancing drugs (IPEDs) interventions

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Abstract:
Recent decades have seen increased public attention devoted to the use of image and performance-enhancing drugs (IPEDs). As research into the epidemiology and aetiology of IPED use has grown substantially, so has interest amongst scholars and policy makers in developing and implementing a variety of public health interventions that target potential and current IPED users. However, the evidence base on IPED interventions remains underdeveloped and few firm conclusions can be made about their impact. In short, we know very little about whether IPED interventions are appropriate, effective, ineffective, or even harmful, or why and how this is the case. In this article, we make the case for applying recent insights from intervention and implementation science to better assess the problems that require intervention, enhance the development, implementation and evaluation of IPED interventions, and improve the quality and size of the evidence base. This is necessary if we are to develop evidence-based IPED interventions that support good health and avoid the potential to do harm. We begin by discussing the different types of IPED interventions that have been introduced and what we know about their impact from the limited evaluations that have been published to date. We then discuss how methods and frameworks from intervention and implementation science can provide important insights that will greatly enhance the development, implementation, and evaluation of these interventions. Drawing on examples of IPED interventions implemented in a variety of countries we explore how these methods can be applied by those working in this field and identify guidance and tools that support their uptake. We conclude by proposing five key priorities to support the development of a more robust evidence base of IPED interventions that will, ultimately, support an evidence-based public health response to IPED use.

Keywords: IPEDs, interventions, public health, implementation science

1. Introduction

In the three decades since the need for interventions to address the use of image and performance-enhancing drugs (IPEDs) was first discussed (Council on Scientific Affairs, 1988; Marcello et al., 1989; Morrison, 1994; Nutter, 1993), a wide range of interventions have been introduced (Backhouse et al., 2016; Bates, Begley, et al., 2019; Bates, Van Hout, et al., 2019; Christiansen et al., 2019; Johannisson et al., 2012). Whilst these interventions represent a variety of guiding principles, goals, approaches, populations, and settings, they share a common ambition to prevent and reduce IPED-related health risks in order to improve public health. IPEDs, the most commonly studied of which are anabolic androgenic steroids (AAS), are associated with increasing risk of experiencing a range of side effects and harmful physical and psychological health outcomes that range from cosmetic to acute and chronic. These have been extensively summarised elsewhere (ACMD, 2010; McVeigh & Begley, 2017; Pope et al., 2014) but include concerns such as changes to cognitive function (Bjørnebekk et al., 2019), cardiovascular disease (Baggish et al., 2017; Rasmussen et al., 2018; Thiblin et al., 2015), reproductive dysfunction (Christou et al., 2017), blood-borne virus transmission (Hope et al., 2016), injection site injuries and infections (Hope et al., 2015), and dependence (Kanayama et al., 2009).

Our understanding of the associations between IPED use and harm is still developing, but factors such as dosage, length of time that IPEDs are used for, and mode of administration appear important (Pope et al., 2014). People who use IPEDs represent a heterogeneous population with variation in their usage pattern, their motivations, and their level of risk (Christiansen et al., 2017; Zahnow et al., 2018). Their decisions and experience of harms are therefore likely to vary, suggesting that no 'one size fits all' approach is likely to be suitable. Instead, a variety of interventions will be required as part of an effective public health response.

However, it is unclear whether these interventions are in fact effective or not at achieving their aims, or if they are even potentially causing harm. For instance, there is some evidence from evaluations of IPED prevention interventions to suggest that these interventions may actually harm the target

population (Elbe & Brand, 2016; Goldberg et al., 2003; Goldberg et al., 2007; Sagoe et al., 2016), yet many interventions currently being delivered have not been rigorously evaluated to address their impact. Additionally, it is unclear whether IPED interventions are being developed according to a thorough assessment of the problem and therefore whether the approaches taken are optimal, necessary, or ethically justifiable; particularly when we do not know what their impact is. Table 1 presents a brief overview of different types of IPED interventions, including their characteristics and an assessment of the strength of the current evidence base to support their impact based upon the number and methodological quality of available evaluation studies. Its purpose is to demonstrate the variety of IPED interventions that have been developed and the state of the evidence base evaluating these interventions.

Table 1. Types of IPED interventions and the content and quality of the available evidence base evaluating these interventions.

Intervention category	**Primary aim**	**Primary target population**	**Example approaches (example studies)**	**Strength of the evidence base**
Universal prevention/ health promotion	To prevent initiation of IPED use	Low risk non-users	School-based education of adolescents (Elliot et al., 2004; Goldberg, Elliot, Clarke, MacKinnon, Zoref, et al., 1996)	Fair: Includes several evaluations of mixed methodological quality
Targeted prevention	To prevent initiation of IPED use	High-risk non-users	Anti-doping campaigns or education in gyms (Jalilian et al., 2011; Molero et al., 2016)	Weak: Includes few evaluations of mixed methodological quality
Harm reduction	To promote safe initiation of IPED use and prevent/reduce health risks from IPED use	IPED users	Provision of injecting equipment; advice and information (NICE, 2014)	Weak to non-existent: Includes very few evaluations
Treatment/ recovery	To promote and support cessation and abstinence/ treat related medical conditions	IPED users and ex-users	Treatment of IPED dependence; motivating cessation (Oslo University Hospital, 2020; Region Örebro County, 2020; Smit & de Ronde, 2018)	Weak to non-existent: Includes very few evaluations

The table and accompanying discussion of the extent and limitations of the evidence base are based on the findings of recent systematic reviews that have identified and assessed the available evidence from evaluations of prevention, harm reduction and treatment interventions related to IPED use (Backhouse et al., 2016; Bates, Begley, et al., 2019; Bates et al., 2014; Bates, Van Hout, et al., 2019). In addition to this, we cite examples of IPED interventions identified through our work in the field that have been developed but that have not been subject to formal evaluation, or at least for which no evaluation has been published internationally. These examples are not intended to be an exhaustive list, as we recognise there may be numerous other examples of interventions of all types that have not been subject to any evaluation.

The table highlights that many different types of IPED interventions have been developed and delivered to different populations of people who use (or are at risk of using) IPEDs and with different goals, but that published evaluations of most of these approaches are rare or even non-existent. We believe that breaking down these interventions by target population or goal (e.g., to prevent initiation of IPED use or to reduce harm amongst people who already use IPEDs) is a helpful way to make sense of and identify gaps in the evidence base, and to recognise that interventions have been developed to respond to different problems. Different approaches have been favoured in different countries (for example, a harm reduction approach in the UK compared with a primary prevention/treatment approach in Scandinavia) and with different populations (for example, education for young athletes compared with provision of health services for adults who choose to use IPEDs), and referring to IPED interventions as one group is potentially confusing and misleading.

We believe that enhancing the size and quality of the IPED intervention evidence base is long overdue. In this article we discuss the gaps in the evidence and their implications, before highlighting how we can better develop evidence-based IPED interventions. We introduce methods and principles from the fields of intervention and implementation science that together help public health researchers and practitioners to assess the problems they wish to address, and to systematically develop, implement

and evaluate interventions based upon this assessment. We conclude by identifying five key priorities to improve the IPED intervention evidence base that we believe are necessary if we are to produce effective, appropriate and sustainable public health IPED interventions.

2. The state of the evidence on IPED interventions

The IPED intervention literature is dominated by academic-led evaluations of universal prevention programs that have typically been delivered in schools to adolescents in the US and Europe (Backhouse et al., 2016; Bates, Begley, et al., 2019; Christiansen, 2020). Many appear based on limited theoretical foundations, and little is known about whether they are effective or not at preventing subsequent IPED use, as their impact has only been evaluated in the short-term (Bates, Begley, et al., 2019). While this literature therefore represents, at best, an incomplete evidence base, it is far more advanced in comparison to the evidence on the other categories of IPED interventions presented in table 1. There is a significant gap therefore between the number of interventions being delivered internationally to address IPED use and the number of studies available in the academic literature describing and evaluating such interventions.

The response to IPED use has varied internationally in the focus and type of interventions. For example, in countries such as the UK and Australia, needle and syringe programmes (NSPs) have long provided health and harm reduction interventions to IPED users, primarily through the provision of sterile injecting equipment. In the UK, specialist IPED clinics have been championed since the 1990s as settings to engage with users and deliver harm reduction interventions (Kimergard & McVeigh, 2014; Morrison, 1994). Community-based prevention approaches based broadly on 'anti-doping' principles but applied to recreational IPED users have been introduced in Scandinavia, Austria, the Netherlands, and Belgium, for example through law enforcement and drug testing approaches in gyms alongside a range of other preventive measures such as certification schemes and education campaigns (Christiansen, 2020; Christiansen et al., 2019; Johannisson et al., 2012; van de Ven, 2016). Apart from a few examples, however, it is unclear to what extent these approaches have been

systematically developed and whether any of these interventions are effective or perhaps even harmful as we do not have examples of published evaluations to draw upon (Backhouse et al., 2016; Bates, Begley, et al., 2019; Bates et al., 2014; Bates, Van Hout, et al., 2019). If we consider that it is almost exclusively interventions that fall within the area of universal prevention that have been subject to robust evaluation, the evidence base on IPED interventions has clearly not kept up with the ever-increasing body of evidence exploring the prevalence and correlates of IPED use (Blank et al., 2016; Brennan et al., 2017; Ntoumanis et al., 2014; Sagoe, Molde, et al., 2014), the motivations and behaviours of IPED users (Sagoe, Andreassen, et al., 2014), and the associated physiological and psychological harms (ACMD, 2010; Christou et al., 2017; Kanayama et al., 2009; Pope et al., 2014).

There is a clear need therefore for evidence of the impact of existing interventions and evaluations of factors influencing their implementation. The challenge for those working with IPED interventions is to i) identify the best evidence available to support the development, implementation, and delivery of effective interventions; and ii) to improve the evidence base by prioritising evaluation of these interventions. Importantly, these should not be understood as distinct processes, but rather as part of an ongoing process of developing a deeper understanding of what works for different populations and in different contexts. A mature evidence base will not only include studies that evaluate intervention effectiveness but also enable us to understand how these different interventions work and what factors will lead to variation in delivery and impact.

3. A science of interventions

One key step towards developing a high-quality evidence base of IPED interventions is to apply principles and practice from the growing field of intervention and implementation science. In the context of public health, implementation science can be defined as the study of methods to promote the uptake of research and evidence into practice (Eccles & Mittman, 2006). It emphasizes the design and evaluation of interventions, including how and under what circumstances the intervention brings about change. Substantial advances have been made within this field in the past two decades in terms

of developing methods, frameworks, models, and approaches to design, evaluate, implement, and adapt so-called 'complex interventions' that together support the adoption of a scientific approach to interventions (Craig et al., 2008; Minary et al., 2019; Movsisyan et al., 2019; Nilsen, 2015; O'Cathain et al., 2019; Richards & Hallberg, 2015). The term 'complex intervention' is used within public health research to describe interventions delivered in a natural or 'real world' context that aim to prevent, promote, change, or maintain health-related behaviour to improve public health. The multifaceted nature of the issues that complex interventions seek to address (i.e., various influences across different 'socioecological levels') means that they do not lend themselves to the same level of control as, for instance, pharmacological or exercise interventions that are often conducted under tightly controlled laboratory conditions. Since many IPED interventions share these characteristics, we believe this research area is a good starting point for advancing IPED intervention research.

Applying concepts from implementation science can help improve our understanding of IPED interventions. Given that relevant 'justificatory conditions' such as *necessity* and *proportionality* are met (Childress et al., 2002), one of the most important questions to address when evaluating a public health intervention undoubtedly is if it works. Two closely related questions concern *how well* it works and whether it is *cost-effective*. Indeed, outcome and economic evaluations that examine the direction, magnitude, and persistence of potential intervention effects, as well as the costs weighed against the benefits are important because they provide policy makers, intervention developers, and other relevant stakeholders with crucial information to support them in deciding whether to adopt an intervention and implement it into routine practice (Craig et al., 2008; Minary et al., 2019). However, important as they are, these questions do not tell the full story. For instance, the fact that most school based IPED interventions have little or no impact on behavioural outcomes does not necessarily mean that these interventions are ineffective and should be discarded accordingly (Bates, Begley, et al., 2019). Rather, this begs the question: *Why didn't they work?*

Interventions may be ineffective for several reasons, including when they are based on an inadequate understanding of the problem (a weak 'theory of the problem') or when the intervention content is inappropriate to bring about the desired change (a weak 'theory of change') (Bartholomew et al., 2006). However, the lack of impact may also be explained by issues that do not relate to the intervention content *per se,* but instead to how the intervention was implemented and delivered. Examples of factors that may have undermined intervention effectiveness are low implementation fidelity (i.e., the intervention was not delivered as intended), timing and dosage of the intervention, and a failure account for contextual factors affecting intervention outcomes. Exploring these issues in a process evaluation provides a unique opportunity to learn what might (or might not) work for whom under what circumstances. Process evaluation can also be used to investigate 'causal pathways' or 'mechanisms of actions', that is, the processes through which an intervention brings about change (Craig et al., 2008; Moore et al., 2014).

There is a third possibility that relates to the selection of intervention outcomes. Critics could reasonably object that the school based IPED interventions mentioned above are weighed on the wrong scale: Given the low baseline levels of IPED use consistently observed across these interventions, it is unfair to determine their impact based on whether they are successful in reducing the prevalence of IPED use. Since few IPED users (approximately 20% for AAS) initiate their use of these drugs before age 20, and almost none before age 16 (Pope et al., 2014), the often limited timeframe of these interventions (short duration and lack of long-term follow-up) makes it difficult to detect reductions in actual IPED use (Bates, Begley, et al., 2019). While we agree with this critique, it stands in contrast with the explicit aim of these interventions to 'prevent' or 'reduce' actual IPED use (Bates, Begley, et al., 2019). This points to the importance of carefully aligning the aims and outcomes of an intervention with the nature and characteristics of the problem that it seeks to address. Instead, these interventions should be deemed successful if they cost-effectively reduce risk factors for IPED use (or increase protective factors). For instance, the ATLAS intervention, which aimed to prevent AAS use amongst adolescent (student) athletes, had positive and lasting effects on important risk factors

for AAS use such as intentions to use AAS, AAS knowledge and attitudes, and skills to resist drug offers (Goldberg, Elliot, Clarke, MacKinnon, Moe, et al., 1996).

4. Applying insights from intervention and implementation science to IPED interventions

4.1 Developing and implementing interventions

In their highly influential 2008 article that has been cited over 8,000 times and applied to a wide range of health topics and settings, the UK Medical Research Council published guidance on the development and evaluation of complex interventions that emphasised the importance of development and piloting work during early stages (Craig et al., 2008). In line with this, a number of recent intervention development approaches highlight the need to spend considerable amounts of time during this stage in order to fully understand the problem and its causes, and identify a feasible intervention strategy, before proceeding to large-scale evaluation (Campbell et al., 2007; Fraser et al., 2009; Gitlin & Czaja, 2015; Hawkins et al., 2017; Michie et al., 2014; Wight et al., 2016). Interventions that are not carefully developed or based on a thorough understanding of the problem are less likely to be effective and more likely to cause harm. It is well established that interventions may, despite good intentions, negatively impact the target population. This can undermine the net benefit of an intervention and the risk of harmful effects should therefore be kept in mind throughout the entire intervention development and evaluation process (Bonell et al., 2015; Michie et al., 2014). We recognise that not all teams working on IPED interventions will want to, or have the resources to, engage fully with these highly systematic and technical approaches, but may still apply the principles and concepts they promote.

The development of intervention strategies supported by guidance and focussing on implementation and design factors has been readily adopted by teams developing health interventions in other fields, for example in smoking cessation interventions (Fulton et al., 2016; Gould et al., 2017; Tombor et al., 2016), which has helped to advance the evidence base considerably. Adopting a similar approach to developing IPED interventions would have great benefits to this field. Fundamentally, a better

understanding of the problem will support the design of more effective interventions based upon appropriate strategies rather than assumptions of what might work. This is a well-recognised problem in interventions seeking to change health behaviours, which are commonly based on pre-determined assumptions rather than a thorough analysis of the problem and what actually needs to change (Brown et al., 2020; Michie et al., 2014). Involving stakeholders in development can improve the understanding of what needs to change, as well as the factors likely to affect implementation (O'Cathain et al., 2019). For example, those aiming to address IPED use within gyms can consider engaging during development with people who use IPEDs as well as gym staff and local health professionals to understand what is needed, and what is feasible to be implemented. This engagement can be an ongoing process, and intervention providers can seek feedback and assess the extent to which the intervention is effective. Where this is already happening, making the findings of such engagements available so that other researchers and practitioners can learn from them will help to improve the evidence base.

Beyond failing to improve public health, interventions that are revealed to be ineffective or unsustainable are a waste of the scarce resources and limited opportunity to intervene that those working in this field will no doubt be familiar with. Therefore, it is critical to consider implementation during intervention development. Various principles and recommendations for decision-making during intervention development have been proposed. An example is the APEASE criteria which can be employed to assess intervention affordability, practicability, effectiveness and cost-effectiveness, acceptability, side-effects, and equity (Michie et al., 2014). Similarly, in their study identifying interventions to prioritise relating to physical activity interventions, Morton and colleagues (2017) propose to consider factors including intervention reach, equality, acceptability and cost, as well as effectiveness. While this may seem like a daunting task, by developing a thorough understanding of the problem and its context, our understanding of these implementation issues will improve.

With few exceptions, authors of IPED intervention evaluations provide little detail about how and why interventions were developed (Bates, Begley, et al., 2019; Bates, Van Hout, et al., 2019). Studies such as evaluations of the ATLAS study (Goldberg, Elliot, Clarke, MacKinnon, Zoref, et al., 1996; MacKinnon et al., 2001) demonstrate how theory can be used to support intervention development, but generally the IPED intervention literature contains scant detail on the theory underpinning interventions or the process of development. This question of why interventions have been developed in the manner they have might lead us to question the justification for well-established approaches. For example, the provision of sterile injecting equipment to reduce transmission of blood-borne viruses (BBVs) has long been the focus of the UK government's IPEDs policy (HM Government, 2017; Independent Expert Working Group, 2017). However, it is unclear on what basis needle and syringe programmes in pharmacies and drug treatment services have been determined to be the most suitable setting to deliver this intervention to UK IPED users, or why BBV prevention is prioritised over other types of interventions that UK stakeholders have identified as being as, if not more, important (Bates et al., 2021). Likewise, there is currently no evidence to support the deterrent and preventive effects of drug testing in gyms, yet drug testing has remained a core element of the anti-doping campaign in Danish gyms for almost two decades. Adding to this uncertainty is the fact that others have questioned the proportionality of this approach because the (potential) public health benefits of testing does not seem to outweigh the infringement of gym users' rights to privacy and bodily integrity (Christiansen, 2020).

4.2 Reporting studies

Transparency is critical to support knowledge transfer and the replication of interventions, and to understand why they were effective or not. However, in many of the studies of IPED interventions, it is challenging for the reader to understand what the specific components are in the intervention (Bates, Begley, et al., 2019). It is important that authors provide sufficient information for others to understand specifically what was delivered, and how. The TIDieR checklist (Hoffmann et al., 2014) has

been designed to help authors describe their interventions in sufficient detail for interventions to be replicated by other research teams and has been widely adopted. Reporting standards have been adopted by researchers to improve transparency and quality of reporting in studies based on a variety of designs, such as CONSORT (Schulz et al., 2010) for randomised controlled trials and TREND (Des Jarlais et al., 2004) for nonrandomised evaluations of behavioural and public health interventions. Journal editors can support this improved quality and transparency in reporting by encouraging or even requiring authors to refer to these standards.

4.3 Assessing feasibility

Conducting a small-scale pilot study during the final stages of intervention development is a useful way to explore the feasibility of an intervention before it is tested and evaluated in a large-scale trial. Results from a pilot study can give early indications of intervention (in)effectiveness or potential harms caused by the intervention and provide key insights into factors that may impede or enhance implementation quality such as acceptability amongst decision makers, intervention providers, and the target population (Craig et al., 2008). In the context of IPED interventions, pilot work is rarely reported in evaluation studies (Bates, Begley, et al., 2019). Thus, it appears that IPED interventions are generally designed without a preliminary assessment of feasibility. Although piloting of an intervention prior to evaluation is no guarantee of success, we contend that it is beneficial to do so. To illustrate, Elbe & Brand (2016) evaluated the effects of an ethical decision-making training program to prevent the use of IPEDs amongst young athletes. Contrary to the authors' expectations, it turned out that athletes in the intervention group had more positive attitudes toward performance enhancing drugs at post-intervention when compared with standard anti-doping education and no education (Elbe & Brand, 2016). The unintended intervention effects observed in this intervention (i.e., more positive drug attitudes) could have been addressed, and perhaps even prevented, had a small-scale pilot study been conducted during intervention development.

4.4 Evaluating interventions

To improve the current evidence base there is a need firstly to start evaluating the public health interventions already in place internationally, such as IPED interventions being delivered by local authorities, public health agencies, and anti-doping organisations. Secondly, and of equal importance, the results from these evaluations need to be disseminated internationally in reports or scientific journals to support the sharing of good practice. As mentioned earlier, national anti-doping campaigns in gyms have long served as the main public health response to IPED use in many European countries (Christiansen et al., 2019; Johannisson et al., 2012). However, despite their shared aim of ultimately preventing IPED use, very little is known about the impact of these interventions on *actual IPED use*. This is not to say that for these interventions there are no evaluations available of any kind, but rather that when evaluations are conducted, they rarely measure the impact of the intervention on long-term behavioural outcomes. In addition, when evaluations are performed, the results of these evaluations are rarely disseminated to a wider audience. One exception is the Swedish programme, 100% Pure Hard Training, a community-based intervention that has been delivered in Swedish gyms since 2007 (Molero et al., 2016). This programme has been formally evaluated twice (in 2010 and 2018) using a quasi-experimental design and showed promising, albeit statistically uncertain, effects (Christiansen et al., 2019; Dehnov & Molero, 2018; Johannisson et al., 2012).

There may be several explanations for the shortcoming of internationally available, robust evaluations of IPED interventions. Whilst we can only speculate about the reasons why local and national stakeholders rarely evaluate the impact of their IPED interventions, a recent pan-European study of IPED prevention in recreational sport identified a number of 'implementation barriers' that may also apply to evaluation more generally. When asked to list the most important barriers to implementing prevention in recreational sport, European stakeholders reported 'lack of financial and human resources' to be the most important barrier followed by 'lack of cooperation between key stakeholders' and 'lack of good practice' (Christiansen et al., 2019). Since it requires expertise and can be time consuming to set up, conduct, and report the results of evaluations, other tasks such as the day-to-day coordination and delivery of the intervention might take priority over evaluation for

289 stakeholders providing the types of interventions discussed in this article. It may also be that
290 evaluations are taking place, but that findings are not being promoted widely or published in
291 accessible places.

292 Another possible explanation for the lack of evaluations relates to the discrepancy between
293 researchers' and practitioners' preferences and needs in terms of selecting an appropriate study
294 design. There has long been a tendency amongst scholars and policy makers alike to favour the
295 randomised controlled trial (RCT) as the golden standard of evidence when it comes to evaluating
296 public health interventions, even when the classical RCT is not necessarily the most appropriate design
297 (Craig et al., 2008; Victora et al., 2004). There are many reasons for the widespread preference of the
298 RCT design including the scientific obsession with internal validity, that is, the ability to establish a
299 cause-and-effect relationship and rule out alternative explanations, at the cost of external validity,
300 that is, the generalizability of findings beyond the 'laboratory setting' (Minary et al., 2019). This may
301 in part explain the fact that most published IPED interventions are educational interventions aimed at
302 preventing IPED use in school populations. Because the school setting lends itself more easily to high
303 levels of control than, say, an entire community, school-based interventions sit well with the RCT
304 design. Indeed, few (if any) designs outperform the RCT in terms of drawing causal inferences about
305 intervention effects under controlled conditions (Victora et al., 2004).

306 However, regardless of the short-term impact they may have on behaviour, it is unlikely that
307 standalone interventions delivered in schools will lead to sustained behaviour change due to the host
308 of risk factors that many individuals will inevitably be exposed to beyond the school setting. Thus,
309 although school interventions may theoretically prevent future IPED use initiation through a reduction
310 of risk factors (or an increase in protective factors), these effects are unlikely to persist unless they are
311 reinforced in other interventions such as targeted interventions in high-risk environments like gyms
312 or sports clubs. The predominant focus in academia on evaluating standalone IPED interventions in
313 RCTs despite the need for evaluations of system-wide interventions has led to increased scepticism

and reluctance amongst some stakeholders to engage with the academic community and, as a result, missed opportunities to assess the impact of IPED interventions that are already in place. As pointed out by a representative of the UK national anti-doping organisation (UKAD) in a recent study of doping prevention in recreational sport across the EU28:

"As outsiders, we see the academic community spending money and resources towards the benefit of clean sport. We support this absolutely. However, some challenges exist for us. Typically, the research proposal is centred on a one-off intervention which we know do not work […] That information [obtained from single interventions] is part of a larger system, which we are trying to embed in the environment. And it is that system we want to evaluate, not the one-off intervention." (Christiansen et al., 2019, p. 60)

The idea that interventions such as those alluded to above should be regarded, not as single events to be evaluated in isolation, but rather as parts of a wider prevention system consisting of multiple but complementary interventions aligns with a recent shift in public health research towards considering interventions as 'events' in complex systems (Hawe et al., 2009; Moore et al., 2019). It is often necessary to employ more flexible and pragmatic designs (e.g., pragmatic RCTs, realist evaluation, or natural experiments) when evaluating these types of interventions because the causal chain between the intervention components and the outcomes are often long and complex (Minary et al., 2019; Victora et al., 2004). A 'systems approach' to interventions may provide a useful conceptual framework for future work on IPED interventions because it seems to strike the right balance between the scientific interest in isolating causal mechanisms and a more pragmatic interest in what works in 'the real world'. Taking such an approach may help to reduce the research/practice-gap described above and, ultimately, overcome key barriers that are currently preventing IPED interventions from being evaluated. However, it is beyond the scope of this article to explore in detail what a systems approach to IPED use might look like.

5. Conclusion

In the past thirty years researchers and practitioners have developed and delivered a wide range of interesting and innovative interventions to address IPED use. In this article, we have made the case for embracing the principles of implementation and intervention science in the IPED intervention field to i) enhance the quantity and quality of this evidence base, and ii) support the development of interventions that are appropriate, justifiable, feasible, sustainable and effective in line with their goals and the needs of the populations they target. This is necessary now if we are to develop evidence-based public health interventions that respond to IPED use, support population health and avoid causing harm. Based on our analysis in this article and our reflections on the evidence presented in recent systematic reviews (Bates et al., 2014; Bates, Begley et al., 2019, Bates, Van Hout et al., 2019; Backhouse et al., 2016), we recommend five key priorities to enhance the IPED intervention evidence base which address the areas where the discrepancy between the IPED intervention field and what is considered best practice within the broader field of implementation and intervention science is most pronounced (see Box 1). This will support IPED researchers and practitioners to better respond to the problems they identify through development and delivery of cost-effective interventions and, ultimately, the identification of strategies to improve public health and the provision of support and healthcare for people who use IPEDs.

Box 1: Five key priorities to improve the IPED intervention evidence base

1. Use available frameworks and guidance to support the development, implementation and evaluation of new interventions e.g., the Medical Research Council guidance (Craig et al., 2008)
2. Invest time in the early stages of development to develop a thorough understanding of the target population to ensure that interventions are based on a thorough assessment of the problem and context, and to prevent harmful effects.
3. Explore implementation factors in intervention development such as feasibility, reach, sustainability and acceptability, and identify possible unintended consequences. Consider pilot studies and process evaluations before full-scale implementation to understand these issues.
4. Evaluate existing and new interventions to understand whether they are effective, ineffective, or even harmful. Where feasible, use robust study designs and select appropriate outcomes to measure effectiveness against intervention goals.
5. Publish evaluation findings so that others can learn from and adapt effective interventions. Use relevant tools (e.g., TIDieR, Hoffmann et al., 2014) to support the reporting of interventions to increase transparency and knowledge transfer.

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